IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

OMNI MEDSCI, INC., *Plaintiff*, v. SAMSUNG ELECTRONICS, CO. LTD., SAMSUNG ELECTRONICS AMERICA, INC., FOSSIL GROUP, INC., FOSSIL STORES I, INC., FOSSIL PARTNERS, L.P., ONEPLUS TECHNOLOGY (SHENZHEN) CO., LTD., and ŌURA HEALTH OY, *Defendants*.	Civil No. 2:24-cv-01070-JRG-RSP JURY TRIAL DEMANDED

ONEPLUS TECHNOLOGY (SHENZHEN) CO., LTD.'S
INVALIDITY AND SUBJECT MATTER ELIGIBILITY CONTENTIONS

Pursuant to Patent Rules 3-3 and 3-4, Defendant OnePlus Technology (Shenzhen) Co., Ltd. ("OnePlus" or "Defendant") hereby provides its Invalidity Contentions to Omni MedSci, Inc. ("Omni" or "Plaintiff").[1]

OnePlus's Invalidity Contentions include the accompanying claim charts concerning U.S. Patent Nos. 9,055,868 ("the '868 Patent"); 9,651,533 ("the '533 Patent"); 10,517,484 ("the '484 Patent"); 10,874,304 ("the '304 Patent"); 11,160,455 ("the '455 Patent"); 12,193,790 ("the '790 Patent"), and 12,268,475 ("the '475 Patent") (collectively the "Asserted Patents").

OnePlus also submits its Subject Matter Eligibility Contentions concerning the Asserted Patents in accordance with the Court's July 25, 2019, Standing Order Regarding Subject Matter

[1] In written correspondence dated September 12, 2025, OnePlus accepted Plaintiff's written proposal (dated September 9, 2025) that the deadline for OnePlus to serve its Invalidity Contentions in this matter is September 30, 2025.

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Eligibility Contentions Applicable to All Patent Infringement Cases Assigned to Chief District Judge Rodney Gilstrap ("Standing Order").

OnePlus hereby incorporates by reference the prior document productions previously made by the co-defendants in this matter in connection with their Invalidity Contentions served on Plaintiff on June 3, 2025 and July 18, 2025. Specifically, OnePlus relies upon and references the documents previously produced by the co-defendants bearing Bates numbers DEFS-PA_0000001 – DEFS-PA_0009759, and any other/supplemental prior art production similarly bates-labeled with the prefix "DEFS-PA." To avoid unnecessary duplication, OnePlus is not re-producing these materials, but affirms that they form part of its supporting documentation under P.R. 3-4(a).

I. Introduction

Plaintiff failed to timely serve its P.R. 3-1 infringement contentions on OnePlus.[2] Under P.R. 3-1, Plaintiff's infringement contentions were due no later than 10 days after the March 26, 2025 scheduling conference—i.e., on April 7, 2025. Plaintiff did not serve any P.R. 3-1 claim charts on OnePlus by that deadline; and it did not obtain consent from OnePlus or leave of Court for an extension as to OnePlus. Plaintiff's later attempt to provide a file-sharing link months after the deadline, and before OnePlus had appeared in this action, does not cure the missed deadline or constitute proper service under Fed. R. Civ. P. 5. OnePlus reserves all rights to move to strike or otherwise challenge Plaintiff's untimely contentions and to seek any appropriate relief, including adjustment of the case schedule and preclusion of any late-served infringement theories.

[2] In written correspondence dated August 21, 2025, counsel for Plaintiff stated, "[Omni] served OnePlus's in-house counsel with infringement contentions on May 30." The alleged service concerned an email with a hyperlink that was inactive when first accessed on August 21, 2025. A separate P.R. 3-1 Disclosure cover letter dated May 9, 2025, which purports to separately address U.S. Patent No. 12,268,475, contains a certificate of service certifying service only "to counsel for Samsung, Fossil, and Ouri." There was no effective and timely service of the same document to OnePlus.

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As presently understood, Plaintiff asserts the following patents and claims against OnePlus:

Patent	Asserted Claims	Omni's Alleged Priority Date	Chart Prefix
'868 Patent	7 and 9	September 3, 2002	A
'533 Patent	12	December 31, 2012	B
'484 Patent	8 and 9	December 31, 2012	C
'304 Patent	11, 14-16, 19-22	December 31, 2012	D
'455 Patent	1-3, 8-10, 15	December 31, 2012	E
'790 Patent	7	December 31, 2012	F
'475 Patent	1, 5-8, 11-13	December 31, 2012	G

The claims identified above are referenced as "the Asserted Claims" unless reference is made specifically with respect to particularly identified one or more of the Asserted Patents and/or one or more of the Asserted Claims. By identifying Omni's alleged priority date for the Asserted Claims of each patent above, OnePlus does not concede that Omni's claims of priority are correct. Further, the citation of prior art herein and the accompanying exhibits are not intended to reflect OnePlus's claim construction contentions, which will be disclosed in due course. Instead, OnePlus's Invalidity Contentions and Subject Matter Eligibility Contentions as set forth herein and in the accompanying exhibits may reflect Plaintiff's apparent claim constructions based on its Infringement Contentions, with which OnePlus disagrees.

As further detailed in and supported by these Invalidity Contentions, OnePlus contends that each of the Asserted Claims is invalid under at least 35 U.S.C. §§ 101, 102, 103, and/or 112.[3] OnePlus reserves the right to prove the invalidity of the Asserted Claims on bases other than those required to be disclosed in these disclosures pursuant to P.R. 3-3.

[3] References to Title 35 of the United States Code are to statutes prior to amendment under the America Invents Act ("AIA"), to the extent that the Asserted Patents have effective filing dates prior to applicable AIA effective dates, and to the current statutory provisions with respect to Asserted Patents having effective filing dates after the applicable AIA effective dates.

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II. Amendment / Supplementation

OnePlus's Invalidity Contentions and Subject Matter Eligibility Contentions pertain to the Asserted Claims as identified in Plaintiff's Infringement Contentions. To the extent the Court later allows Plaintiff to amend its infringement contentions and/or assert one or more claims other than the Asserted Claims, OnePlus reserves the right to modify, amend, or supplement these Invalidity Contentions and Subject Matter Eligibility Contentions accordingly—for example, to show the invalidity and/or ineligibility of any such newly Asserted Claims.

These Invalidity Contentions and Subject Matter Eligibility Contentions are based on OnePlus's current understanding of the Asserted Claims and Plaintiff's apparent view of the scope of those claims as shown, for example, in Plaintiff's Infringement Contentions. A *Markman* Order in this case has not yet been issued, and in no way should these Invalidity Contentions and Subject Matter Eligibility Contentions be taken as any admission or acquiescence by OnePlus as to the proper scope of the Asserted Claims and/or proper claim constructions of terms and phrases recited in those claims. By identifying prior art that anticipates and/or renders obvious the Asserted Claims, OnePlus does not admit that the claim limitations are capable of construction, does not admit that any claim limitations are supported with an appropriate written description and enabling disclosure in the applicable patent specifications, and does not adopt Plaintiff's apparent claim constructions or admit the accuracy of any particular claim construction.[4] OnePlus reserves all

[4] OnePlus does not concede that Plaintiff's apparent interpretation of the claims is correct, but rather asserts the well-established principle that whatever infringes a claim if later in time anticipates if earlier in time. *Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc.*, 246 F.3d 1368, 1378 (Fed. Cir. 2001). Thus, where Plaintiff for purposes of its infringement case alleges that a feature of an accused product meets a particular limitation recited in one or more of the Asserted Claims, then that feature, should it be found in the prior art, would also cause that limitation to be met for invalidity purposes.

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rights to later challenge or oppose any claim constructions advanced by Plaintiff and to present their own claim construction positions as permitted by the Court.

OnePlus further reserves the right to revise these Invalidity Contentions and Subject Matter Eligibility Contentions in view of the Court's construction of terms and phrases recited in one or more of the Asserted Claims, additional information obtained during discovery, additional infringement theories put forth by Plaintiff during fact and/or expert discovery, any findings as to the priority date(s) of the Asserted Claims, and/or positions that Plaintiff, its fact witnesses, or its expert witness(es) may take concerning claim construction, infringement, and/or invalidity issues, as permitted by the Court. OnePlus further reserves the right to supplement its P.R. 3-4(b) document productions should it later discover additional prior art documents, information, testimony, prior art systems and related documentation, and/or software or hardware code, including information provided by third parties after the date of service of these Invalidity Contention and Subject Matter Eligibility Contentions.

Additionally, Plaintiff has not identified in its contentions regarding the level of ordinary skill in the art for any of the Asserted Patents. Thus, OnePlus has based its Invalidity and Subject Matter Eligibility Contentions on the level of skill in the art apparent from the face of the asserted patents. For the avoidance of doubt, OnePlus contends that the asserted claims are invalid for the reasons set forth in their Invalidity and Subject Matter Eligibility contentions under any plausible definition of the level of ordinary skill for each of the Asserted Patents. Nevertheless, OnePlus reserves the right to revise these Invalidity Contentions and Subject Matter Eligibility Contentions in response to any position taken by Plaintiff on the level of ordinary skill in the art applicable to a given Asserted Patent.

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OnePlus may further rely on inventor admissions concerning the scope or state of the prior art relevant to the Asserted Claims, the patent prosecution histories of the Asserted Patents, related patents and/or patent applications, any deposition or trial testimony of the named inventors on the Asserted Patents, and the papers filed and any evidence produced or submitted by Plaintiff in connection with these cases or other related litigation. OnePlus reserves the right to contend that one or more of the Asserted Claims are invalid under 35 U.S.C. § 102(f) in the event OnePlus obtains evidence that one or more of the named inventors did not invent the subject matter in the Asserted Claims.

Prior art not included in these Invalidity Contentions and Subject Matter Eligibility Contentions, whether known or not known to OnePlus, may become relevant. OnePlus is currently unaware of the extent, if any, to which Plaintiff will contend that limitations of the Asserted Claims are not disclosed in the prior art identified in these Invalidity Contentions and Subject Matter Eligibility Contentions. Accordingly, OnePlus reserves the right to identify other references that would disclose the allegedly missing limitation(s) of the claimed method, device, or system.

The references identified in these Invalidity Contentions and Subject Matter Eligibility Contentions, which include the attached claim charts, may disclose the elements of the Asserted Claims explicitly and/or inherently, render those elements alone or in combination obvious to those of ordinary skill in the art even absent an explicit or inherent disclosure, and/or they may be relied upon to show the state of the art in the relevant time frame. References identified in these Invalidity Contentions and Subject Matter Eligibility Contentions, as well as the "References Cited" on the face of the Asserted Patents and the patents cited within the body of the Asserted Patents, may be used to illustrate, but not limit the scope of, the state of the art to which the Asserted Patents pertain (i.e., at a time prior to the date of alleged inventions of the Asserted Claims

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of the Asserted Patents). Moreover, OnePlus reserves the ability to rely on later-identified sources of information, including but not limited to witness testimony and other discovery, to establish the state of the art in the relevant time frame pertaining to the Asserted Patents.

OnePlus anticipates that additional prior art and invalidity bases may be found. OnePlus's investigation and analysis of the prior art is continuing, and thus OnePlus reserves the right to supplement, amend, and/or revise the information provided herein as OnePlus conducts further investigation and/or analysis, including identifying, charting, and relying on additional references.

Additionally, in view of likely third-party discovery that will be taken, OnePlus reserves the right to present additional items of prior art under 35 U.S.C. §§ 102(a), (b), (e), and/or (g) and/or § 103 located during discovery or further investigation, and to assert contentions of invalidity under 35 U.S.C. §§ 102(c), (d), or (f). For example, OnePlus expects to issue subpoenas to third parties believed to have knowledge, documents, and/or other evidence concerning invalidity of one or more of the Asserted Claims.

In addition to the positions and prior art identified in these Invalidity Contentions and Subject Matter Eligibility Contentions (including the accompanying claim charts), OnePlus also incorporates by reference all invalidity contentions and subject matter eligibility contentions, prior art,[5] and invalidity claim charts (including, without limitation, all anticipation positions, obviousness positions [including all prior art combinations and motivations to combine], indefiniteness positions, written description positions, and non-enablement positions) concerning one or more of the Asserted Patents, as disclosed at any time. This includes without limitation disclosures in previous or related litigation, in United States Patent & Trademark Office

[5] Prior art appearing in the file histories of the Asserted Patents is not required to be separately produced by OnePlus under P. R. 3-4(b).

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("USPTO") proceedings, by the Plaintiff, by any other parties accused of patent infringement by the Plaintiff, or by the named inventors or any individuals associated with the prosecution and/or any form of post-grant review or reexamination of the Asserted Patents.

Specifically, for example, OnePlus identifies, as prior art upon which they may rely to show the invalidity of the Asserted Claims, the prior art references disclosed by parties in this or any other litigation (including inter partes review and/or reexamination proceedings) involving one or more of the Asserted Patents, any patent related to any of the Asserted Patents, and/or any other patent allegedly assigned to Plaintiff claiming priority to the Asserted Patents (collectively, "Other Omni Proceedings").

Plaintiff has a present and ongoing duty to produce to OnePlus all relevant documents from any Other Omni Proceedings, including but not limited to all prior art, invalidity contentions, and expert reports on invalidity (among other relevant items).

OnePlus reserves the right to supplement or otherwise amend these Invalidity Contentions and Subject Matter Eligibility Contentions in response to any relevant discovery provided by third parties, Plaintiff, opening or rebuttal expert reports, fact or expert depositions, or in response to any claim construction ruling(s) issued by this Court (regardless of how and when such ruling is made). OnePlus also reserves the right to supplement or otherwise amend these Invalidity Contentions and Subject Matter Eligibility Contentions in response to any rebuttal evidence disclosed by Plaintiff or as otherwise may be necessary or appropriate under the circumstances.

III. P. R. 3-3(a) – Identification of Prior Art

Pursuant to P.R. 3-3(a), and subject to OnePlus's reservations of rights, OnePlus identifies

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each item of prior art that anticipates or renders obvious the Asserted Claims below.[6]

A. U.S. Patent No. 9,055,868

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '868 Patent are provided in attached Exhibits A1 through A10.

Table 1-A: Prior Art Patents and Printed Publications for the '868 Patent

Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 2003/0208113 ("Mault") [Ex. A1]	Nov. 6, 2003	July 18, 2001
US 6,067,463 ("Jeng") [Ex. A2]	May 23, 2000	Jan. 5, 1999
US 5,891,022 ("Pologe") [Ex. A3]	April 6, 1999	Sept. 25, 1996
US 2002/0198473 ("Kumar") [Ex. A4]	Dec. 26, 2002	March 28, 2002
US 2004/0002634 ("Nihtila") [Ex. A5]	Jan. 1, 2004	June 28, 2002
JP 2000-74829 ("Shigeki") [Ex. A6]	Sept. 2, 1999	March 14, 2000
US 6,168,563 ("Brown") [Ex. A7]	Jan. 2, 2001	March 17, 1999
US 2002/0049389 ("Abreu") [Ex. A8]	April 25, 2002	Feb. 23, 2001
US 6,602,191 ("Quy") [Ex. A9]	Aug. 5, 2003	Dec. 15, 2000
US 5,830,137 ("Scharf") [Ex. A10]	Nov. 3, 1998	Nov. 18, 1996

Table 2-A: Prior Art Systems and Inventions for the '868 Patent

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20

[6] OnePlus's disclosure of prior art is premised on the alleged priority dates of the Asserted Patents as identified in Plaintiff's Infringement Contentions. OnePlus contends Plaintiff is not entitled to the alleged priority dates and reserve the right to modify, amend, or supplement their invalidity contentions with additional prior art references if any Asserted Claim is shown to not be entitled to the respective alleged priority date or if Plaintiff alleges any other priority date for any of the Asserted Claims. Notwithstanding that reservation of rights, OnePlus also reserves the right to argue that it has been unduly prejudiced should Plaintiff allege a different priority date for any of the Asserted Claims, and that accordingly Plaintiff should not be allowed to do so.

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems, Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	At least as early as 1988
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical,	At least as early as 2008

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, OnePlus has listed documents (previously produced by co-defendants in this litigation) as evidence of the relevant features and functionality to the extent that they are presently available and have been located. OnePlus has obtained or is in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may

also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.

Further, OnePlus is actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-A.

Discovery is ongoing, and OnePlus may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and OnePlus reserves the right to supplement these contentions accordingly. OnePlus continues to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserves the right to supplement these contentions and accompanying claim charts after further investigation.

OnePlus's reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '868 Patent. OnePlus's investigation of such prior art systems is still ongoing, and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '868 Patent. As such, OnePlus reserves all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the

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Asserted Claims of the ’868 Patent. OnePlus has obtained, and is in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this lawsuit, which OnePlus reserves the right to rely upon to corroborate the prior art status of the prior art identified herein. OnePlus reserves the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, OnePlus will make all such devices, software programs, or other products in OnePlus’s possession, custody, or control available for inspection by Plaintiff.

Consequently, OnePlus reserves the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, OnePlus identifies, responsive to Plaintiff’s Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-A and 2-A as evidence of the state of the art as it relates to physiological monitoring devices / systems.

Each of these references show that the concept of “physiological monitoring” is not novel and was well-known for many years before the alleged priority date of the ’868 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the Asserted Claims of the ’868 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the ’868 Patent to which it is applied

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for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because OnePlus has not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, OnePlus reserves the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

B. U.S. Patent No. 9,651,533

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '533 Patent are provided in attached Exhibits B1 through B8.

Table 1-B: Prior Art Patents and Printed Publications for the '533 Patent

Patent No. or Title (Primary Inventor/Author)	**Date of Issue/ Publication**	**Filing Date**
US 2011/0028802 ("Addison") [Ex. B1]	February 3, 2011	July 31, 2009
US 2015/0057511[7] ("Basu") [Ex. B2]	February 26, 2015	March 27, 2013
US 2005/0049468 ("Carslon") [Ex. B3]	March 3, 2005	September 3, 2003
US 2012/0197093 ("LeBoeuf") [Ex. B4]	August 2, 2012	January 25, 2012
US 9,241,676 ("Lisogurski") [Ex. B5]	January 26, 2016	May 31, 2012
US 9,596,990 ("Park") [Ex. B6]	March 21, 2017	November 6, 2013
US 8,923,918 ("Kreger") [Ex. B7]	December 30, 2014	December 18, 2010
US 7,507,207 ("Sakai") [Ex. B8]	March 24, 2009	October 5, 2004

[7] Invalidity contentions relying on this reference herein will make reference to the Provisional Application No. 61/616524, which is incorporated by reference into Basu.

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Table 2-B: Prior Art Systems and Inventions for the ’533 Patent

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems, Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	At least as early as 1988
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, OnePlus has listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. OnePlus has obtained or is in the process of attempting

to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.

Further, OnePlus is actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-B.

Discovery is ongoing, and OnePlus may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and OnePlus reserves the right to supplement these contentions accordingly. OnePlus continues to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserves the right to supplement these contentions and accompanying claim charts after further investigation.

OnePlus's reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '533 Patent. OnePlus's investigation of such prior art systems is still ongoing, and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether any of the third-party

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prior art systems anticipate or render obvious the Asserted Claims of the ’533 Patent. As such, OnePlus reserves all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the ’533 Patent. OnePlus has obtained, and is in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this lawsuit, which OnePlus reserves the right to rely upon to corroborate the prior art status of the prior art identified herein. OnePlus reserves the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, OnePlus will make all such devices, software programs, or other products in OnePlus’s possession, custody, or control available for inspection by Plaintiff.

Consequently, OnePlus reserves the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, OnePlus identifies, responsive to Plaintiff’s Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-B and 2-B as evidence of the state of the art as it relates to physiological monitoring devices / systems.

Each of these references show that the concept of “physiological monitoring” is not novel and was well-known for many years before the alleged priority date of the ’533 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the

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Asserted Claims of the ’533 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the ’533 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because OnePlus has not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, OnePlus reserves the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

C. U.S. Patent No. 10,517,484

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the ’484 Patent are provided in attached Exhibits C1 through C14.

Table 1-C: Prior Art Patents and Printed Publications for the ’484 Patent

Patent No. or Title (Primary Inventor/Author)	**Date of Issue/ Publication**	**Filing Date**
US 9,241,676 (“Lisogurski”) [Ex. C1]	Jan. 26, 2016	May 31, 2012
US 2015/0057511 (“Basu”) [Ex. C2]	Feb. 26, 2015	Mar. 27, 2013
US 6,616,613 (“Goodman”) [Ex. C3]	Sep. 9, 2003	Apr. 29, 2000
WO 2012/099536 (“Kassim”) [Ex. C4]	Jul. 26, 2012	Jan. 20, 2011
US 9,095,291 (“Soller”) [Ex. C5]	Aug. 4, 2015	Aug. 7, 2009
US 11,638,532 (“Poeze”) [Ex. C6]	May 2, 2023	Jul. 1, 2010
US 2012/0150047 (“Terumoto”) [Ex. C7]	June 14, 2012	Nov. 14, 2011
US 8,172,761 (“Rulkov”) [Ex. C8]	May 8, 2012	Oct. 4, 2011

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Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 2011/0066050 (“Moon”) [Ex. C9]	Mar. 17, 2011	Sep. 15, 2009
US 2005/0049468 (“Carlson”) [Ex. C10]	Mar. 3, 2005	Sep. 3, 2003
US 8,108,036 (“Tran”) [Ex. C11]	Jan. 31, 2012	Jun. 18, 2009
Plug-and-Play, Single-Chip Photoplethysmography (“Chandrasekar”) [Ex. C12]	Sep. 2012	N/A
US 8,923,918 (“Kreger”) [Ex. C13]	Dec. 30, 2014	Dec. 18, 2010
US 7,507,207 (“Sakai”) [Ex. C14]	Mar. 24, 2009	Oct. 5, 2004

Table 2-C: Prior Art Systems and Inventions for the ’484 Patent

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems, Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	At least as early as 1988
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc.,	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda,	At least as early as 2007

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
including but not limited to TuffSat, and its accessories (e.g., sensor probe)	

For each of the prior art devices identified above, OnePlus has listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. OnePlus has obtained or is in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.

Further, OnePlus is actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-C.

Discovery is ongoing, and OnePlus may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and OnePlus reserves the right to supplement these contentions accordingly. OnePlus continues to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserves the right to supplement these contentions and accompanying claim charts after further investigation.

OnePlus's reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and

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belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '484 Patent. OnePlus's investigation of such prior art systems is still ongoing, and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '484 Patent. As such, OnePlus reserves all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '484 Patent. OnePlus has obtained, and is in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this lawsuit, which OnePlus reserves the right to rely upon to corroborate the prior art status of the prior art identified herein. OnePlus reserves the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, OnePlus will make all such devices, software programs, or other products in OnePlus's possession, custody, or control available for inspection by Plaintiff.

Consequently, OnePlus reserves the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

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In addition, OnePlus identifies, responsive to Plaintiff's Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-C and 2-C as evidence of the state of the art as it relates to physiological monitoring devices / systems.

Each of these references show that the concept of "physiological monitoring" is not novel and was well-known for many years before the alleged priority date of the '484 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '484 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '484 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because OnePlus has not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, OnePlus reserves the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

D. U.S. Patent No. 10,874,304

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '304 Patent are provided in attached Exhibits D1 through D19.

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Table 1-D: Prior Art Patents and Printed Publications for the '304 Patent

Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 2015/0057511A1 ("Basu") [Ex. D1]	2/26/2015	3/27/2013
US 2005/0049468A1 ("Carlson") [Ex. D2]	3/3/2005	9/3/2003
US 6,616,613 ("Goodman") [Ex. D3]	9/9/2003	4/27/2000
US 6,519,037B2 ("Jung") [Ex. D4]	2/11/2003	6/1/2001
WO 2012/99536 ("Kassim") [Ex. D5]	7/26/2012	1/20/2011
US 2011/0237911A1 ("Lamego") [Ex. D6]	9/29/2011	3/28/2011
US 2010/0217102A1 ("LeBoeuf") [Ex. D7]	8/26/2010	1/21/2010
US 9,241,676 ("Lisogurski") [Ex. D8]	1/26/2016	5/31/2012
US 5,746,206 ("Mannheimer") [Ex. D9]	5/5/1998	6/10/1996
US 2003/0208113A1 ("Mault") [Ex. D10]	11/6/2003	7/18/2001
US 2011/0082711A1 ("Poeze") [Ex. D11]	4/7/2011	10/5/2010
US 5,891,022 ("Pologe") [Ex. D12]	4/6/1999	9/25/1996
US 8,108,036 ("Tran") [Ex. D13]	1/31/2012	6/18/2009
US 2012/0197093A1 ("Valencell") [Ex. D14]	8/2/2012	1/25/2012
D. Chandrasekar, et al., "Plug-and-Play, Single-Chip Photoplethysmography" ("Chandrasekar2012") [Ex. D15]	8/28/2012 - 9/1/2012	received 3/29/12
US 7,507,207 ("Sakai") [Ex. D16]	3/24/2009	10/5/2004
US 8,923,918 ("Kreger") [Ex. D17]	12/30/2014	12/18/2010
US 2006/0184040 ("Keller") [Ex. D18]	8/17/2006	12/7/2005
US 7,139,076 ("Marbach") [Ex. D19]	11/21/2006	8/8/2003

Table 2-D: Prior Art Systems and Inventions for the '304 Patent

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems, Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	At least as early as 1988
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not	At least as early as 1999

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld	At least as early as 2010

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse Oximeter, and its accessories (e.g., sensor probe)	
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, OnePlus has listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. OnePlus has obtained or is in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C.

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§§ 102 and/or 103.

Further, OnePlus is actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-D.

Discovery is ongoing, and OnePlus may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and OnePlus reserves the right to supplement these contentions accordingly. OnePlus continues to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserves the right to supplement these contentions and accompanying claim charts after further investigation.

OnePlus's reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '304 Patent. OnePlus's investigation of such prior art systems is still ongoing, and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '304 Patent. As such, OnePlus reserves all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '304 Patent. OnePlus has obtained, and is in the process of obtaining,

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additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this lawsuit, which OnePlus reserves the right to rely upon to corroborate the prior art status of the prior art identified herein. OnePlus reserves the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, OnePlus will make all such devices, software programs, or other products in OnePlus's possession, custody, or control available for inspection by Plaintiff.

Consequently, OnePlus reserves the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, OnePlus identifies, responsive to Plaintiff's Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-D and 2-D as evidence of the state of the art as it relates to physiological monitoring device/system.

Each of these references show that the concept of "physiological monitoring" is not novel and was well-known for many years before the alleged priority date of the '304 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '304 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '304 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such

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reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because OnePlus has not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, OnePlus reserves the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

E. U.S. Patent No. 11,160,455

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '455 Patent are provided in attached Exhibits E1 through E18.

Table 1-E: Prior Art Patents and Printed Publications for the '455 Patent

Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 2015/0057511A1 ("Basu") [Ex. E1]	2/26/2015	3/27/2013
US 2005/0049468A1 ("Carlson") [Ex. E2]	3/3/2005	9/3/2003
US 6,616,613 ("Goodman") [Ex. E3]	9/9/2003	4/27/2000
US 6,519,037B2 ("Jung") [Ex. E4]	2/11/2003	6/1/2001
WO 2012/99536 ("Kassim") [Ex. E5]	7/26/2012	1/20/2011
US 2011/0237911A1 ("Lamego") [Ex. E6]	9/29/2011	3/28/2011
US 2010/0217102A1 ("LeBoeuf") [Ex. E7]	8/26/2010	1/21/2010
US 9,241,676 ("Lisogurski") [Ex. E8]	1/26/2016	5/31/2012
US 5,746,206 ("Mannheimer") [Ex. E9]	5/5/1998	6/10/1996
US 2003/0208113A1 ("Mault") [Ex. E10]	11/6/2003	7/18/2001
US 2011/0082711A1 ("Poeze") [Ex. E11]	4/7/2011	10/5/2010
US 5,891,022 ("Pologe") [Ex. E12]	4/6/1999	9/25/1996
US 8,108,036 ("Tran") [Ex. E13]	1/31/2012	6/18/2009
US 2012/0197093A1 ("Valencell") [Ex. E14]	8/2/2012	1/25/2012
D. Chandrasekar, et al., "Plug-and-Play, Single-Chip Photoplethysmography" ("Chandrasekar2012") [Ex. E15]	8/28/2012 - 9/1/2012	received 3/29/12
US 7,507,207 ("Sakai") [Ex. E16]	3/24/2009	10/5/2004

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Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 8,923,918 ("Kreger") [Ex. E17]	12/30/2014	12/18/2010
US 8,725,226 (“Isaacson”) [Ex. E18]	5/13/2014	11/13/2009

Table 2-E: Prior Art Systems and Inventions for the ’455 Patent

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems, Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	At least as early as 1988
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical	At least as early as 1999 (Model 513) and 2007 (Model 2001)

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, OnePlus has listed and produced documents as evidence of the relevant features and functionality to the extent that they are

presently available and have been located. OnePlus has obtained or is in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.

Further, OnePlus is actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-E.

Discovery is ongoing, and OnePlus may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and OnePlus reserves the right to supplement these contentions accordingly. OnePlus continues to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserves the right to supplement these contentions and accompanying claim charts after further investigation.

OnePlus's reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '455 Patent. OnePlus's investigation of such prior art systems is still ongoing and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example,

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subsequent discovery may provide additional information regarding whether or not any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the ’455 Patent. As such, OnePlus reserves all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the ’455 Patent. OnePlus has obtained, and is in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the particular individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third party discovery during this lawsuit, which OnePlus reserves the right to rely upon to corroborate the prior art status of the prior art identified herein. OnePlus reserves the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, OnePlus will make all such devices, software programs, or other products in OnePlus’s possession, custody, or control available for inspection by Plaintiff.

Consequently, OnePlus reserves the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, OnePlus identifies, responsive to Plaintiff’s Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-E and 2-E as evidence of the state of the art as it relates to physiological monitoring devices / systems.

Each of these references show that the concept of “physiological monitoring” is not novel and was well-known for many years before the alleged priority date of the ’455 Patent, as discussed

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in more detail in Section IV.B (obviousness). In light of the references discussed herein, the Asserted Claims of the ’455 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the ’455 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because OnePlus has not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, OnePlus reserves the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

F. U.S. Patent No. 12,193,790

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the ’790 Patent are provided in attached Exhibits F1 through F14.

Table 1-F: Prior Art Patents and Printed Publications for the ’790 Patent

Patent No. or Title (Primary Inventor/Author)	**Date of Issue/ Publication**	**Filing Date**
US 9,241,676 (“Lisogurski”) [Ex. F1]	Jan. 26, 2016	May 31, 2012
US 2015/0057511 (“Basu”) [Ex. F2]	Feb. 26, 2015	Mar. 27, 2013
US 6,616,613 (“Goodman”) [Ex. F3]	Sep. 9, 2003	Apr. 29, 2000
WO 2012/099536 (“Kassim”) [Ex. F4]	Jul. 26, 2012	Jan. 20, 2011
US 9,095,291 (“Soller”) [Ex. F5]	Aug. 4, 2015	Aug. 7, 2009
US 11,638,532 (“Poeze”) [Ex. F6]	May 2, 2023	Jul. 1, 2010

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Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 2012/0150047 (“Terumoto”) [Ex. F7]	June 14, 2012	Nov. 14, 2011
US 8,172,761 (“Rulkov”) [Ex. F8]	May 8, 2012	Oct. 4, 2011
US 2011/0066050 (“Moon”) [Ex. F9]	Mar. 17, 2011	Sep. 15, 2009
US 2005/0049468 (“Carlson”) [Ex. F10]	Mar. 3, 2005	Sep. 3, 2003
US 2008/0242958 (“Al-Ali”) [Ex. F11]	Oct. 2, 2008	Mar. 26, 2008
Plug-and-Play, Single-Chip Photoplethysmography (“Chandrasekar”) [Ex. F12]	September 2012	N/A
US 8,923,918 (“Kreger”) [Ex. F13]	Dec. 30, 2014	Dec. 18, 2010
US 7,507,207 (“Sakai”) [Ex. F14]	Mar. 24, 2009	Oct. 5, 2004

Table 2-F: Prior Art Systems and Inventions for the ’790 Patent

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems, Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	At least as early as 1988
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, OnePlus has listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. OnePlus has obtained or is in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.

Further, OnePlus is actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-F.

Discovery is ongoing, and OnePlus may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and OnePlus reserves the right to supplement these contentions accordingly. OnePlus continues to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserves the right to supplement these contentions and accompanying claim charts after further investigation.

OnePlus's reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding

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patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '790 Patent. OnePlus's investigation of such prior art systems is still ongoing, and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '790 Patent. As such, OnePlus reserves all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '790 Patent. OnePlus has obtained, and is in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this lawsuit, which OnePlus reserves the right to rely upon to corroborate the prior art status of the prior art identified herein. OnePlus reserves the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, OnePlus will make all such devices, software programs, or other products in OnePlus's possession, custody, or control available for inspection by Plaintiff.

Consequently, OnePlus reserves the right to amend, modify, or supplement these Invalidity

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Contentions should additional information become available to them through discovery.

In addition, OnePlus identifies, responsive to Plaintiff's Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-F and 2-F as evidence of the state of the art as it relates to physiological monitoring devices / systems.

Each of these references show that the concept of "physiological monitoring" is not novel and was well-known for many years before the alleged priority date of the '790 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '790 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '790 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because OnePlus has not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, OnePlus reserves the right to supplement these contentions with facts, documents, or other information learned at a later point through discovery or further investigation.

G. U.S. Patent No. 12,268,475

Invalidity claim charts identifying disclosures in the references identified in the tables below as to the Asserted Claims of the '475 Patent are provided in attached Exhibits G1 through

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G14.

Table 1-G: Prior Art Patents and Printed Publications for the ’475 Patent

Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
US 9,241,676 (“Lisogurski”) [Ex. G1]	Jan. 26, 2016	May 31, 2012
US 2015/0057511 (“Basu”) [Ex. G2]	Feb. 26, 2015	Mar. 27, 2013
US 6,616,613 (“Goodman”) [Ex. G3]	Sep. 9, 2003	Apr. 29, 2000
WO 2012/099536 (“Kassim”) [Ex. G4]	Jul. 26, 2012	Jan. 20, 2011
US 9,095,291 (“Soller”) [Ex. G5]	Aug. 4, 2015	Aug. 7, 2009
US 11,638,532 (“Poeze”) [Ex. G6]	May 2, 2023	Jul. 1, 2010
US 2012/0150047 (“Terumoto”) [Ex. G7]	June 14, 2012	Nov. 14, 2011
US 8,172,761 (“Rulkov”) [Ex. G8]	May 8, 2012	Oct. 4, 2011
US 2011/0066050 (“Moon”) [Ex. G9]	Mar. 17, 2011	Sep. 15, 2009
US 2005/0049468 (“Carlson”) [Ex. G10]	Mar. 3, 2005	Sep. 3, 2003
US 2008/0242958 (“Al-Ali”) [Ex. G11]	Oct. 2, 2008	Mar. 26, 2008
US 2010/0217102 (“LeBeouf”) [Ex. G12]	Aug. 26, 2010	Jan. 21, 2010
US 8,108,036 (“Tran”) [Ex. G13]	Jan. 31, 2012	Jun. 18, 2009
US 8,922,788 (“Addison-788”) [Ex. G14]	Dec. 30, 2014	Dec 22, 2012

Table 2-G: Prior Art Systems and Inventions for the ’475 Patent

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by ChoiceMMed, including but not limited to ChoiceMMed MD300C318T, and its accessories (e.g., sensor probe)	At least as early as 2011-05-20
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Criticare Systems, Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	At least as early as 1988
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by GE Marquette Medical Systems, Inc., including but not limited to Dash 2000 Patient Monitor, and its accessories (e.g., sensor probe)	At least as early as 1999
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Masimo Corp., including but not limited to Rad-5 and Rad-5v Signal Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-57™), 2009 (SET®/Rainbow SET™).

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Mindray DS USA, Inc, including but not limited to Accutorr V, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Covidien AG / Nellcor Puritan Bennett Inc., including but not limited to Nellcor OxiMax Pulse Oximeters, Nellcor N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Nonin Medical, Inc., including but not limited to Onyx, PalmSAT™, and Nonin® Model 7500 Digital Pulse Oximeter, Nonin Onyx® 9500, and their accessories (e.g., sensor probe)	At least as early as 1988 (Onyx), 2007 (PalmSAT™), 2007 (Nonin Onyx® 9500), and 2008 (Nonin® Model 7500)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Novametrix Medical Systems Inc., including but not limited to Novametrix Model 513 and Model 2001, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 513) and 2007 (Model 2001)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Respironics, Inc., including but not limited to Models 920, 920M and 920M PLUS Pulse Oximeter, and their accessories (e.g., sensor probe)	At least as early as 1999 (Model 920 and 920M) and 2007 (Model 920M PLUS)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Smiths Medical, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Utech Co., Ltd., including but not limited to UT100 Handheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2010
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Welch Allyn, including but not limited to Propaq® CS Vital Signs Monitor and Propaq® Encore Vital Signs Monitor, and their accessories (e.g., sensor probe)	At least as early as 2011 (Propaq® Encore Vital Signs Monitor) and 2012 (Propaq® CS Vital Signs Monitor)
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Philips Medical Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Palco Labs Inc, including but not limited to Model 120 Mini Pulse Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by BCI Inc., including but not limited to Capnocheck® Sleep Capnograph/Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2007
Pulse oximeters or similar products publicly disclosed, used, sold, or offered for sale by Datex-Ohmeda, including but not limited to TuffSat, and its accessories (e.g., sensor probe)	At least as early as 2007

For each of the prior art devices identified above, OnePlus has listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. OnePlus has obtained or is in the process of attempting to obtain the identified devices and will make them available for inspection to the extent they are obtained. To the extent that one or more documents (*e.g.*, user manual) may be used to describe aspects of a particular device, that device is a single reference for prior art purposes under 35 U.S.C. § 102. Some or all of the corroborating references may also separately qualify as prior art publications under 35 U.S.C. § 102 and may be used as invalidating references under 35 U.S.C. §§ 102 and/or 103.

Further, OnePlus is actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-G.

Discovery is ongoing, and OnePlus may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and OnePlus reserves the right to supplement these contentions accordingly. OnePlus continues to investigate each of the identified devices, including through potential discovery needed to be obtained via

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third party subpoenas, and reserves the right to supplement these contentions and accompanying claim charts after further investigation.

OnePlus's reference to a particular product, device, or software program in these contentions should be interpreted as a reference to the system itself as well as to any corresponding patents, publications, or product literature relating to the cited system. Upon information and belief, the systems were publicly disclosed, used, sold, or offered for sale in the United States before the alleged priority date of the Asserted Claims of the '475 Patent. OnePlus's investigation of such prior art systems is still ongoing, and discovery has not yet been received from third parties who may have information concerning such prior art systems. Accordingly, subsequent discovery may reveal information that affects the disclosures and contentions herein. For example, subsequent discovery may provide additional information regarding whether any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '475 Patent. As such, OnePlus reserves all rights to supplement their invalidity contentions.

Many of the inventive, research, design, and development activities concerning these systems and technologies occurred in the United States before the alleged priority date of the Asserted Claims of the '475 Patent. OnePlus has obtained, and is in the process of obtaining, additional information regarding the dates by which the cited products and services were publicly disclosed, used, sold, or offered for sale, the circumstances under which the research, design, and development activities were conducted, and the identities of the individuals involved in such activities through publicly available patents, publications, and product literature. The actual dates, circumstances, and identities of individuals will be the subject of third-party discovery during this lawsuit, which OnePlus reserves the right to rely upon to corroborate the prior art status of the prior art identified herein. OnePlus reserves the right to modify, amend, or supplement these

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contentions if additional information becomes available during the course of this lawsuit. Furthermore, OnePlus will make all such devices, software programs, or other products in OnePlus's possession, custody, or control available for inspection by Plaintiff.

Consequently, OnePlus reserves the right to amend, modify, or supplement these Invalidity Contentions should additional information become available to them through discovery.

In addition, OnePlus identifies, responsive to Plaintiff's Infringement Contentions, the patents, publications, and/or systems listed in Tables 1-G and 2-G as evidence of the state of the art as it relates to physiological monitoring devices / systems.

Each of these references show that the concept of "physiological monitoring" is not novel and was well-known for many years before the alleged priority date of the '475 Patent, as discussed in more detail in Section IV.B (obviousness). In light of the references discussed herein, the Asserted Claims of the '475 Patent cannot be valid.

Each prior art patent, publication, or product identified above was either effectively filed or issued (for patents), published (for publications) or known, used, offered for sale or sold (for products) before either the earliest claimed priority date of the '475 Patent to which it is applied for invalidity, and none appears to have been abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g), if it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents, the authors listed on the above-identified publications, and the entities and individuals identified in connection with the above-identified products.

Because OnePlus has not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, OnePlus reserves the right to supplement these contentions with facts, documents, or other information

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learned at a later point through discovery or further investigation.

H. State of the Art

OnePlus identifies, responsive to Plaintiff's infringement contentions, the references listed in Tables 1-A through 1-G, Tables 2-A through 2-G, and the following patents, publications, and systems as evidence of the state of the art as it relates to each of the Asserted Patents:

- U.S. Patent No. 3,514,538
- U.S. Patent No. 3,789,601
- U.S. Patent No. 4,015,595
- U.S. Patent No. 4,589,078
- U.S. Patent No. 4,591,659
- U.S. Patent No. 4,941,236
- U.S. Patent No. 5,028,787
- U.S. Patent No. 5,222,496,
- U.S. Patent No. 5,254,388
- U.S. Patent No. 5,259,381
- U.S. Patent No. 5,267,152
- U.S. Patent No. 5,334,916
- U.S. Patent No. 5,348,002
- U.S. Patent No. 5,370,114
- U.S. Patent No. 5,527,261
- U.S. Patent No. 5,555,882
- U.S. Patent No. 5,590,652
- U.S. Patent No. 5,632,272
- U.S. Patent No. 5,638,818
- U.S. Patent No. 5,687,721
- U.S. Patent No. 5,746,206
- U.S. Patent No. 5,795,300
- U.S. Patent No. 5,807,261
- U.S. Patent No. 5,830,137
- U.S. Patent No. 5,879,294
- U.S. Patent No. 5,924,069
- U.S. Patent No. 6,018,673
- U.S. Patent No. 6,064,898
- U.S. Patent No. 6,067,463
- U.S. Patent No. 6,081,782
- U.S. Patent No. 6,108,634
- U.S. Patent No. 6,120,460
- U.S. Patent No. 6,126,595
- U.S. Patent No. 6,152,876

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- U.S. Patent No. 6,158,245
- U.S. Patent No. 6,168,563
- U.S. Patent No. 6,171,237
- U.S. Patent No. 6,172,743
- U.S. Patent No. 6,174,291
- U.S. Patent No. 6,178,343
- U.S. Patent No. 6,278,975
- U.S. Patent No. 6,285,454
- U.S. Patent No. 6,293,915
- U.S. Patent No. 6,336,900
- U.S. Patent No. 6,343,223
- U.S. Patent No. 6,393,311
- U.S. Patent No. 6,483,976
- U.S. Patent No. 6,505,133
- U.S. Patent No. 6,553,242
- U.S. Patent No. 6,584,336
- U.S. Patent No. 6,591,239
- U.S. Patent No. 6,591,239
- U.S. Patent No. 6,602,191
- U.S. Patent No. 6,605,038
- U.S. Patent No. 6,608,562
- U.S. Patent No. 6,648,820
- U.S. Patent No. 6,705,990
- U.S. Patent No. 6,705,991
- U.S. Patent No. 6,801,799
- U.S. Patent No. 6,816,266
- U.S. Patent No. 6,886,964
- U.S. Patent No. 6,912,413
- U.S. Patent No. 6,937,885
- U.S. Patent No. 6,961,599
- U.S. Patent No. 6,990,365
- U.S. Patent No. 7,031,728
- U.S. Patent No. 7,236,811
- U.S. Patent No. 7,346,174
- U.S. Patent No. 7,403,804
- U.S. Patent No. 7,507,207
- U.S. Patent No. 7,624,028
- U.S. Patent No. 7,658,613
- U.S. Patent No. 7,899,506
- U.S. Patent No. 8,095,195
- U.S. Patent No. 8,108,036
- U.S. Patent No. 8,125,331
- U.S. Patent No. 8,172,761
- U.S. Patent No. 8,326,390

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- U.S. Patent No. 8,537,343
- U.S. Patent No. 8,670,819
- U.S. Patent No. 8,725,226
- U.S. Patent No. 8,764,651
- U.S. Patent No. 8,923,918
- U.S. Patent No. 9,055,868
- U.S. Patent No. 9,241,676
- U.S. Patent No. 9,392,946
- U.S. Patent No. 9,596,990
- U.S. Patent No. 9,651,633
- U.S. Patent No. 9,820,658
- U.S. Patent No. 10,517,484
- U.S. Patent No. 10,729,335
- U.S. Patent No. 10,729,335
- U.S. Patent No. 10,874,304
- U.S. Patent No. 11,160,455
- U.S. Patent No. 11,242,072
- U.S. Patent No. 11,330,993
- U.S. Patent No. 11,342,072
- U.S. Patent No. 12,193,790
- "Plug-and-Play, Single-Chip Photoplethysmography", by D. Chandrasekar, B. Arnetz, P. Levy, A. Basu
- "Supercontinuum generation from ~1.9 to 4:5 μm in ZBLAN fiber with high average power generation beyond 3:8 μm using a thulium-doped fiber amplifier" by O. Kulkarni, V. Alexander, M. Kumar, M.Freeman, M. N. Islam, F. Terry, Jr., M. Neelakandan, and A. Chan
- "Supercontinuum Generation in Silica Fibers by Amplified Nanosecond Laser Diode Pulses" by C. Xia, M. Kumar, M. Cheng, O. Kulkarni, M. Islam, A. Galvanauskas, F. Terry, Jr., M. Freeman, D. Nolan, and W. Wood
- "Towards a Wearable Non-invasive Blood Glucose Monitoring Device" by J. Anders, J. Solanki, O. Choudhary, S. Chouksey, N. Malvia, P. Chaturvedi, and P. Sen
- "Open Data Kit Sensors: Mobile Data Collection with Wired and Wireless Sensors" by R. Chaudhri, W. Brunette, M. Goel, R. Sodt, J. VanORden, M. Falcone, G. Borriello
- "Android Based Body Area Network for the Evaluation of Medical Parameters" by M. Wagner, B. Kuch, C. Cabrera, P. Enoksson, A. Sieber
- "Noninvasice Cardiac Output Estimation Using a Novel Photoplethsymogram Index" by L. Wang, E. Pickwell-MacPherson, Y.P. Liang, Y.T. Zhang
- "Towards a Wearable Non-invasive Blood Glucose Monitoring Device" by J. Andrews, J. Solanki, O. Choudhary, S. Chouksey, N. Malvia, P. Chaturvedi, P. Sen
- U.S. Patent No. 5,511,553
- U.S. Patent No. 5,554,273
- U.S. Patent No. 5,592,124
- U.S. Patent No. 5,822,473
- U.S. Patent No. 5,942,749

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- U.S. Patent No. 5,953,713
- U.S. Patent No. 6,931,269
- U.S. Patent No. 7,023,557
- U.S. Patent No. 7,187,900
- U.S. Patent No. 8,050,730
- U.S. Patent No. 8,079,735
- U.S. Patent No. 8,852,103
- U.S. Patent No. 8,996,088
- U.S. Patent No. 9,239,951
- U.S. Patent Pub. No. 2007/0149868
- U.S. Patent Pub. No. 2007/0194939
- "The Biomedical Engineering Handbook," by Joseph D. Bronzino (1995)
- E.F. Schubert, Light-Emitting Diodes (Cambridge Univ. Press, 2nd ed. reprinted 2014)
- JP 3552090

IV. P. R. 3-3(b) – Invalidity Grounds

Pursuant to P.R. 3-3(b), OnePlus contends that certain prior art references below anticipate one or more Asserted Claims and that to the extent the identified prior art references do not anticipate the Asserted Claims, those claims are invalid as obvious under 35 U.S.C. §103. Each anticipatory prior art reference, either alone or in combination with other prior art, also renders the Asserted Claims invalid as obvious. In particular, each anticipatory prior art reference may be combined with (1) information generally known to persons skilled in the art at the time of the alleged invention, and/or (2) any of the other identified prior art references. To the extent that Plaintiff contends that any of the anticipatory prior art fails to disclose one or more limitations of the Asserted Claims, OnePlus contends that any difference between the reference and the corresponding patent claims would have been obvious to one of ordinary skill in the art. Thus, all anticipation charts should be interpreted as both reflecting anticipation by the reference as well as invalidity due to single reference obviousness, to the extent that Plaintiff contends that any limitation is missing.

A. Anticipation

As stated above, OnePlus incorporates by reference all other invalidity contentions related

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to the Asserted Patents served on or otherwise provided to Plaintiff, whether past or future. In accordance with P.R. 3-3(a), prior art references anticipating the Asserted Claims are provided below. The prior art listed below anticipates the Asserted Claims under the proper construction of the claims and/or under Plaintiff's apparent interpretation of the claims reflected by Plaintiff's Complaint and Infringement Contentions.

1. U.S. Patent No. 9,055,868

The Asserted Claims of the '868 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), OnePlus identifies the prior art references that anticipate or render obvious the '868 Patent Asserted Claims in the claim charts of Exhibits A1 through A10 (collectively "Appendix A") which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix A show how these prior art references teach or suggest each and every element of the '868 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, OnePlus indicates whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the '868 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix A, OnePlus further contends that the '868 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, OnePlus continues to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '868 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix A, OnePlus further contends that the knowledge of skill evidenced by those references render those claims invalid. OnePlus further

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contends that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

OnePlus's reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix A should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix A that relates to the cited component, circuit, software program, device, or product. In addition, OnePlus may rely on other documents or things that have not yet been located to support its contentions regarding such prior art component(s), circuit(s), software program(s), device(s) or product(s) that are referenced in the charts.

OnePlus incorporates by reference, as if set forth fully herein, all prior art cited during the prosecution of the '868 Patent, all prior art cited during reexamination proceedings of the '868 Patent, all prior art as described in any future *inter partes* review proceedings of the '868 Patent, and all prior art disclosed during previous litigation proceedings.

OnePlus further identifies and hereby incorporates by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the '868 Patent, its foreign counterparts, or any parent or child patent of the '868 Patent. OnePlus reserves the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

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Where OnePlus identifies a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), OnePlus's citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. OnePlus therefore reserves the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

OnePlus also reserves the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more

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other prior art references identified in Appendix A.

2. U.S. Patent No. 9,651,533

The Asserted Claims of the ’533 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), OnePlus identifies the prior art references that anticipate or render obvious the ’533 Patent Asserted Claims in the claim charts of Exhibits B1 through B8 (collectively “Appendix B”) which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix B show how these prior art references teach or suggest each and every element of the ’533 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, OnePlus indicates whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the ’533 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix B, OnePlus further contends that the ’533 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, OnePlus continues to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the ’533 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix B, OnePlus further contends that the knowledge of skill evidenced by those references render those claims invalid. OnePlus further contends that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

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OnePlus's reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix B should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix B that relates to the cited component, circuit, software program, device, or product. In addition, OnePlus may rely on other documents or things that have not yet been located to support its contentions regarding such prior art component(s), circuit(s), software program(s), device(s) or product(s) that are referenced in the charts.

OnePlus incorporates by reference, as if set forth fully herein, all prior art cited during the prosecution of the '533 Patent, all prior art cited during reexamination proceedings of the '533 Patent, all prior art as described in any future *inter partes* review proceedings of the '533 Patent, and all prior art disclosed during previous litigation proceedings.

OnePlus further identifies and hereby incorporates by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the '533 Patent, its foreign counterparts, or any parent or child patent of the '533 Patent. OnePlus reserves the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where OnePlus identifies a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include

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the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), OnePlus's citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. OnePlus therefore reserves the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

OnePlus also reserves the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix B.

3. U.S. Patent No. 10,517,484

The Asserted Claims of the '484 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), OnePlus identifies the prior art references that anticipate or render obvious the '484 Patent Asserted Claims in the claim charts of Exhibits C1 through C14

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(collectively "Appendix C") which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix C show how these prior art references teach or suggest each and every element of the '484 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, OnePlus indicates whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the '484 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix C, OnePlus further contends that the '484 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, OnePlus continues to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '484 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix C, OnePlus further contends that the knowledge of skill evidenced by those references render those claims invalid. OnePlus further contends that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

OnePlus's reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix C should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix C that relates to the cited component, circuit, software program, device, or

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product. In addition, OnePlus may rely on other documents or things that have not yet been located to support its contentions regarding such prior art component(s), circuit(s), software program(s), device(s) or product(s) that are referenced in the charts.

OnePlus incorporates by reference, as if set forth fully herein, all prior art cited during the prosecution of the '484 Patent, all prior art cited during reexamination proceedings of the '484 Patent, all prior art as described in any future *inter partes* review proceedings of the '484 Patent, and all prior art disclosed during previous litigation proceedings.

OnePlus further identifies and hereby incorporates by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the '484 Patent, its foreign counterparts, or any parent or child patent of the '484 Patent. OnePlus reserves the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where OnePlus identifies a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), OnePlus's citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally

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read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. OnePlus therefore reserves the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

OnePlus also reserves the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix C.

4. U.S. Patent No. 10,874,304

The Asserted Claims of the ’304 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), OnePlus identifies the prior art references that anticipate or render obvious the ’304 Patent Asserted Claims in the claim charts of Exhibits D1 through D19 (collectively “Appendix D”) which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix D show how these prior art references teach or suggest each and every element of the ’304 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, OnePlus indicates whether the prior art renders the claim

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anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the '304 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix D, OnePlus further contends that the '304 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, OnePlus continues to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '304 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix D, OnePlus further contends that the knowledge of skill evidenced by those references render those claims invalid. OnePlus further contends that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

OnePlus's reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix D should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix D that relates to the cited component, circuit, software program, device, or product. In addition, OnePlus may rely on other documents or things that have not yet been located to support its contentions regarding such prior art component(s), circuit(s), software program(s), device(s), or product(s) that are referenced in the charts.

OnePlus incorporates by reference, as if set forth fully herein, all prior art cited during the

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prosecution of the ’304 Patent, all prior art cited during reexamination proceedings of the ’304 Patent, all prior art as described in any *inter partes* review proceedings of the ’304 Patent, and all prior art disclosed during previous litigation proceedings.

OnePlus further identifies and hereby incorporates by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the ’304 Patent, its foreign counterparts, or any parent or child patent of the ’304 Patent. OnePlus reserves the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where OnePlus identifies a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), OnePlus’s citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. OnePlus therefore reserves the right

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to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

OnePlus also reserves the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix D.

5. U.S. Patent No. 11,160,455

The Asserted Claims of the ’455 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), OnePlus identifies the prior art references that anticipate or render obvious the ’455 Patent Asserted Claims in the claim charts of Exhibits E1 through E18 (collectively “Appendix E”) which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix E show how these prior art references teach or suggest each and every element of the ’455 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, OnePlus indicates whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the ’455 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix E, OnePlus further contends that the ’455 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b),

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and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, OnePlus continues to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the '455 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix E, OnePlus further contends that the knowledge of skill evidenced by those references render those claims invalid. OnePlus further contends that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

OnePlus's reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix E should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix E that relates to the cited component, circuit, software program, device, or product. In addition, OnePlus may rely on other documents or things that have not yet been located to support its contentions regarding such prior art component(s), circuit(s), software program(s), device(s) or product(s) that are referenced in the charts.

OnePlus incorporates by reference, as if set forth fully herein, all prior art cited during the prosecution of the '455 Patent, all prior art cited during reexamination proceedings of the '455 Patent, all prior art as described in any future *inter partes* review proceedings of the '455 Patent, and all prior art disclosed during previous litigation proceedings.

OnePlus further identifies and hereby incorporates by reference as if set forth fully herein

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the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the '455 Patent, its foreign counterparts, or any parent or child patent of the '455 Patent. OnePlus reserves the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where OnePlus identifies a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), OnePlus's citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. OnePlus therefore reserves the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

OnePlus also reserves the right to rely upon other portions of the prior art references, other

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publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix E.

6. U.S. Patent No. 12,193,790

The Asserted Claims of the ’790 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), OnePlus identifies the prior art references that anticipate or render obvious the ’790 Patent Asserted Claims in the claim charts of Exhibits F1 through F14 (collectively “Appendix F”) which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix F show how these prior art references teach or suggest each and every element of the ’790 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, OnePlus indicates whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the ’790 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix F, OnePlus further contends that the ’790 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, OnePlus continues to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition

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to contending that the ’790 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix F, OnePlus further contends that the knowledge of skill evidenced by those references render those claims invalid. OnePlus further contends that, even if a prior art reference does not expressly disclose all limitations as arranged or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

OnePlus’s reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix F should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix F that relates to the cited encoder, decoder, circuit, software program, device, or product. In addition, OnePlus may rely on other documents or things that have not yet been located to support its contentions regarding such prior art encoder(s), decoder(s), circuit(s), software program(s), device(s) or product(s) that are referenced in the charts.

OnePlus incorporates by reference, as if set forth fully herein, all prior art cited during the prosecution of the ’790 Patent, all prior art cited during reexamination proceedings of the ’790 Patent, all prior art as described in any future *inter partes* review proceedings of the ’790 Patent, and all prior art disclosed during previous litigation proceedings.

OnePlus further identifies and hereby incorporates by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the ’790 Patent, its foreign counterparts, or any parent or child patent of the ’790 Patent. OnePlus reserves the right to use any and all portions of the publication, related publications, commercial embodiments of the

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publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where OnePlus identifies a particular figure in a prior art reference, the identification should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), OnePlus's citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. OnePlus therefore reserves the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

OnePlus also reserves the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole

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would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix F.

7. U.S. Patent No. 12,268,475

The Asserted Claims of the ’475 Patent are anticipated and/or rendered obvious by prior art. Pursuant to P.R. 3-3(a), OnePlus identifies the prior art references that anticipate or render obvious the ’475 Patent Asserted Claims in the claim charts of Exhibits G1 through G14 (collectively “Appendix G”) which are hereby incorporated by reference as if fully set forth herein. The claim charts of Appendix G show how these prior art references teach or suggest each and every element of the ’475 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, OnePlus indicates whether the prior art renders the claim anticipated and/or obvious pursuant to P.R. 3-3(b).

In addition to contending that the ’475 Patent Asserted Claims are invalid in view of the prior art references cited in the claim charts of Appendix G, OnePlus further contends that the ’475 Patent Asserted Claims are invalid as anticipated and/or obvious under U.S.C. §§ 102(a), 102(b), and/or 103 in view of public knowledge and uses and/or offers for sale of products and services related to the subject matter of the cited references. As discovery is ongoing, OnePlus continues to investigate these items and to reserve the right to amend or supplement these contentions to include additional information or documents regarding such products and/or systems. In addition to contending that the ’475 Patent Asserted Claims are invalid in view of the explicit disclosures of the prior art references cited in the claim charts of Appendix G, OnePlus further contends that the knowledge of skill evidenced by those references render those claims invalid. OnePlus further contends that, even if a prior art reference does not expressly disclose all limitations as arranged

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or combined in the same manner as an asserted claim, a skilled artisan reading the reference would at once envisage the claimed arrangement or combination. *See, e.g.*, *Kennametal Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376 (Fed. Cir. 2015).

OnePlus's reference to particular components, circuits, software programs, devices, or products in the claim charts of Appendix G should be interpreted alternatively as both as a reference to the product itself and to any corresponding patents, publications, or product literature cited in Appendix G that relates to the cited encoder, decoder, circuit, software program, device, or product. In addition, OnePlus may rely on other documents or things that have not yet been located to support its contentions regarding such prior art encoder(s), decoder(s), circuit(s), software program(s), device(s) or product(s) that are referenced in the charts.

OnePlus incorporates by reference, as if set forth fully herein, all prior art cited during the prosecution of the '475 Patent, all prior art cited during reexamination proceedings of the '475 Patent, all prior art as described in any future *inter partes* review proceedings of the '475 Patent, and all prior art disclosed during previous litigation proceedings.

OnePlus further identifies and hereby incorporates by reference as if set forth fully herein the prior art references and invalidity contentions as described in any Other Omni Proceedings wherein invalidity contentions have been, or will be, provided regarding the '475 Patent, its foreign counterparts, or any parent or child patent of the '475 Patent. OnePlus reserves the right to use any and all portions of the publication, related publications, commercial embodiments of the publication, and other evidence that is discovered in these lawsuits to demonstrate and/or evidence the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where OnePlus identifies a particular figure in a prior art reference, the identification

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should be understood to encompass the caption and description of the figure, as well as any text relating to the figure in addition to the figure itself. Similarly, where an identified portion of text refers to a figure, embodiment, or other material, the identification should be understood to include the referenced figure, embodiment, or other material as well. Consistent with P.R. 3-3(c), OnePlus's citations to specific statements, figures, or disclosures in a prior art reference are sufficient to put Plaintiff on notice where each element of each asserted claim is found in the prior art. However, it should be recognized that a person of ordinary skill in the art would generally read a prior art reference as a whole and in the context of other publications, literature, and general knowledge in the field. To understand and interpret any specific statement or disclosure in a prior art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. OnePlus therefore reserves the right to rely upon other unidentified portions of the prior art references and on other publications and expert testimony to provide context and to aid understanding and interpretation of the identified portions.

OnePlus also reserves the right to rely upon other portions of the prior art references, other publications, and the testimony of experts to establish that the alleged inventions would have been obvious to a person of ordinary skill in the art, including the basis of modifying or combining certain cited references. To the extent any limitation is deemed not to be exactly met by an item of prior art, then any purported differences are such that the claimed subject matter as a whole would have been obvious to one skilled in the art at the time of the alleged invention, in view of the state of the art and knowledge of those skilled in the art. To the extent that an element of an Asserted Claim is not anticipated, the claim is rendered obvious by combination with one or more other prior art references identified in Appendix G.

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B. Obviousness

As stated above, OnePlus incorporates by reference all other invalidity contentions related to the Asserted Patents served on or otherwise provided to Plaintiff, whether past or in the future. In addition to certain claims being anticipated at least under Plaintiff's apparent claim constructions as indicated above, the Asserted Claims are also invalid as obvious over the same teachings identified for anticipation. Further, the Asserted Claims are obvious over various combinations of the references shown in the claim charts accompanying or incorporated by reference into this disclosure. No Asserted Claim goes beyond combining known elements to achieve predictable results or does more than choose between clear alternatives known to those of skill in the art. Thus, to the extent that an Asserted Claim is not anticipated, it is nevertheless invalid as obvious. Specifically, OnePlus asserts that any charted or incorporated reference in combination with one or more other charted or incorporated references renders the Asserted Claims obvious.

In *KSR International Co. v. Teleflex, Inc.*, the United States Supreme Court held that, among other things, "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." 550 U.S. 398, 416 (2007); *see also id.* at 417 ("[A] court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions."). A patent is obvious where "the content of the prior art, the scope of the patent claim, and the level of ordinary skill are not in material dispute, and the obviousness of the claim is apparent in light of these factors." *Id.* at 427. The Supreme Court found that "if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." *Id.* at 417.

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Moreover, the Supreme Court recognizes that market pressures will motivate a person of ordinary skill to survey known art for solutions to problems. *Id.* at 421 ("When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp."). When a person of ordinary skill uses an identified, predictable solution to solve a problem, "it is likely the product not of innovation but of ordinary skill and common sense." *Id.* In addition, when a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. *Id.* at 417. If a person of ordinary skill can implement a predictable variation, U.S.C. § 103 bars its patentability. *Id.*

"'[A]ny need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.'" *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1379 (Fed. Cir. 2023) (quoting *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 420 (2007)). "Additionally, 'universal' motivations known in a particular field to improve technology provide 'a motivation to combine prior art references ***even absent any hint of suggestion*** in the references themselves.'" *Id.* (quoting *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 797-99 (Fed. Cir. 2021)) (original emphasis). Thus, motivations to combine, as well as the general state of the art, may be found in a variety of places including, but not limited to, in the references defined above, and the specification of the Asserted Patents. For example, each piece of prior art relates to systems and methods for physiological monitoring devices / systems. A person of ordinary skill in the art at the time of the alleged invention would have been motivated to combine any one piece of identified prior art with any other identified piece of prior art. For at least this reason, it would have been obvious to a person of skill in the art

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at the time of the alleged invention of the Asserted Claims to combine the various references cited herein so as to practice the Asserted Claims and there is a motivation in the art to make such a combination. Further reasons to combine the references identified in these charts include the nature of the problem being solved, the express, implied, and/or inherent teachings of the prior art, the knowledge of persons of ordinary skill in the art, the fact that the prior art is generally directed towards methods and systems for physiological monitoring, that such combinations would have yielded predictable results, and that such combinations would have represented known alternatives to a person of ordinary skill in the art.

The law does not require evidence of a specific motivation to combine prior art where the combination would yield expected results and at most simply represents a known alternative or design choice to one of skill in the art. *See Apple Inc. v. Samsung Elecs. Co*., 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co*., 869 F.3d 1336, 1344 (Fed. Cir. 2017); *KSR Int'l Co. v. Teleflex, Inc*., 127 S. Ct. 1727, 1739-40 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, and instead applying an "expansive and flexible" approach). Indeed, the Supreme Court held that a POSITA is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *KSR*, 550 U.S. at 420-21.

Nevertheless, in addition to the information contained immediately above and elsewhere in these contentions, OnePlus identifies additional motivations and reasons to combine. For example, in addition to the specific motivations identified herein, motivation to modify a particular reference or to combine any two or more of the identified references comes from (a) the nature of the problem being solved, (b) the teachings of the prior art, (c) the knowledge of persons of

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ordinary skill in the art, (d) the fact that all of the references teach systems, apparatuses, and methods related to the subject matter and address the same technical issues described in the Asserted Patents, and (e) one would be motivated by considerations of efficiency, effectiveness, convenience, cost-savings, and accessibility, to combine the various teachings of the references. Additionally, one would be motivated to address the alleged problems or achieve the purported objectives identified in the Background sections of the Asserted Patents, of the references cited on the face of the Asserted Patents, and of the other references cited herein.

In sum, motivations to modify or combine the identified references including the references listed above can be found via, for example, discussions in the cited references, the state of the art discussed in the references, and the knowledge of one of ordinary skill in the art. One of ordinary skill in the art would have been motivated to combine these references, because these references relate to common objectives and subject matter. The references share commonalities in terms of their general subject matter as well as the types of equipment, products, systems, and/or methods used. Further, certain prior art references explicitly or implicitly reference other prior art references, share common authors or inventors, were published in the same journals, were compiled by a common author of a compilation or reference book, were presented at the same conferences, and/or were developed at common companies, schools, or organizations, which would motivate one of ordinary skill in the art to combine them. These references are within the field of the Asserted Patents and are directed to similar subject matter within the field. Additionally, the references, and any products, devices, or processes described in the references, existed and/or were invented in the same time period providing further motivation for combination. These disclosures were provided without prejudice to any arguments or objections concerning the relevance of motivation to combine in connection with any invalidity contentions.

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OnePlus reserves the right to further specify the motivations to combine the prior art in response to positions that Plaintiff may take later in this case and as discovery, including third party discovery, proceeds. OnePlus may rely on any and all portions of the prior art, other documents, and expert testimony to establish that a person of ordinary skill in the art would have been motivated to modify or combine the prior art so as to render the claims invalid as obvious. Moreover, OnePlus reserves the right to rely on later identified sources of information, including but not limited to witness testimony and other discovery, to establish the state of the art in the relevant time frame pertaining to the Asserted Patents.

Additionally, OnePlus notes that Plaintiff has neither provided any contention that secondary considerations of non-obviousness exist for any Asserted Patent nor provided any evidence of such secondary considerations. OnePlus is not aware of any evidence supporting the existence of any such secondary considerations. This lack of evidence further renders the Asserted Claims obvious. Proving any such secondary considerations is Omni's burden. *See, e.g.*, *ZUP, LLC v. Nach Mfg., Inc.*, 896 F.3d 1365, 1373 (Fed. Cir. 2018) ("[A] patentee bears the burden of production with respect to evidence of secondary considerations of nonobviousness."). To the extent Omni is permitted to introduce contentions and/or evidence concerning secondary considerations in the future, OnePlus reserves all rights to rebut those contentions if and when Omni identifies them. In the meantime, OnePlus notes the complete lack of any such evidence in the record. Moreover, OnePlus further contends that, in any event, the evidence of obviousness for each asserted claim is so overwhelming that secondary considerations are necessarily insufficient to rebut OnePlus's showing. *See, e.g.*, *Ohio Willow Wood Co. v. Alps South, LLC*, 735 F.3d 1333, 1344 (Fed. Cir. 2013) ("[W]here a claimed invention represents no more than the predictable use of prior art elements according to established functions, as here, evidence of

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secondary indicia are frequently deemed inadequate to establish non-obviousness.").

While OnePlus reserves the right to rely on any combination of the references reflected in their charts or incorporated herein by reference, OnePlus provides the following exemplary and non-exhaustive references and/or combinations evidencing invalidity of the claims of the Asserted Patents. The combinations of prior art listed below render obvious the Asserted Claims under the proper construction of the claims and/or under Plaintiff's apparent interpretation of the claims as set forth by Plaintiff in its Complaint and Infringement Contentions.

1. U.S. Patent No. 9,055,868

Pursuant to P.R. 3-3(a) and (b), OnePlus identifies in Appendix A the prior art references that render obvious the Asserted Claims of the '868 Patent and include below exemplary combinations showing the obviousness of the '868 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix A, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the '868 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix A, such reference may be combined with any other references listed in Appendix A for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the '868 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '868 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

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a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix A along with the knowledge of one of ordinary skill in the art to meet the limitations of the '868 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the '868 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. OnePlus may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix A, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

Reservation of Rights: Moreover, as mentioned above, OnePlus has not yet completed its search or discovery concerning additional prior art. As such, OnePlus's inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and OnePlus reserves the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '868 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. OnePlus further believes that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the

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attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co*., 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co*., 869 F.3d 1336, 1344 (Fed. Cir. 2017). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, OnePlus identifies motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix A would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix A would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to

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combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '868 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix A is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix A because all of these references relate to the same area of technology and/or are from analogous art. The '868 Patent Asserted Claims are directed to a diagnostic system comprising a light source, a software application capable of operating on a control system, and a host. '868 Patent at Abstract. The '868 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their

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respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the '868 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the '868 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to wirelessly collecting and processing physiological information using a light source and related features.

Demand and Market Forces: For example, market forces suggested a demand for wirelessly collecting and processing physiological information using a light source, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the '868 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to

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combine the known options that are within his or her technical grasp. For the '868 Patent, there are a finite number of approaches for wirelessly collecting and processing physiological information using a light source. For example, as of the priority date of the '868 Patent, a POSITA would have been very familiar with basic elements of the '868 Patent's claims such as devices using light passing through a user's body, including blood, to measure physiological information; semiconductor diodes; software; the wireless transmission of data, including via mobile phones and the internet; tracking location of a remote device; differing inputs to a computing system, including voice commands, touchscreens, keypads, etc. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the '868 Patent's claims does not render them novel or non-obvious.

There are significant similarities in subject matter and objectives for each of many references used in these contentions for the '868 Patent.

Wireless Physiological Monitoring References: For example, charted reference Mault, as well as numerous other references such as Kumar, Nihtila, Brown, and Quy all include teachings related to wirelessly collecting and analyzing physiological data, including data known to be collected using spectroscopy. These references provide numerous methods for collecting physiological data, as well as different methods for wirelessly transmitting and processing the data. For example, Mault teaches "a system embodiment comprising an electronic device 10, a blood glucose sensor 12, a physical activity monitor 14, an insulin pump 16, a communications network 20, and a remote computer system 22." Mault at [0069]. Mault further teaches that "[e]lectronic device 10 can be carried by the person, for example a portable computer, personal digital assistant (PDA), wireless phone with computational functionality, visor-mounted device, or other device" and "[s]ensor 12 can be carried by the person and provides blood glucose measurements at

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intervals." Mault at [0069]-[0070]. Mault teaches that "using a non-invasive spectroscopic technique, the PDA/module combination may be placed against part of the body to obtain a blood glucose reading." Mault at [0073]. Kumar teaches "system architecture 100 for network-based monitoring of data from a patient-side physiological collecting device . . . includ[ing] one or more patient-side devices 102 for collecting data from a patient/client, one or more provider-side devices 104, and an engine implemented on a central server 106." Kumar at [0067]. Kumar further teaches that "[t]he system may be adapted to include web-enabled spirometers and oximeters, allowing healthcare practitioners to perform remote spirometry and oximetry tests." Kumar at [0072]. Kumar also teaches that "[t]he patient-side device may then be connected via a computing device 110, such as a computer, handheld devices such as personal digital assistants (PDAs) and pocket PCs . . . ." Kumar at [0072]. Nihtila teaches "a system for acquiring physiological data from a user and communicating the physiological data via a mobile terminal to a network server for integration into a virtual physiological model established for the user in accordance with an embodiment of the present invention." Nihtila at [0035]. Nihtila further teaches that "[t]he physiological data communicated from the mobile terminal 122 to the network 124 is routed to a server 126 which is configured to accept and process this data. . . . and executes processing software that, in general, operates on the physiological data received from each of a number of users." Nihtila at [0038]. Brown teaches "blood glucose monitor 16 operates in conjunction with data management unit 10 and handheld microprocessor unit 12 to: (a) perform a test or calibration sequence in which tests are performed to confirm that the system is operating properly; and, (b) perform the blood glucose test sequence in which blood glucose meter 16 senses the user's blood glucose level. Brown at 20:28-67. Brown further teaches that "each apparatus may be placed in communication with server 2018 via wireless communication networks, cellular networks, telephone networks, or any other

network which allows each apparatus to exchange data with server 2018." Brown at 25:12-25. Quy is titled "Method and Apparatus for Health and Disease Management Combining Patient Data Monitoring with Wireless Internet Connectivity." Quy at Title. Quy teaches "[t]he system includes a wireless health-monitoring apparatus ('WHMA') 10 . . . [which] is linked in a wireless fashion to a wireless connection point of presence ("POP") 19, the same including at least a base station antenna 15 coupled to a server 17." Quy at 6:29-32. Quy teaches "[s]erver 17 is in turn connected to the wired, or even a wireless (not shown) Internet 21, which may include the World Wide Web." Quy at 6:33-35.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that collect and transmit physiological data. These methods are known to be effective in collecting and transmitting data. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of collecting and transmitting physiological data.

Physiological Monitoring Using Spectroscopy References: For example, charted reference Mault, as well as numerous other references such as Jeng[8], Pologe, Shigeki, Kumar, Nihtila, Quy, Abreu, and Scharf. all include teachings related to physiological monitoring using spectroscopy. These references provide numerous methods for measuring physiological information, such as blood glucose levels and blood oxygenation, using measurements of light. For example, Mault teaches "sensor 12 may use spectroscopic detection of a glucose oxidase

[8] Mault incorporates Jeng by reference (*see* Mault at [0011], [0073]), thus, references to Jeng should be understood to be references to Mault and/or Jeng.

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reaction . . . and may also use in-vivo spectroscopy techniques to measure blood glucose." Mault at [0073]. Jeng discloses "a method and apparatus for measuring the concentration of an analyte of interest, e.g. glucose, in blood non-invasively, i.e., without penetrating the skin or obtaining a biological sample from the body of a patient." Jeng at 4:28-39. Jeng further discloses that "[l]ight passing through the body part 'B' is transmitted through an aperture 49 and then through a lens system 50 to deliver light to a dispersive element 52." Jeng at 6:57-7:4. Pologe discloses "a system for performing photoplethysmographic measurements using wavelength division multiplexing." Pologe at 4:20-32. Pologe further discloses that "[t]he received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood." Pologe at 4:33-54. Shigeki discloses a "glucose sensor" that "measures the blood glucose concentration of blood flowing through the microvessels in the earlobe 4 of the human body." Shigeki at [0009]. Shigeki further discloses that "[t]he volume of blood flow is measured using the Doppler effect, so infrared light, which has good transmissibility through biological tissue, is used to minimize the attenuation of light reflected by hemoglobin." Shigeki at [0009]. Kumar discloses that "[t]he patient-side device is located with a patient and can be any device that gathers physiological data from the patient." Kumar at [0071]. Kumar further discloses that "[t]he system may be adapted to include web-enabled spirometers and oximeters, allowing healthcare practitioners to perform remote spirometry and oximetry tests." Kumar at [0203]. Nihtila discloses "systems and methods for using mobile communication techniques to enhance an understanding of the physiological state of an individual based on physiological information acquired from the individual in real-time." Nihtila at [0024]. Nihtila firther discloses that "a physiological data acquisition system of the present invention can include a blood sensing device 211 . . . [which] can be used to measure a number of blood related

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parameters," including "oxygen saturation, oxygen consumption, blood chemistry, and blood pressure, for example." Nihtila at [0054]. Quy teaches "while various types of medical devices have been mentioned, numerous other types may also be used in the embodiments of the invention, including pulse oximeters, syringe drivers, infusion pumps, spirometers, ventilators, anesthesia monitors, and so on." Quy at 12:51-13:22. Abreu teaches "FIG. 100(C) shows a schematic block diagram of one preferred far-infrared spectroscopy measuring apparatus of the present invention." Abreu at [1159]. Abreu further teaches "[b]esides near-infrared spectroscopy, the present invention provides superior results and higher signal to noise ratio when using any other form of electromagnetic radiation such as for example mid-infrared radiation, radio wave impedance, photoacoustic spectroscopy, Raman spectroscopy, visible spectroscopy, ultraviolet spectroscopy, fluorescent spectroscopy, scattering spectroscopy, and optical rotation of polarized light as well as other techniques such as fluorescent (including Maillard reaction, light induced fluorescence, and induction of glucose fluorescence by ultraviolet light), colorimetric, refractive index, light reflection, thermal gradient, Attenuated Total Internal Reflection, molecular imprinting, and the like. Abreu at [0276]. Scharf teaches "[a] reflectance pulse oximeter that determines oxygen saturation of hemoglobin using two sources of electromagnetic radiation in the green optical region, which provides the maximum reflectance pulsation spectrum." Scharf at Abstract. Scharf further teaches "[t]he oximeter 10 of the present invention comprises two emitters of green light 12, 14 that illuminate a volume of intravascular blood 4." Scharf at 4:8-22.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that measure physiological information, such as blood glucose levels and blood oxygenation, using measurements of light. These methods use light to measure physiological information. Moreover, to the extent that any of these references

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includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological information, such as blood glucose levels and blood oxygenation, using measurements of light.

Physiological Monitoring with Lenses References: For example, charted reference Jeng, as well as numerous other references such as Pologe, Shigeki, and Scharf all include teachings related to using light with lens systems to collect physiological data. These references provide numerous methods for collecting physiological data using spectroscopy, including using systems with lenses. For example, Jeng teaches that "[t]he body part, e.g., a finger, earlobe, is positioned at the place where the beam from the source of light is focused. Light passing through the body part is transmitted through an aperture 24 and then through a lens system 25 to deliver light to the detector 20." Jeng at 6:31-44. Jeng further discloses that "Light passing through the body part 'B' is transmitted through an aperture 49 and then through a lens system 50 to deliver light to a dispersive element 52." Jeng at 6:57-7:4. Pologue discloses that "the WDM coupler can include any of a number of coupler types, such as those using lenses, prisms, interference filters, diffraction gratings, or butt coupling." Pologe at 3:43-55. Shigeki discloses that "[t]he wavelength of the light outputted from the first semiconductor laser 1 is 1.55 μm, which is within the glucose absorption wavelength band." Shigeki at [0009]. Shigeki further discloses that the light "passes through the earlobe 4 and is received by the first photodetector 20." Shigeki at [0009]. Abreu teaches "[t]he light radiation 2302 can be directly emitted from a light source 2300 and directly collected by a photodetector 2318, or the light radiation 2302 can be delivered and collected using optic fiber cables." Abreu at [1086]. Abreu further teaches "[a]n interface lens system can be used to convert the rays to spatial parallel rays, such as from an incident divergent beam to a spatially parallel

beam." Abreu at [1086]. Scharf teaches "[s]uitable optical filters include custom-made molded acrylic aspheric lens/filters having peak wavelengths of 560 nm and 580 nm, respectively, and which have bandwidths of less than 5 nm, which are available from Innovations In Optics, Inc., address 38 Montvale Avenue, Suite 215, Storeham, Mass. 02180, (716) 279-0806." Scharf at 4:22-37. Scharf further teaches "Although shown as flat surfaces, face pieces 16, 18, and 91 can alternatively be shaped to form discrete lenses (not shown) to focus the radiant energy from the LEDs 13a-13d and 15a-15d onto the skin 2 and into the blood 4 and from the skin 2 onto the photodiode 26, 62." Scharf at 8:59-65.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that measure physiological information using light with a lens system. These methods use light with a lens system to measure physiological information. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological information using light with a lens system.

Wavelength Division Multiplexing References: For example, charted reference Pologe, as well as numerous other references such as Jeng, Abreu, and Scharf all include teachings related to using wavelength division multiplexing to measure physiological information. These references provide numerous methods for using wavelength division multiplexing to measure physiological information, particularly relating to blood measurements. For example, Pologe teaches "the present invention relates to a system for performing photoplethysmographic measurements using wavelength division multiplexing." Pologe at 4:20-32. Pologe further discloses "the WDM coupler

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is capable of producing a wavelength multiplexed pulse on the single light guide that includes the spectral contents of all of the multiple light pulses. In this regard, the WDM coupler can include any of a number of coupler types, such as those using lenses, prisms, interference filters, diffraction gratings, or butt coupling. In addition, active WDM couplers can also be used." Pologe at 3:43-55. Jeng discloses that "[t]he band-pass filter set 14 selects one desired wavelength at a time by rotating the set to place a given filter in the path of the beam." Jeng at 6:11-30. Jeng further discloses that "[a] lens system 47 is used to focus the light from the beam splitter onto the detector 48." Jeng at 6:45-56. Jeng discloses that "[l]ight passing through the body part 'B' is transmitted through an aperture 49 and then through a lens system 50 to deliver light to a dispersive element 52." Jeng at 6:57-7:4. Abreu teaches "[a] variety of radiation sources 2300 can be used in the present invention including LEDs with or without a spectral filter, a variety of lasers including diode lasers, halogen lights and white light sources having maximum output power in the near infrared region with or without a filter, and the like . . . ." Abreu at [1085]. Abreu further teaches "[t]he contact device filter system allowed passage of the glucose band which is used as a reference measuring point while simultaneously measuring thermal energy absorption outside the glucose band." Abreu at [1166]. Scharf teaches "[d]epending on the particular green light sources chosen, green optical filters 16, 18 might be needed. For example, if the Toshiba Ltd. part nos. TLGA183P and TLPGA-183P are used as green LEDs 13, 15 then narrow-band optical filters 16, 18 need to be used." Scharf at 4:22-37.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that use wavelength division multiplexing to measure physiological information. These methods use principles of wavelength division multiplexing to measure physiological information. Moreover, to the extent that any of these references includes

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a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of using wavelength division multiplexing to measure physiological information.

Semiconductor Diode References: For example, charted reference Jeng, as well as numerous other references such as Pologe, Shigeki, Abreu, and Scharf all include teachings related to using semiconductor diodes to measure physiological information. These references provide numerous methods for using semiconductor diodes to measure physiological information, particularly information related to a subject's blood. For example, Jeng teaches that "[t]he light sources are either laser diodes or light emitting diodes." Jeng at 15:1-27. Pologe teaches that "[t]he plurality of separate emitters includes multiple separate light sources, such as light emitting diodes (LEDs) and laser diodes." Pologe at 3:1-17. Shigeki teaches that "[t]he wavelength of the light outputted from the first semiconductor laser 1 is 1.55 μm, which is within the glucose absorption wavelength band" Shigeki at [0009]. Abreu teaches "[a] variety of radiation sources 2300 can be used in the present invention including LEDs with or without a spectral filter, a variety of lasers including diode lasers, halogen lights and white light sources having maximum output power in the near infrared region with or without a filter, and the like . . . ." Abreu at [1085]. Scharf teaches "The green light sources 12, 14 are shown schematically as including light emitting diodes (LEDs) 13, 15 in FIG. 1; however, other green light sources can be used, such as laser diodes, filtered white light sources, filtered broad-band LEDs, etc. Suitable LEDs 13, 15 include part. nos. TLGA-183P (peak wavelength 574 nm) and TLPGA-183P (peak wavelength 562 nm) from Toshiba Ltd. through various sources, such as Marktech International, 5 Hemlock Street, Latham, N.Y. 12110, (518) 786-6591." Scharf at 4:8-22.

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A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that use semiconductor diodes to measure physiological information. These methods use semiconductor diodes to measure physiological information. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological information.

Software Application References: For example, charted reference Mault, as well as numerous other references such as Jeng, Pologe, Shigeki, Kumar, Nihtila, Brown, Quy, Abreu, and Scharf all include teachings related to using software to analyze the collected physiological data. These references provide numerous methods for using software to analyze the collected physiological data, including generating a status of a user based on the physiological data. For example, Mault teaches that "FIG. 19 shows a flowchart representing a software program running on a computing device." Mault at [0187]. Mault further teaches that "Box 516 corresponds to performing a blood test at intervals, and providing the data to a glycemic response algorithm." Mault at [0187]. Mault teaches that "[t]he PDA has a software program, such as a calorie management program, having a glycemic response algorithm for the subject." Mault at [0109]. Jeng teaches that "[t]he computer controls the software operation for collecting data and storing measurement readings as a data file." Jeng at 6:31-44. Pologe teaches that "The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood." Pologe at 4:33-54. Pologe further teaches that "[p]rocessing methods to determine the blood analyte levels are known and, therefore, will not be discussed further." Pologe at 4:33-54. Shigeki

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teaches that "[i]n the arithmetic control circuit 8, calculations are performed to calculate the amount of glucose using the relationship between glucose concentration values previously written to the EEPROM and the photodetector output values, and the relationship between glucose solution temperatures and the photodetector output values." Shigeki at [0012]. Kumar teaches that "[t]he present invention may be implemented on a program or code that can be stored in a computer-readable (or electronically-readable) medium." Kumar at [0087]. Kumar further teaches that "[t]he data interpretation and analysis module 114 is used to interpret the data stream from the client-side device, perform mathematical analysis on the data using FFT, DFT, etc., and generate statistics." Kumar at [0075]. Nihtila teaches that "The processing software integrates currently or recently acquired physiological data into the user's virtual physiological model (i.e., avatar)." Nihtila at [0038]. Nihtila further teaches that "The processing software further computes fitness data (FD) of various types, including, textual, graphical, animation, audio, video, or other form of fitness data." Nihtila at [0040]. Brown teaches that "[w]hen inserted in the handheld microprocessor unit, the program cartridge provides the software necessary (program instructions) to program the handheld microprocessor unit for operation with the microprocessor-based data management unit." Brown at 6:18-45. Brown further teaches that "Remotely Programmable Patient Apparatus 320 comprises a Patient Interaction Unit 322, which is connected through a patient communication network 324 to a Patient Data Management Unit 326." Brown at 35:50-36:8. Quy teaches "[a]pplication 62 may include an algorithm 63 for analyzing data from the HMD, and either application 62 or algorithm 63 may optionally access data from an external data source 74 and may further consult an artificial intelligence system 76." Quy at 8:9-14. Quy further teaches "wireless application 70 may correspondingly send a large amount of health data to server application 62." Quy at 8:47-62. Abreu teaches "[s]uitable analyzers include modified Fourier

Transform Infrared (FTIR) spectrometers with chemometric software packages. Those are available from the PerkinElmer Corporation (Wellesley, Mass.) and Thermo Nicolet Company (Madison, Wis.)." Abreu at [1103]. Abreu further teaches "[p]rocessor 2324 can contain or be connected to a memory unit 2326 which can store data related to calibration, patient's measurement data, reference data, suitable algorithms, and the like." Abreu at [1083]. Scharf teaches "[a] reflectance pulse oximeter that determines oxygen saturation of hemoglobin using two sources of electromagnetic radiation in the green optical region, which provides the maximum reflectance pulsation spectrum." Scharf at Abstract. Scharf further teaches "the processor 30 collects data in the form of a digitized signal, calculates a coefficient for the oxygen saturation value from the digitized signal, determines the final saturation value by reading the saturation value for the calculated coefficient from a look-up table stored in memory, and then causes the display(s) 38, 40 to display a visual image corresponding to the final saturation value or other oximetry data." Scharf at 11:5-14.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that use software to analyze the collected physiological data. These methods use software to analyze the collected physiological data, including generating a status of a user based on the physiological data. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of using software to analyze the collected physiological data.

Touch Screen, Voice, and Manual Inputs References: For example, charted reference Mault as well as numerous other references such as Pologe, Kumar, Nihtila, Brown, and Quy all

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include teachings related to receiving touch screen, voice, or manual input to the system for measuring physiological data. These references provide numerous methods for receiving various inputs to systems that measure physiological data. For example, Mault teaches that "Other data entry mechanisms can be used, such as a stylus, touch pad, tracker device, biofeedback system, roller-jog dial, voice recognition, and the like." Mault at [0109]. Mault also teaches that "[t]he computer [which can be a PDA] can have a display, a microprocessor, memory (in the form of RAM, ROM, and a data storage device), and data entry mechanisms such as a keyboard, buttons, stylus, voice entry, roller-jog dial, track ball, finger tracking device, and the like." Mault at [0121]. Pologe discloses that "[t]he main test unit 12 includes: . . . and an input device 34, such as a keypad or a touch screen, for allowing the user to input commands and other information to the processor unit 28." Pologe at 4:63, 5:9. Kumar teaches that "the system allows for the real-time streaming of raw, interpreted, and processed physiological data as well as textual/audio/video data from a patient/client to a health care provider." Kumar at [0010]. Nihtila teaches that "the user can input weight, height, age, gender, and other physical and personal information to the user's virtual physiological model via the mobile terminal's user interface 216." Nihtila at [0046]. Brown teaches that "the user input buttons may be replaced by switches, keys, a touch sensitive display screen, or any other data input device." Brown at 26:1-8. Brown further teaches "the patient interaction unit is a palm-top computer, the display means being provided by a display screen of the palm top computer, and the patient interaction unit input device is a palm-top computer input device such as a touch screen." Brown at claim 2. Brown teaches "the user interface includes a speech synthesizer for audibly communicating the queries and a speech recognizer for receiving spoken responses to the queries." Brown at 9:47-52. Quy teaches "[t]he deployment of voice processing technology may be used to enable an even more convenient user interface: i.e., one to which

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patients can talk." Quy at 4:62-65. Quy further teaches "[t]hese applications may accept as inputs data from a sensor 24 as well as from a manual input 36." Quy at 7:61-8:8.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that receiving touch screen, voice, or manual input to the system for measuring physiological data. These methods allow the systems to receive touch screen, voice, or manual input to the system. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of receiving touch screen, voice, or manual input to the system for measuring physiological data.

Remote Server with Storage References: For example, charted reference Mault as well as numerous other references such as Kumar, Nihtila, Brown, Quy, Abreu, and Scharf all include teachings related to using remote systems, such as servers, to store and/or process physiological information. These references provide numerous methods for using remote systems, such as servers, to store and/or process physiological information. For example, Mault teaches "[t]he portable computing device 30 is in linked to a communications network 52, allowing communication a remote computer system 54, which may be located at the person's home, doctor's office, or other remote location." Mault at [0079]. Mault teaches that "[a] remote server system 56 is also accessible through the communications network 52, and can be used to store a database of physiological parameters, activity, and diet relating to the person, for medical, nutritional, or computer expert system analysis." Mault at [0079]. Mault teaches that "[a] global positioning system (GPS) may also be added to the PDA, to facilitate medical rescue in an emergency." Mault at [0077]. Kumar teaches "the system includes one or more patient-side devices 102 for collecting

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data from a patient/client, one or more provider-side devices 104, and an engine implemented on a central server 106." Kumar at [0067]. Kumar teaches "the data may be stored in a secured storage device at the central server for later access, replay, and/or analysis." Kumar at [0083]. Nihtila teaches that "there is illustrated a system for acquiring physiological data from a user and communicating the physiological data via a mobile terminal to a network server for integration into a virtual physiological model established for the user in accordance with an embodiment of the present invention." Nihtila at [0035]. Nihtila teaches "the mobile terminal 122 operates effectively as a modem to facilitated the transfer of acquired physiological data between the physiological sensor device, mobile terminal 122, network 124, and server 126 in real-time." Nihtila at [0044]. Brown teaches "[m]onitoring application 2048 is a controlling software application executed by server 2018 to perform the various functions described below." Brown at 27:11-14. Quy teaches "[s]erver 22 has a base server application 62 with which the same calculates or provides a response based at least in part on data from WHMA 10." Quy at 8:9-14. Quy further teaches "[i]t should also be noted that each of application 62, algorithm 63, external data source 74, or AI system 76, may physically reside on more than one server, e.g., on an array of servers for, e.g., storage or multiple processing purposes." Quy at 8:40-46. Abreu teaches "[t]he signal can be communicated by wires or radio telemetered to an externally placed receiver. The signal can then be processed, analyzed and stored." Abreu at Abstract; *see also* Abreu at [0099]. Scharf teaches "[t]he processor 30 and the remote display 40 are placed in circuit communication via a transmitter 42 and receiver 44." Scharf at 7:48-67. Scharf further teaches "the processor 30 is also in circuit communication with a remote display 40 to display a second visual image corresponding to the oximetry data." Scharf at 7:38-47.

A person of skill in the art would understand that the functionality taught in these references

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could be added to other methods and systems that use remote systems, such as servers, to store and/or process physiological information. These methods use remote systems, such as servers, to store and/or process physiological information Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of using remote systems, such as servers, to store and/or process physiological information.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix A with any other reference or references listed in Appendix A along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the ’868 Patent.

For example, and without limitation, the Asserted Claims of the ’868 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) Mault Combined with Jeng, Pologe, Shigeki, Abreu and/or Scharf

A POSITA would have had reason to combine Mault with any one of Jeng, Pologe, Shigeki, Abreu and/or Scharf all of which relate to systems and methods for obtaining physiological measurements of a user. Each of Mault, Jeng, Pologe, Shigeki, Abreu, and Scharf relate to obtaining physiological measurements of a user, including blood measurements obtained by using light. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Jeng, Pologe, Shigeki, Abreu, and Scharf provide means—not necessarily expressly present in all other references—for measuring physiological data of a user using light. A POSITA would have understood that the systems and methods for Jeng, Pologe,

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Shigeki, Abreu, and Scharf were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for Jeng, Pologe, Shigeki, Abreu, and Scharf provide improvements such as advances in measuring physiological data of a user using light. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological data of a user using light would commonly be combined with a wireless, wearable system, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for measuring physiological data of a user using light, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Kumar Combined with Jeng, Pologe, Shigeki, Abreu, and/or Scharf

A POSITA would have had reason to combine Kumar with any one of Jeng, Pologe, Shigeki, Abreu and/or Scharf all of which relate to systems and methods for obtaining physiological measurements of a user. Each of Kumar, Jeng, Pologe, Shigeki, Abreu, and Scharf relate to obtaining physiological measurements of a user, including blood measurements obtained by using light. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Jeng, Pologe, Shigeki, Abreu, and Scharf provide means—not necessarily expressly present in all other references—for measuring physiological data of a user using light. A POSITA would have understood that the systems and methods for Jeng, Pologe, Shigeki, Abreu, and Scharf were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for Jeng, Pologe, Shigeki, Abreu, and Scharf provide improvements such as advances in measuring physiological data of a user using

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light. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological data of a user using light would commonly be combined with a wireless, wearable system, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for measuring physiological data of a user using light, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) Nihtila Combined with Jeng, Pologe, Shigeki, Abreu, and/or Scharf

A POSITA would have had reason to combine Nihtila with any one of Jeng, Pologe, Shigeki, Abreu and/or Scharf all of which relate to systems and methods for obtaining physiological measurements of a user. Each of Nihtila, Jeng, Pologe, Shigeki, Abreu, and Scharf relate to obtaining physiological measurements of a user, including blood measurements obtained by using light. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Jeng, Pologe, Shigeki, Abreu, and Scharf provide means—not necessarily expressly present in all other references—for measuring physiological data of a user using light. A POSITA would have understood that the systems and methods for Jeng, Pologe, Shigeki, Abreu, and Scharf were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for Jeng, Pologe, Shigeki, Abreu, and Scharf provide improvements such as advances in measuring physiological data of a user using light. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological data of a user using light would commonly be combined with a wireless, wearable system, and thus a POSITA would have been

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motivated to combine the teachings of these references. The combination would apply known techniques for measuring physiological data of a user using light, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iv) Mault, Kumar, Nihtila, Brown, and/or Quy, Combined with any of the References Disclosing Remaining Features

A POSITA would have had reason to combine references Mault, Kumar, Nihtila, Brown, and/or Quy with any one of the references disclosing physiological monitoring using spectroscopy; physiological monitoring with lenses; wavelength division multiplexing; the use of semiconductor diodes; software applications; touch screen, voice, and manual inputs; and remote servers with storage (collectively, the "remaining features") all of which relate to systems and methods for obtaining physiological measurements of a user, including blood measurements. Each of the references teaching the remaining features relate to obtaining physiological measurements of a user, including blood measurements, using light. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the references teaching the remaining features provide means—not necessarily expressly present in all other references—for obtaining physiological measurements of a user, including blood measurements, using light. A POSITA would have understood that the systems and methods for the references teaching the remaining features were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for the references teaching the remaining features provide improvements such as specific methods and systems for obtaining physiological measurements using light. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for a wireless system for collecting and

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processing physiological data would commonly be combined with obtaining physiological measurements (for example, blood glucose levels and blood oxygenation) using light, and thus a POSITA would have been motivated to combine the teachings of these references. Two non-limiting examples of such combinations, which are provided for illustrative purposes only, include Brown in view of Jeng, Pologe, Shigeki, Abreu, and/or Scharf and Quy in view of Jeng, Pologe, Shigeki, Abreu, and/or Scharf. The combinations would apply known techniques for obtaining physiological measurements using light, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combinations would further be "obvious to try," because they would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits A1 through A10 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-A, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the wireless physiological monitoring references; the physiological monitoring using spectroscopy references; the physiological monitoring with lenses references; the wavelength division multiplexing references; the semiconductor diode references; the software application references; the touch screen, voice, and manual inputs references; the remote server with storage references, for the reasons discussed above.

2. U.S. Patent No. 9,651,533

Pursuant to P.R. 3-3(a) and (b), OnePlus identifies in Appendix B the prior art references that render obvious the Asserted Claims of the '533 Patent and include below exemplary combinations showing the obviousness of the '533 Patent Asserted Claims in view of the prior art.

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To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix B, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the '533 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix B, such reference may be combined with any other references listed in Appendix B for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the '533 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '533 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix B along with the knowledge of one of ordinary skill in the art to meet the limitations of the '533 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the '533 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and

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therefore invalid) each of Omni's Asserted Claims. OnePlus may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix B, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

Reservation of Rights: Moreover, as mentioned above, OnePlus has not yet completed its search or discovery concerning additional prior art. As such, OnePlus's inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and OnePlus reserves the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '533 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. OnePlus further believes that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co*., 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co*., 869 F.3d 1336, 1344 (Fed. Cir. 2017). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, OnePlus

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identifies motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix B would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix B would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the ’533 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix B is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results

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obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix B because all of these references relate to the same area of technology and/or are from analogous art. The ’533 Patent Asserted Claims are directed to an optical measurement system with a personal device and a remote device. ’533 Patent at Claim 5. The ’533 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the ’533 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For

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the ’533 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references concerning features related to known techniques for increasing the signal-to-noise ratio and known components and functionalities of personal devices and remote devices.

Demand and Market Forces: For example, market forces suggested a demand for improving signal-to-noise ratio and wirelessly transmitting information from optical measurement systems to devices such as personal devices and remote devices, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the ’533 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the ’533 Patent, there are a finite number of approaches for increasing signal-to-noise ratio and communicating information to other devices. For example, as of the priority date of the ’533 Patent, a POSITA would have been very familiar with basic elements of the ’533 Patent’s claims such as increasing a light intensity, increasing a pulse rate, using a plurality of lenses to direct an output optical beam, and communicating information with a personal device and a remote device. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the ’533 Patent’s claims does not render them novel or non-obvious.

There are significant similarities in subject matter and objectives for each of many

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references used in these contentions for the ’533 Patent.

References disclosing techniques for increasing signal-to-noise ratio: For example, charted reference Basu, as well as numerous other references such as Lisogurski, Carlson, LeBoeuf, and Park all include teachings related to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. These references provide numerous methods for increasing a light intensity and increasing a pulse rate of an LED. For example, Basu teaches that “[t]o maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector. In the OPS 10, the LED intensity and modulation frequencies are programmable through the serial interface. In the case of the Vishay VCNL4000, the intensity is programmable from 10-200 mA in 10 mA increments.” Basu at [0048]. Lisogurski teaches “that modulation of the light drive signal . . . may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof” and that “[t]he system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio.” Lisogurski at 27:44-55, 9:46-60. Carlson teaches that the “frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio.” Carlson at [0069]. LeBoeuf teaches that “the intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight” and that “it is important to consider the emitter pulsing frequency and sampling approach” because

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"choosing a frequency that is too low may result in unsatisfactory subtraction." LeBoeuf at [0123], [0139]. Park teaches that "the light source intensity may be increased to maintain the output signal from the light detector within a desired range of output values." Park at 16:8-20.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with improving signal-to-noise ratio in optical measurement systems. These methods are known to be effective in improving the signal-to-noise ratio for such systems, and merely modulate the functioning of the existing LEDs in each system. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of improving signal-to-noise ratio.

References disclosing lenses: For example, charted reference Basu, as well as numerous other references such as Carlson, LeBoeuf, Park, and Sakai all include teachings related to using a plurality of lenses configured to receive a portion of the output optical beam and to deliver an analysis output beam to a sample. These references provide numerous methods for using lenses to direct an optical output beam. For example, Basu teaches that "[e]ach of the LEDs is separated from the photo detector by an optical barrier." Basu at [0087]. Carlson teaches "a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise—and signal/Background ratio" Carlson at [0014]. LeBoeuf teaches that "the at least one sensor module include a lens positioned above at least one of the optical emitter and filter. The lens may include respective first and second portions configured to matingly engage respective

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first and second apertures in the light-opaque material." LeBoeuf at [0022]. Park teaches that "the transmissive structures may employ a material and/or optical design to facilitate low light loss (for example, a lens) thereby improving SNR of the photo detector and/or reducing power consumption of the light emitter(s) and/or light detector(s)." Park at 11:32-57. Sakai teaches that "[i]nfrared light or green light is emitted to the human body via a light transmitting plate 2029." Sakai at 28:01-32.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with using lenses to direct an optical output beam. These methods are known to be effective in directing an optical output beam using known lens structures. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of directing an optical output beam.

References disclosing a personal device: For example, charted reference Basu, as well as numerous other references such as Addison, LeBoeuf, Park, and Kreger all include teachings related to a personal device. These references provide numerous methods for incorporating a personal device into an optical measurement system. For example, Basu teaches "a wireless ring which combines the sensor with a Bluetooth transmitter linked to an Android application running on the user's cell phone." Basu at [0057]. Addison teaches that "[o]utput 414 may be any suitable output device such as, for example, . . . one or more display devices (e.g., monitor, PDA, mobile phone, any other suitable display device, or any combination thereof), one or more audio devices, . . . or any combination thereof." Addison at [0069]. LeBoeuf teaches that "headsets configured to monitor an individual's physiology and/or environment may be wired to a device that stores and/or

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processes data or there may be a combination of wired and wireless communications." LeBoeuf at [0106]. Park teaches that a "secondary device may be equipped with a display to output data obtained by the secondary device or data transferred to it by the biometric monitoring device, the external service, or a combination of data from the biometric monitoring device, the secondary device, and/or the external service." Park at 9:17-40. Kreger teaches "sensor data and measurements may be transmitted to remote medical personnel, internet servers, and others using WiFi transceiver 68, Bluetooth transceiver 72 or other RF transmitter such as for a cellular phone network. As well, the signals and measurements on the mobile 12 may be transferred via a cable connected to USB connector 28 c or docking connector 28 b to another computer storage device, over a computer network, to a personal computer, and so forth." Kreger at 7:39-46.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with incorporating a personal device into optical measurement systems. These methods are known to be effective in incorporating a personal device into such systems. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of communicating with a personal device.

References disclosing a remote device: For example, charted reference Basu, as well as numerous other references such as Addison, LeBoeuf, Park, and Kreger all include teachings related to a remote device. These references provide numerous methods for incorporating a remote device into an optical measurement system. For example, Basu teaches that "[a] 'cloud-based' RPM infrastructure can actively manage cardiovascular health (Fig. 1). Using OPS technology,

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cardiovascular parameters can be monitored on a 24-hour ambulatory basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record." Basu at [0055]. Carlson teaches that "health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised." Carlson at [0078]. LeBoeuf teaches that "the processed energy response signal is transmitted to a remote device, for example wirelessly transmitted." LeBoeuf at [0035]. Park teaches that "the secondary device may communicate with an external service such as www.fitbit.com or server (e.g., personal computer). Communication may be achieved through wired (e.g., Ethernet, USB) or wireless (e.g., WLAN, Bluetooth, RFID, NFC, cellular) circuitry and protocols to transfer data to and/or from the secondary device." Park at 8:53-9:16. Kreger teaches "sensor data and measurements may be transmitted to remote medical personnel, internet servers, and others using WiFi transceiver 68, Bluetooth transceiver 72 or other RF transmitter such as for a cellular phone network. As well, the signals and measurements on the mobile 12 may be transferred via a cable connected to USB connector 28 c or docking connector 28 b to another computer storage device, over a computer network, to a personal computer, and so forth." Kreger at 7:39-46.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with incorporating a remote device into optical measurement systems. These methods are known to be effective in incorporating a remote device into such systems. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of

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communicating with a remote device.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix B with any other reference or references listed in Appendix B along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the ’533 Patent.

For example, and without limitation, the Asserted Claims of the ’533 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) Basu Combined with Lisogurski, Carlson, LeBoeuf, Park, Kreger, and/or Sakai

A POSITA would have had reason to combine Basu with any one of Lisogurski, Carlson, LeBoeuf, and Park all of which relate to systems and methods for optical measurement. Each of Lisogurski, Carlson, LeBoeuf, and Park relate to increasing signal-to-noise ratio in optical measurement systems. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Lisogurski, Carlson, LeBoeuf, and Park provide means—not necessarily expressly present in all other references—for increasing signal-to-noise ratio. A POSITA would have understood that the systems and methods for increasing signal-to-noise ratio were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for increasing intensity and pulse rate provide improvements such as increasing signal-to-noise ratio. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for increasing signal-to-noise ratio would commonly be combined with increasing intensity and pulse rate, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for increasing signal-to-noise ratio, to wearable

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measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Basu Combined with Addison and/or Kreger

A POSITA would have had reason to combine Basu with Addison, which relates to systems and methods for optical measurement. Addison and Kreger relate to incorporating personal and remote devices into systems for optical measurement. Indeed, such components and/or processes were conventional as of the time these references were known. Addison and Kreger provide means—not necessarily expressly present in all other references—for incorporating personal and remote devices into systems for optical measurement. A POSITA would have understood that the systems and methods for incorporating personal and remote devices into systems for optical measurement were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for incorporating personal and remote devices into systems for optical measurement provide improvements such as improved mobility and remote medical monitoring. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement would commonly be combined with personal and remote devices, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for incorporating personal and remote devices into systems for optical measurement, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) Addison, Carslon, LeBoeuf, Lisogurski, Park, Kreger, Sakai, Combined with any of the References Disclosing Remaining Features

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A POSITA would have had reason to combine references Addison, Carslon, LeBoeuf, Lisogurski, Park, Kreger, or Sakai with any one of the references disclosing increasing signal-to-noise ratio, lenses, a personal device, a remote device (collectively, the "remaining features") all of which relate to systems and methods for obtaining and processing physiological measurements of a user. Each of the references teaching the remaining features relate to obtaining and processing physiological measurements of a user using light. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the references teaching the remaining features provide means—not necessarily expressly present in all other references—for obtaining and processing physiological measurements of a user. A POSITA would have understood that the systems and methods for the references teaching the remaining features were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for the references teaching the remaining features provide improvements such as specific methods and systems for obtaining and processing physiological measurements using light. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for a wireless system for collecting and processing physiological data would commonly be combined with obtaining physiological measurements (for example, blood glucose levels and blood oxygenation) using light, and thus a POSITA would have been motivated to combine the teachings of these references. The combinations would apply known techniques for obtaining physiological measurements using light, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combinations would further be “obvious to try,” because they would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

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Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits B1 through B8 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-B, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the References disclosing techniques for increasing signal-to-noise ratio, References disclosing lenses, References disclosing a personal device, and References disclosing a remote device, for the reasons discussed above.

3. U.S. Patent No. 10,517,484

Pursuant to P.R. 3-3(a) and (b), OnePlus identifies in Appendix C the prior art references that render obvious the Asserted Claims of the '484 Patent and include below exemplary combinations showing the obviousness of the '484 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix C, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the '484 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix C, such reference may be combined with any other references listed in Appendix C for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the '484 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '484 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear

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alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix C along with the knowledge of one of ordinary skill in the art to meet the limitations of the '484 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the '484 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. OnePlus may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix C, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

Reservation of Rights: Moreover, as mentioned above, OnePlus has not yet completed its search or discovery concerning additional prior art. As such, OnePlus's inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and OnePlus reserves the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '484 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. OnePlus further believes that no showing of a specific

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motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co*., 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co*., 869 F.3d 1336, 1344 (Fed. Cir. 2017). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, OnePlus identifies motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix C would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix C would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

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Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '484 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix C is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix C because all of these references relate to the same area of technology and/or are from analogous art. The '484 Patent Asserted Claims are directed to "A wearable device includes a measurement device to measure a physiological parameter adapted to be placed on a wrist or an ear of a user." '484 Patent at

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Abstract. The ’484 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the ’484 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the ’484 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to wearable devices measuring physiological parameters.

Demand and Market Forces: For example, market forces suggested a demand for wearable devices for measuring physiological parameters, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the ’484 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to

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combine the known options that are within his or her technical grasp. For the ’484 Patent, there are a finite number of approaches for providing a wearable device for measuring physiological parameters. For example, as of the priority date of the ’484 Patent, a POSITA would have been very familiar with basic elements of the ’484 Patent’s claims such as semiconductors, optical wavelengths, lenses, signal-to-noise ratio, detectors, analog to digital convertors, smart phones, tablets, cloud, and artificial intelligence. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the ’484 Patent’s claims does not render them novel or non-obvious.

There are significant similarities in subject matter and objectives for each of many references used in these contentions for the ’484 Patent.

References disclosing smart phone or tablet: For example, charted reference Basu, Rulkov, Goodman, Kassim, Poeze, Terumoto, Moon, Tran, and Kreger, as well as other references such as Mault, all include teachings related to incorporating a smart phone or tablet into an optical measurement system. For example, Rulkov discloses “a device such as a personal digital assistant, laptop computer, mobile telephone, exercise equipment, or the like for display and even processing of the user's real-time vital signs information.” Rulkov at 5:48-64. Basu discloses that “[i]n smart phones, for example, OPS detect when a phone is placed in a pocket, triggering touch-screen locking.” Basu at [0035]. Goodman discloses “FIG. 5 shows another possible configuration of system 10 wherein processing device 14 is a PDA (e.g. Palm Pilot™) having PPG sensor 12 interfaced therein.” Goodman at 13:26-42. Kassim discloses “the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is not exhaustive by any means.” Kassim at 12:12-19. Poeze discloses “the patient monitor may include a display device, a network interface communicating with any

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one or combination of a computer network, a handheld computing device, a mobile phone, the Internet, or the like." Poeze at 2:47-60. Terumoto discloses "the wireless communication circuit 33 transmits the measurement data acquired at the measurement unit 10 (i.e., the raw data provided from the amplifier circuit 14, the processed data various processes has performed provided from the processing circuit 15, or the stored data provided from the memory 32) to the external personal computer or a cell phone." Terumoto at [0130]. Moon discloses, "FIG. 14 indicates how the wrist-worn transceiver 72 can communicate wirelessly with either a networked computer 198 (e.g. a tablet computer located at a central nursing station) or a hand-held computer 199 (e.g. a cell phone or PDA, typically carried by the medical professional)." Moon at [0107]. Tran teaches that while a patient with a wearable device is outside a mesh network range, "the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection." Tran, 34:4-30. Kreger discloses "In other embodiments, the mobile communications device can be any of a number of mobile phones such as an iPhone® or an Android® phone, a personal digital assistant (PDA) such as a Blackberry®, a portable audio playback device such as an MP3 player, a portable media playback device such as an iPod®, or a handheld tablet such as an iPad®." Kreger at 5:48-53. Mault teaches a blood glucose monitoring system including an electronic device that "can be a portable electronic device or system carried by the person, or a device or system combining multiple functionalities, such as:…a portable computer; any portable Internet access device; [or] a wireless phone…." Mault [0069]-[0070].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with incorporating a smart phone or tablet into optical measurement systems. These methods are known to be effective in incorporating a smart phone or tablet into such systems. Moreover, to the extent that any of these

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references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of communicating with a smart phone or tablet.

References disclosing lenses: For example, charted reference Carlson, Poeze, and Soller, as well as numerous other references such as LeBoeuf and Park, all include teachings related to using one or more lenses configured to receive a portion of at least one of the output optical lights and to direct a lens output light to tissue. These references provide numerous methods for using lenses to direct an optical output beam. For example, Carlson teaches "us[ing] a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise—and signal/Background ratio. The increase of the S/B ratio is estimated e.g. to a factor 5." Carlson at [0014]. Poeze teaches "[using] a lens which collects attenuated light exiting the measurement site and focuses onto one or more detectors. The protrusion can advantageously include plastic, including a hard opaque plastic, such as a black or other colored plastic, helpful in reducing light noise." Poeze at 7:52-8:7. Soller teaches "a variety of different collimating elements 56 can be used in sensor 10. Exemplary collimating elements include fiber faceplates (e.g., fiber optic windows), collimating hole devices, gradient index (GRIN) lenses, fiber bundles, lens arrays, optical windows (including shaped optical windows), and other similar devices." Soller at 18:37-56.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with using lenses to direct an

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optical output beam. These methods are known to be effective in directing an optical output beam using known lens structures. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of directing an optical output beam.

References disclosing techniques for increasing signal-to-noise ratio: For example, charted reference Basu, Lisogurski, and Carlson, as well as numerous other references such as LeBoeuf and Park, all include teachings related to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. These references provide numerous methods for increasing a light intensity and increasing a pulse rate of an LED. For example, Basu teaches that "[t]o maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector. In the OPS 10, the LED intensity and modulation frequencies are programmable through the serial interface. In the case of the Vishay VCNL4000, the intensity is programmable from 10-200 mA in 10 mA increments." Basu at [0058]. Lisogurski teaches "that modulation of the light drive signal . . . may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof" and that "[t]he system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio." Lisogurski at 27:44-55, 9:46-60. Carlson teaches that the "frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz

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increasing significantly the Signal-to-Noise and Signal-to-Background ratio." Carlson at [0069]. LeBoeuf teaches that "the intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight" and that "it is important to consider the emitter pulsing frequency and sampling approach" because "choosing a frequency that is too low may result in unsatisfactory subtraction." LeBoeuf at [0123], [0139]. Park teaches that "the light source intensity may be increased to maintain the output signal from the light detector within a desired range of output values." Park at 16:8-20.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with improving signal-to-noise ratio in optical measurement systems. These methods are known to be effective in improving the signal-to-noise ratio for such systems, and merely modulate the functioning of the existing LEDs in each system. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of improving signal-to-noise ratio.

References disclosing an analog to digital converter: For example, charted reference Basu, Goodman, Lisogurski, Rulkov, Moon, Poeze, Chandrasekar, Kreger, and Sakai all include teachings related to an analog to digital converter. These references provide numerous methods for using an analog to digital converter coupled to a detector. For example, Basu discloses "a digital interface for communication with a microcontroller." Basu at [0007]. Goodman discloses "On board analog-to-digital converter A/D 44 (10 bit, 5 channel input) is used to convert the conditioned PPG signals at B and B′ into time sampled digital signals which are then provided to processing device 14. Goodman at 11:66-12:21. Lisogurski discloses a "[f]ront end processing

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circuitry 150 may perform various analog and digital processing of the detector signal." Lisogurski at 12:42-51. Rulkov discloses that "The microprocessor741 has a LED control715 connected to DAC702 for controlling the intensity of the LEDs737. The signal from the photodetector736 is transmitted to a high pass filter (HPF) 703 which sends it to an analog to digital converter704, and the signal from the photodetector737 is also sent directly to a second analog to digital converter704." Rulkov at 11:39-60. Moon discloses that "[a] filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG." Moon at [0091]. Poeze discloses "[f]ront-end interfaces 108 may be implemented using transimpedance amplifiers that are coupled to analog to digital converters in a sigma delta converter." Poeze at 40:15-27. Chandrasekar discloses "In principle, PPGs are considered simple devices; however, in practice, implementation requires a careful design involving optics (multiple paths, alignments, leakage barriers) and mixed signal electronics (transimpedance amplifiers, analog digital conversion, drivers, modulators, filters)." Chandrasekar at 1. Kreger discloses "Biosensor signals may also be received by one or more RF receivers in the dock 246 (not shown) and communicated to the mobile 212 via wired electrical connector 246, for example, to allow the wireless sensor to utilize the features of the wired audio input's anti-alias filters and analog to digital converter as will be explained in detail below." Kreger at 10:14-28. Sakai discloses "A/D converter 2013 d which converts a voltage value of analog signal into 10-bit digital value."

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with incorporating an analog to digital converter into optical measurement systems. These methods are known to be effective in

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incorporating an analog to digital converter into such systems. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of signal processing.

References disclosing a cloud: For example, charted references Basu and Kassim, as well as numerous other references such as Mault and US2011/0082711A1, include teachings related to using a cloud. These references provide numerous methods for communicating with a cloud. For example, Basu teaches that "a "cloud-based" RPM infrastructure can actively manage cardiovascular health. Using OPS technology, cardiovascular parameters can be monitored on a 24-hour ambulatory basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record." Basu at [0064]. Kassim teaches that "[t]he computer platform may further be connected to network resources 2006 which connect to the Internet or other components of a local public or private network. The network resources 2006 may provide instructions and data to the computer platform from a remote location on a network 2007." Kassim, 33:34-34:19. Mault teaches "[t]he PDA can access the communications network, such as the Internet, using a wireless connection. Data can be transferred to the remote system over the communications network 20." Mault, [0077]. US 2011/0082711A1 teaches "the camera is paired with an optical character recognition module so that scanned medical forms can be converted into data that can be uploaded for synchronization at a server in a network (e.g. a cloud computing network) or stored on the personal health organizer device." At [0048].

A person of skill in the art would understand that the functionality taught in this reference could be added to other methods and systems for measuring physiological parameters. These

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methods provide communication with a cloud which allows for remote storage and computation on the cloud. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological parameters.

References disclosing artificial intelligence: For example, charted reference Tran, as well as other references such as Quy, include teachings related to using artificial intelligence. For example, Tran teaches "Various mathematical techniques and Artificial Intelligence (AI) analyzer can be applied. … AI approaches towards signal recognition include Artificial Neural Networks (ANN), dynamic recurrent neural networks (DRNN), fuzzy logic system, Genetic Algorithm (GA), and Hidden Markov Model (HMM)." Tran at 94:49-65. Quy teaches "[a]pplication 62 may include an algorithm 63 for analyzing data from the HMD, and either application 62 or algorithm 63 may optionally access data from an external data source 74 and may further consult an artificial intelligence system 76." Quy at 8:9-14.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for measuring physiological parameters. These methods provide using artificial intelligence. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological parameters.

References disclosing spatially separated detectors: For example, charted references Lisogurski, Poeze, Soller, Terumoto, and Tran, all include teachings related to using detectors that

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are spatially separated. These references provide numerous methods for using light detectors. For example, Lisogurski teaches that "[o]ne or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart." Lisogurski at 17:35-45. Poeze discloses that "multiple detectors are employed and arranged in a spatial geometry. This spatial geometry provides a diversity of path lengths among at least some of the detectors and allows for multiple bulk and pulsatile measurements that are robust." Poeze at 9:18-27. Soller discloses "a plurality of spectral detectors attached to the circuit board, each spectral detector being configured to analyze radiation derived from the radiation source" and depicts the detectors as spatially separated. Soller at 3:16-27; Fig. 34. Terumoto discloses "[t]he light sensor portions 101-1 to 101-n are located equally spaced from one another and to go round the armlet type housing 107 same as the fourth to sixth implementations." Terumoto at [0152]. Tran discloses "[t]he electrode array sensor can be a geometric array of discrete electrodes having an equally-spaced geometry of multiple nodes that are capable of functioning as sense and reference electrodes. In a typical tomography application the electrodes are equally-spaced in a circular configuration. Alternatively, the electrodes can have non-equal spacing and/or can be in rectangular or other configurations in one circuit or multiple circuits." Tran at 50:61-51:8.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that detect light. These methods provide using detectors that are spatially separated. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the

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other references in order to better achieve their common goals of measuring physiological parameters.

References disclosing detection system is synchronized to the light source: For example, charted reference Lisogurski, Carlson, Poeze, Kreger, and Sakai all include teachings related to detection system is synchronized to the light source. These references provide numerous methods for synchronizing detection system with the light source. For example, Lisogurski discloses "he front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals." Lisogurski at 11:33-49. Carlson discloses "[t]he basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3." Carlson at [0065]. Poeze teaches that "[a] control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 104. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 104 to follow a precise timing and consistent pattern." Poeze at 15:27-48. Kreger discloses "Thus, it is another object to provide compatible signals to the mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise and drift, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth." Kreger

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at 3:17-23. Sakai discloses "he A/D converter 14 operates in synchronization with the light emission timing of the driver 12, to thereby convert the pulse wave detection signal detected upon light emission from the green LED 11 a and the body motion detection signal detected upon light emission from the infrared LED 11 b into digital data, and provides these digital data, as biological information, to the information processor 20." Sakai at 5:66-6:9.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with measuring physiological parameters. These methods are known to be effective in incorporating synchronizing detection system with the light source. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of signal processing.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix C with any other reference or references listed in Appendix C along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the '484 Patent.

For example, and without limitation, the Asserted Claims of the '484 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) <u>Carlson, Lisgurski, Chandersekar, Soller, Tran, and Sakai combined with References disclosing smart phone or tablet</u>

A POSITA would have had reason to combine references Carlson, Lisgurski, Moon, Soller, and Sakai with any one of References disclosing smart phone or tablet, all of which relate to systems and methods for incorporating a smart phone or tablet into an optical measurement system.

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Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing smart phone or tablet provide means—not necessarily expressly present in all other references—for incorporating a smart phone or tablet into an optical measurement system. A POSITA would have understood that the systems and methods for References disclosing smart phone or tablet were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using smart phone or tablet into an optical measurement system provide improvements such as the ability to coomunicate with smart phone or tablet. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using smart phone or tablet would commonly be combined with optical measurement system, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using smart phone or tablet, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Rulkov, Basu, Goodman, Chandersekar, Kassim, Lisogurski, Moon, Terumoto, Tran, Kreger, and Sakai combined with References disclosing lenses

A POSITA would have had reason to combine references Rulkov, Basu, Goodman, Kassim, Lisogurski, Moon, Terumoto, Tran, Kreger, and Sakai with any one of References disclosing lenses, all of which relate to systems and methods for using lenses to direct an optical output beam. Each of References disclosing lenses relate to using one or more lenses configured to receive a portion of at least one of the output optical lights and to direct a lens output light to tissue. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing lenses provide means—not necessarily

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expressly present in all other references—for using lenses to direct an optical output beam. A POSITA would have understood that the systems and methods for References disclosing lenses were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using lenses provide improvements such as disrecting the light to tissue. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using lenses to direct an optical output beam would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using lenses to direct an optical output beam, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) Kassim, Rulkov, Goodman, Moon, Chandersekar, Poeze, Soller, Terumoto, Tran, Kreger, and Sakai combined with References disclosing techniques for increasing signal-to-noise ratio

A POSITA would have had reason to combine Kassim, Rulkov, Goodman, Moon, Poeze, Soller, Terumoto, Tran, Kreger, and Sakai with any one of References disclosing techniques for increasing signal-to-noise ratio, all of which relate to systems and methods for increasing a light intensity and increasing a pulse rate of an LED. Each of References disclosing techniques for increasing signal-to-noise ratio relate to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing techniques for increasing signal-to-noise ratio provide means—not necessarily expressly present in all other references—for increasing signal-to-noise ratio relate to

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increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. A POSITA would have understood that the systems and methods for References disclosing techniques for increasing signal-to-noise ratio were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for increasing a light intensity and increasing a pulse rate of an LED provide improvements such as increasing signal-to-noise ratio. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for increasing signal-to-noise ratio would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for increasing signal-to-noise ratio, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iv) Carlson, Kassim, Soller, Chandersekar, Terumoto, and Tran combined with References disclosing an analog to digital converter

A POSITA would have had reason to combine references Carlson, Kassim, Soller, Terumoto, and Tran with any one of References disclosing an analog to digital converter, all of which relate to systems and methods for using an analog to digital converter coupled to a detector. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing an analog to digital converter provide means—not necessarily expressly present in all other references—for using an analog to digital converter coupled to a detector. A POSITA would have understood that the systems and methods for References disclosing an analog to digital converter were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using an analog

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to digital converter provide improvements such as ability to process a signal digitally. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using an analog to digital converter would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using an analog to digital converter, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(v) Carlson, Rulkov, Chandersekar, Goodman, Kassim, Lisogurski, Moon, Poeze, Soller, Terumoto, Tran, Kreger, and Sakai combined with References disclosing a cloud

A POSITA would have had reason to combine references Carlson, Rulkov, Chandersekar, Goodman, Kassim, Lisogurski, Moon, Poeze, Soller, Terumoto, Tran, Kreger, and Sakai with any one of References disclosing a cloud, all of which relate to systems and methods for using a cloud. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing a cloud provide means—not necessarily expressly present in all other references—for using a cloud. A POSITA would have understood that the systems and methods for using a cloud were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using a cloud provide improvements such as remote storage and computing. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with a cloud, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using a cloud, to wearable measurement devices that were ready for improvement,

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in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(vi) Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Lisogurski, Moon, Poeze, Soller, Terumoto, Kreger, and Sakai combined with References disclosing artificial intelligence

A POSITA would have had reason to combine references Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Lisogurski, Moon, Poeze, Soller, Terumoto, Kreger, and Sakai with any one of References disclosing artificial intelligence, all of which relate to systems and methods for using artificial intelligence. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing artificial intelligence provide means—not necessarily expressly present in all other references—for using artificial intelligence. A POSITA would have understood that the systems and methods for References disclosing artificial intelligence were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using artificial intelligence provide improvements such as automation and improved processing power. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with artificial intelligence, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for artificial intelligence, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(vii) Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Kreger, and Sakai combined with References

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disclosing spatially separated detectors

A POSITA would have had reason to combine references Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Kreger, and Sakai with any one of References disclosing spatially separated detectors all of which relate to systems and methods for using spatially separated detectors. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing spatially separated detectors provide means—not necessarily expressly present in all other references—for using spatially separated detectors. A POSITA would have understood that the systems and methods for References disclosing spatially separated detectors were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for spatially separated detectors provide improvements such as improved detection quality. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with spatially separated detectors, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using spatially separated detectors, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(viii) Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Soller, Terumoto, and Tran combined with References disclosing detection system is synchronized to the light source

A POSITA would have had reason to combine references Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Soller, Terumoto, and Tran with any one of References disclosing

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detection system is synchronized to the light source, all of which relate to systems and methods for synchronizing a detection system with a light source. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing detection system is synchronized to the light source provide means—not necessarily expressly present in all other references—for synchronizing a detection system with a light source. A POSITA would have understood that the systems and methods for References disclosing detection system is synchronized to the light source were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for synchronizing a detection system with a light source provide improvements such as improved detection. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with techniques for synchronizing a detection system with a light source, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for synchronizing a detection system with a light source, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits C1 through C14 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-C, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the References disclosing smart phone or tablet, References disclosing lenses, References disclosing techniques for increasing signal-to-noise ratio, References disclosing an analog to digital converter,

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References disclosing a cloud, References disclosing artificial intelligence, References disclosing spatially separated detectors, References disclosing detection system is synchronized to the light source, for the reasons discussed above.

4. U.S. Patent No. 10,874,304

Pursuant to P.R. 3-3(a) and (b), OnePlus identifies in Appendix D the prior art references that render obvious the Asserted Claims of the '304 Patent and include below exemplary combinations showing the obviousness of the '304 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix D, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the '304 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix D, such reference may be combined with any other references listed in Appendix D for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the '304 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '304 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix D along with the

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knowledge of one of ordinary skill in the art to meet the limitations of the '304 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the '304 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. OnePlus may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix D, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

Reservation of Rights: Moreover, as mentioned above, OnePlus has not yet completed its search or discovery concerning additional prior art, including prior art systems that may anticipate and/or render obvious the Asserted Claims (e.g., System Art).. As such, OnePlus's inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and OnePlus reserves the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '304 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. OnePlus further believes that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of

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the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co*., 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co*., 869 F.3d 1336, 1344 (Fed. Cir. 2017). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, OnePlus identifies motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix D would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix D would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious

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solution encompassed by the ’304 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix D is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix D because all of these references relate to the same area of technology and/or are from analogous art. The ’304 Patent Asserted Claims are directed to a physiological measurement system. ’304 Patent at Abstract. The ’304 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for

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one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the ’304 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the ’304 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to wearable devices measuring physiological parameters.

Demand and Market Forces: For example, market forces suggested a demand for wearable devices for measuring physiological parameters, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the ’304 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the ’304 Patent, there are a finite number of approaches for providing a wearable device for measuring physiological parameters. For example, as of the priority date of the ’304 Patent, a POSITA would have been very familiar with basic elements of the ’304 Patent’s claims such as semiconductors, optical

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wavelengths, signal-to-noise ratio, detectors, analog to digital converters, smart phones/tablets, cloud, and their configurations and/or means for the same. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the '304 Patent's claims does not render them novel or non-obvious.

There are significant similarities in subject matter and objectives for each of many references used in these contentions for the '304 Patent.

Reflective Surface References: For example, charted reference **LeBoeuf**, as well as numerous other references such as **Basu** and **Valencell** all include teachings related to physiological measurement systems. These references provide numerous methods for using a reflective surface in a sensor to direct the reflected light from a sample to a detector. For example, **LeBoeuf** teaches using a "cover 18" with a "cladding material 21 [which] may be reflective material" to "serve[] as a light guide that… collects light external to the earbud housing 16 and delivers the collected light to the optical detector 26". LeBoeuf, [0103], [0107], [0115]. **Basu** teaches "[t]he battery 32 may additionally be arranged to provide a reflective surface for the light emitted by the LED 14 toward the photodiode 16." Basu, [0088]. **Valencell** teaches "The light guiding region 2306 helps direct light to and/or from the sensor module …. In some embodiments, the light guiding region 2306 may be a reflector." Valencell, [0152].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for physiological measurements. These methods provide the benefit of improved delivery of the light reflected from tissue to the detectors in the sensor. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been

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motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

SNR Techniques: For example, charted reference **Kassim**, as well as numerous other references such as **Carlson, Basu, Lisogurski, Marbach**, and **LeBoeuf** all include teachings related to physiological measurement systems. These references provide numerous methods for improving signal-to-noise ratio through various methods, including increasing light intensity, increasing pulse rate, and differencing detected signals. For example, **Kassim** teaches "a maximum of the true Red PPG signal (devoid of ambient noise) can simply be obtained by subtracting the obtained maximum value of the Red PPG signal, obtained when the Red LED is turned on, with the obtained maximum value of the ambient PPG signal." Kassim, 22:27-23:3. **Carlson** teaches that "shift[ing] [the] spectrum of signal" can result in "increasing significantly the Signal-to-Noise and Signal-to-Background ratio" when the "frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light." Carlson, [0069]. **Basu** teaches "[t]o maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector." Basu, [0058]. **Lisogurski** teaches "dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak. Lisogurski, 13:60-67. **Marbach** teaches "The LEDs are preferably pulse-modulated with a pulse frequency on the order of several kHz. Low power, quasi-continuous operation is possible by measuring intermittently, e.g., one measurement lasting 10 seconds every 5 minutes. …depending on the sampling rate and SNR requirements." Marbach, 17:1-7. **LeBoeuf** teaches "Channel A refers to inputs from sensors

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that collect physiological information plus noise information, and Channel B refers to inputs from sensors that collect primarily … noise information. … The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as B. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information." LeBoeuf, [0143].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for physiological measurements. These methods and systems provide the benefit of increasing a signal-to-noise ratio of the measure signal. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Smartphone/Tablet References: For example, charted reference **Basu**, as well as numerous other references such as **Kassim**, **Kreger**, **Lisogurski**, **Tran**, all include teachings related to physiological measurement systems. These references provide numerous means for a physiological monitoring system to be configured for use with a smart phone or tablet. For example, **Basu** teaches "health ring 44 which can monitor heart rate on a 24 hour basis," and that "combines the sensor with a…wireless transmitter linked to an application running on the user's cell phone." Basu, [0065]-[0066]. For example, **Kassim** teaches "[t]he optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration," and that "the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is

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not exhaustive by any means." Kassim, 12:5-14. For example, **Kreger** teaches a "biosensor interface apparatus for use with a mobile communication device 10," that "can be any of a number of mobile phones such as an iPhone® or an Android® phone, a personal digital assistant (PDA) such as a Blackberry®, a portable audio playback device such as an MP3 player, a portable media playback device such as an iPod®, or a handheld tablet such as an iPad®." Kreger, 5:40-53; *see also* Kreger, 7:39-46. For example, **Lisogurski** teaches a "monitor [that] may be powered by a battery" with a "[u]ser interface [which] may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device." Lisogurski, 15:19-23, 18:65-67. For example, **Mault** teaches a blood glucose monitoring system including an electronic device that "can be a portable electronic device or system carried by the person, or a device or system combining multiple functionalities, such as:…a portable computer; any portable Internet access device; [or] a wireless phone…." Mault [0069]-[0070]. For example, **Poeze** teaches "a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128," where the "personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc." Poeze, [0034]; *see also* Poeze [0010]. **Tran** teaches that while a patient with a

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wearable device is outside a mesh network range, "the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection." Tran, 34:4-30.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide the benefit of more processing power and more convenient means to flag emergency situations. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Cloud References: For example, charted reference **Kassim**, as well as numerous other references such as **Mault, Basu, Lisogurski**, and **Poeze** all include teachings related to physiological measurement systems. These references provide numerous means for a physiological monitoring system to be configured for use a with cloud. For example, **Kassim** teaches that "[t]he computer platform may further be connected to network resources 2006 which connect to the Internet or other components of a local public or private network. The network resources 2006 may provide instructions and data to the computer platform from a remote location on a network 2007." Kassim, 33:34-34:19. **Mault** teaches "[t]he PDA can access the communications network, such as the Internet, using a wireless connection. Data can be transferred to the remote system over the communications network 20." Mault, [0077]. **Basu** teaches "a cloud-based health monitoring and mentoring framework which integrates remote patient monitoring (RPM) with an online community involving medical caregivers and a social network of the

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patient's peers." Basu, [0081]. **Lisogurski** teaches "monitor 314 and/or multi-parameter physiological monitor 326 may be coupled to a network to enable the sharing of information with servers or other work-stations." Lisogurski, 18:62-65. **Poeze** teaches "the camera is paired with an opti cal character recognition module so that scanned medical forms can be converted into data that can be uploaded for synchronization at a server in a network (e.g. a cloud computing network) or stored on the personal health organizer device." Poeze, [0048].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for physiological measurements. These methods improving the analysis capabilities of measurement systems due to the increased processing and storage power of a cloud. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Optical Detection Techniques References: For example, charted reference **Keller**, as well as numerous other references such as **Mault**, **Carlson, Lisogurski, Basu**, **Jung**, and **Marbach** all include teachings related to physiological measurement systems. These references provide numerous means for effective optical detection through various methods, including synchronizing light sources and detectors and modulating the light source. For example, **Keller** teaches that "[t]he light source 102 may also be pulsed or flashed, in order, for example, to synchronize with the imaging devices 305, 504 (see, FIGS. 3 and 5, respectively) of the invention." Keller, [0088]. **Mault** teaches "electrical modulation of a single device may be used to obtain multiple wavelength emission" Mault, [0020]. **Carlson** teaches "us[ing] a light source modulation

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to temporarily modulate the optical radiation of the LED … in order to shift the power spectrum of the pulsometer signals into a higher frequency range." Carlson, [0063]-[0065]. **Lisogurski** teaches "front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120." Lisogurski, 11:41-43. **Basu** teaches "[t]he LED 14 is modulated at 1 KHz frequency or higher. The received PD signal oscillates at the same frequency." Basu, [0037]. **Jung** teaches "[t]he three monochrome sources, however, are turned on and off rapidly, synchronous with the spectral measurements being taken." Jung, 68:26-30. **Lamego** teaches a "digital-to-analog conversion circuit 338" that includes "a synchronizing latch 323" which "accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332." Lamego, [0044]-[0045]. **Marbach** teaches "The LEDs are preferably pulse-modulated with a pulse frequency on the order of several kHz. Low power, quasi-continuous operation is possible by measuring intermittently, e.g., one measurement lasting 10 seconds every 5 minutes." Marbach, 17:1-5.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for physiological measurements. These methods and systems provide increased accuracy for monitoring physiological parameters. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Artificial Intelligence / Multivariate Techniques References: For example, charted reference **Tran**, as well as numerous other references such as **Mault** and **Marbach** all include teachings related to physiological measurement systems. These references provide numerous

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means for using artificial intelligence and multivariate techniques to make decisions and improve signal-to-noise ratios. For example, **Tran** teaches that "feed forward artificial neural networks (NNs) are used to classify valve-related heart disorders." Tran, 74:45-62. **Mault** teaches that "[f]eedback, generated by a specialist or computer expert system, may be transmitted to the PDA from the remote computer over the communications network." Mault, [0077]. **Marbach** teaches performing "measurement algorithms" on "multivariate input data" of measurement signals in order to "better the measurement accuracy a.k.a. SNR." Marbach, 12:19-27.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for physiological measurements. These methods and systems provide increased decision-making capabilities and minimize noise interference. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Arc References: For example, charted reference **Isaacson**, as well as numerous other references such as **Jung**, and **LeBoeuf** all include teachings related to physiological measurement systems. These references provide numerous methods for utilizing a plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. For example, **Isaacson** teaches emitters 10, 20 and detectors 12, 22 disposed on an arc. Isaacson, 4:64-5:9, Fig. 1. For example, **Jung** teaches "a fiber optic arrangement presented at the forward end of probe tip 1" which "utilizes a single central light source fiber optic…and a plurality of perimeter light receiver fiber optics, denoted as light receivers R1, R2 and R3." Jung, 11:21-50, Fig. 2; *see also* Jung 24:39-48, 24:39-62, 32:66-33:9, 39:41-40:14, Figs. 9, 10A-B, 20, 28A-B. For example,

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LeBoeuf teaches optical emitters 24 and optical detectors 26 configured in an arc. LeBoeuf, [0123]-[1024], Fig. 8B

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods provide the benefit of better acquisition of signals from the samples. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix D with any other reference or references listed in Appendix D along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the ’304 Patent.

For example, and without limitation, the Asserted Claims of the ’304 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Reflective Surface References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of the Reflective Surface References all of which relate to systems and methods for physiological monitoring. Each of references **LeBoeuf, Basu** and **Valencell** relate to physiological monitoring systems which use a reflective surface to direct the reflected light from a sample to a detector. Indeed, such components and/or processes were conventional as of the

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time these references were known. Each of the Reflective Surface References provide means—not necessarily expressly present in all other references—for using a reflective surface in a sensor to direct the reflected light from a sample to a detector. A POSITA would have understood that the systems and methods for the Reflective Surface References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for incorporating reflective surfaces into sensors to direct the reflected light from a sample to a detector provide improvements such as enhancing the efficiency of the delivery of the light reflected from or transmitted through the tissue to the detectors in the sensor, minimizing loss of light intensity due to scattering. *E.g.*, LeBoeuf, [0125] ("An advantage of this configuration is … this configuration may reduce unwanted optical signals from regions that may not be relevant to the physiological activity of interest.") A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement systems would commonly be combined with reflective surfaces, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of including basic optical components, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with SNR Techniques References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim, Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of the SNR Techniques References all of which relate to systems and methods for physiological monitoring. Each of references **Kassim, Carlson, Basu, Lisogurski, Marbach**,

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and **LeBoeuf** relate to physiological monitoring systems which use various methods for improving signal-to-noise ratio. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the SNR Techniques References provide means—not necessarily expressly present in all other references—for various methods, including increasing light intensity, increasing pulse rate, and differencing detected signals to improve the SNR of a detected signal. A POSITA would have understood that the systems and methods for the SNR Techniques References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for incorporating the usage of various SNR techniques into physiological measurement systems provide improvements such as reducing the effects of background noise or ambient light on the measurement signal and improving the accuracy of the measurement. *E.g.*, Kassim, 22:28-22:30 ("The inventors have recognized that by identifying and utilizing only significant information for Sp02 calculation, an efficient and accurate calculation can be carried out"). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement systems would commonly be combined with SNR improvement techniques, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of using known noise reduction and signal enhancement methods, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) <u>Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Smartphone/Tablet References</u>

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A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Smartphone/Tablet References all of which relate to systems and methods for physiological monitoring. Each of references **Basu**, **Kassim**, **Kreger**, **Lisogurski**, **Mault**, **Poeze**, and **Tran** relate to physiological monitoring systems for use with a smartphone or tablet. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Smartphone/Tablet References provide means—not necessarily expressly present in all other references—for a physiological monitoring system to communicate with a smartphone or tablet. A POSITA would have understood that the systems and methods for Smartphone/Tablet References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for connectivity to smartphones or tablets provide improvements improving the analysis capabilities of measurement systems due to the increased processing power of smartphones and tablets and the additional resources provided by their ability to connect to wireless and cell networks. *E.g.*, Basu, [0066] (physiological monitoring system "combines the sensor with a…wireless transmitter linked to an application running on the user's cell phone."); Kreger, 13:1-3 ("Mobile device smart phone 444 may derive measurements, display plots, transmit medical records of biosensor data, and so forth."); Tran, 34:4-40 ("If the wearable appliance detects a cellphone that is mesh network compatible, the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical physiological measurement would commonly be combined with smartphone and personal computing technology and thus a POSITA would have been motivated to combine the teachings of these references. The combination would

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apply known techniques of providing for connectivity to smartphone or personal computing devices in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iv) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Cloud References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of the Cloud References all of which relate to systems and methods for physiological monitoring. Each of references **Kassim**, **Mault, Basu, Lisogurski**, and **Poeze** relate to connecting the physiological monitoring system with a cloud. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the Cloud References provide means—not necessarily expressly present in all other references—for a physiological monitoring system to communicate with a cloud. A POSITA would have understood that the systems and methods for the Cloud References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for connectivity to a cloud provide improvements improving the analysis capabilities of measurement systems due to the increased processing and storage power of a cloud and the additional resources provided by their ability to connect to the internet and other remote networks. *E.g.*, Kassim, 34:14-16 ("The network resources may include 15 storage devices for storing data and executable instructions at a location separate from the computer platform 2001"). *E.g.,* Mault, [0077] ("Data can be transferred to the remote system over the communications network 20, allowing examination by a dietician, physician, other specialist"). A POSITA would further understand that in order to implement a

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wearable measurement device, the systems and methods for optical physiological measurement would commonly be combined with cloud connectivity and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of providing for connectivity to smartphone or personal computing devices in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(v) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Optical Detection Techniques References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of the SNR Techniques References all of which relate to systems and methods for physiological monitoring. Each of references **Keller, Mault**, **Carlson, Lisogurski, Basu**, **Jung**, and **Marbach** relate to physiological monitoring systems which use various methods for effective optical detection. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the Optical Detection References provide means—not necessarily expressly present in all other references—for various methods, including synchronizing light sources and detectors and modulating the light source for effective optical detection of a sample. A POSITA would have understood that the systems and methods for the Optical Detection References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for incorporating the usage of various optical detection techniques into physiological measurement systems provide improvements such as improving the system's ability to effectively detect and measure samples of interest. *E.g.*, Carlson , [0065] ("AC-Coupling or Lock-In Amplification (synchronous detection),

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is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent."); Lamego, [0045] ("[D]river circuit," including "synchronizing latch 323 [that] accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332" "is designed to minimize the noise from the emitters 302."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement systems would commonly be combined with optical detection techniques, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of using known optical detection methods, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(vi) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Artificial Intelligence / Multivariate Techniques References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of the Artificial Intelligence / Multivariate Techniques References all of which relate to systems and methods for physiological monitoring. Each of references **Tran, Mault,** and **Marbach** relate to physiological monitoring systems which use artificial intelligence or multivariate techniques to improve their measurements. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the Artificial Intelligence / Multivariate Techniques References provide means—not necessarily expressly

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present in all other references—for improving a system's decision-making and the SNR of a measured signal. A POSITA would have understood that the systems and methods for the Artificial Intelligence / Multivariate Techniques References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for incorporating the usage artificial intelligence and multivariate techniques into physiological measurement systems provide improvements such as improving the system's ability to effectively make decisions and make accurate measurements with minimal noise interference. *E.g.*, Tran, 5:57-65 ("For example, the system can perform patient behavior analysis such as eating/drinking/smoke habits and medication compliance, among others"). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement systems would commonly be combined with artificial intelligence and multivariate techniques, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of using known artificial intelligence models and multivariate calculation methods, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(vii) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Arc References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix D, with any one of Arc References all of which relate to systems and methods for physiological monitoring. Each of references **Isaacson**, **Jung**, and **LeBoeuf** relate to physiological monitoring systems with their light sources and/or detectors configured in an arc. Indeed, such components and/or

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processes were conventional as of the time these references were known. Each of Arc References provide means—not necessarily expressly present in all other references—for configuring the detectors and/or emitters of a physiological measurement system in an arc formation. A POSITA would have understood that the systems and methods for Arc References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for configuring optical detectors and emitters in an arc formation would provide improvements such as increased measurement accuracy due to lessening the negative effects of light scattering and accounting for the contours of the tissue sample that is being measured. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement would commonly be combined detectors and emitters in an arc formation, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for varying the spatial configurations of emitters and detectors in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits D1 through D19 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-D, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the Lens References, Light Intensity References, Three Wavelength References, Six LED References, Smartphone/Tablet References, Synchronize Light Source/Detector References, and/or Arc References for the reasons discussed above.

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5. U.S. Patent No. 11,160,455

Pursuant to P.R. 3-3(a) and (b), OnePlus identifies in Appendix E the prior art references that render obvious the Asserted Claims of the ’455 Patent and include below exemplary combinations showing the obviousness of the ’455 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix E, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the ’455 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix E, such reference may be combined with any other references listed in Appendix E for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the ’455 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the ’455 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix E along with the knowledge of one of ordinary skill in the art to meet the limitations of the ’455 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the ’455 Patent obvious when the references are read in combination with each other, and/or when

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read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. OnePlus may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix E, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

Reservation of Rights: Moreover, as mentioned above, OnePlus has not yet completed its search or discovery concerning additional prior art, including prior art systems that may anticipate and/or render obvious the Asserted Claims (e.g., System Art). As such, OnePlus's inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and OnePlus reserves the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '455 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. OnePlus further believes that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co*., 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co*., 869 F.3d 1336, 1344 (Fed. Cir. 2017).

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Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, OnePlus identifies motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix E would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix E would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '455 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

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Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix E is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix E because all of these references relate to the same area of technology and/or are from analogous art. The ’455 Patent Asserted Claims are directed to a physiological measurement system. ’455 Patent at Abstract. The ’455 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the ’455 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the

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teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the ’455 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to wearable devices measuring physiological parameters.

Demand and Market Forces: For example, market forces suggested a demand for wearable devices for measuring physiological parameters, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the ’455 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the ’455 Patent, there are a finite number of approaches for providing a wearable device for measuring physiological parameters. For example, as of the priority date of the ’455 Patent, a POSITA would have been very familiar with basic elements of the ’455 Patent’s claims such as semiconductors, optical wavelengths, lenses, signal-to-noise ratio, detectors, analog to digital converters, smart phones/tablets, cloud, and their configurations and/or means for the same. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the ’455 Patent’s claims does not render them novel or non-obvious.

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There are significant similarities in subject matter and objectives for each of many references used in these contentions for the ’455 Patent.

Lens References: For example, charted reference **Carlson**, as well as numerous other references such as **LeBoeuf**, **Poeze**, **Pologe**, and **Valencell** all include teachings related to physiological measurement systems. These references provide numerous means and methods for using lenses to receive at least a portion of the output optical light and to deliver a lens output light to tissue, which were already well known in the art. For example, **Carlson** teaches using “a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light Source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise-and signal/Background ratio.” Carlson, [0014]; *see also* Carlson, [0024]; [0041], [0062], FIG. 6c. Fore example, **LeBoeuf** teaches “lenses 29L [] configured to focus inspection light 111 onto a particular region of the ear.” LeBoeuf, [0114]; *see also* LeBoeuf, [0011], [0019], [0031], [0036], [0097], [0114], [0116] [0117], [0135], [0138], [0161], [0168]. For example, **Poeze** teaches “the device 112 includes an optional tissue thickness adjuster or tissue shaper 522, which can include one or more…lenses….” Poeze, [0102]. **Pologe** further teaches a “wavelength division multiplexing (WDM) coupler[]” using a lens to combine light signals from emitters into a “single multiplexed light signal on output cable 24.” Pologe, 5:16-51. For example, **Valencell** teaches “optical lenses 715 [that] may be designed for the desired optical coupling between the skin/blood vessel region and the emitter 102 or detector 103.” Valencell, [0118]; *see also* Valencell, [0016]-[0017], [0022]-[0023], [0038], [0119], [0121], [0124]-[0125], [0128]-[0131].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These

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methods provide the benefit of increasing the light intensity to increase signal-to-noise ratio, without increasing power usage. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Light Intensity References: For example, charted reference **Basu**, as well as numerous other references such as **Kassim**, **Lisogurski**, and **Valencell** all include teachings related physiological measurement systems. These references provide numerous methods for increasing the signal-to-noise ratio by increasing light intensity of at least one of the semiconductor sources from an initial light intensity. For example, **Basu** teaches "[t]o maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector." Basu, [0058]. For example, **Kassim** teaches "the effects of ambient light signals 30 can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation." Kassim, 16:27-35. For example, **Lisogurski** discloses the "system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio." Lisogurski, 9:46-60. For example, **Valencell** teaches "the intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight." Valencell, [0123].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide the benefit of increasing a signal-to-noise ratio of the measure signal.

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Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Three Wavelength References: For example, charted reference **Basu**, as well as numerous other references such as **Lisogurski**, **Lamego**, **LeBoeuf**, **Poeze**, and **Valencell** all include teachings related to physiological measurement systems. These references provide numerous methods for using three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters and using one of said wavelengths to improve measurement of at least one of the one or more physiological parameters using the output signal corresponding to the other two optical wavelengths. For example, **Lisogurski** discloses that its light source "emit photonic signals having one or more wavelength of light" and "include any number of light sources with any suitable characteristics." Lisogurski, 10:48-60, 10:65-11:6, 17:17-39. For example, **Basu** teaches "three LEDs 14, 14′, and 15 may all emit different wavelengths. LEDs 15, and 14, for example, may emit light in the red and IR spectrum, respectively, while LED 14′ may emit light at a wavelength at which the presence of falsifying components can be detected." Basu, [0109]. For example, **Lamego** teaches a multiwavelength physiological monitor "utiliz[ing] at least three different wavelengths of light . . . to determine blood oxygen saturation," and that "adding wave lengths sensitive to additional significant absorbers can help the system compensate for the additional significant absorbers and enable more accurate calculation of the concentration of each absorber and the blood oxygen saturation." Lamego, [0033], [0035]; *see also* Lamego [0034], [0036]-[0037], [0041]. For example, **LeBoeuf** teaches"[t]he optical detectors 26 and emitters 24 may be of multiple wavelengths, with the goal

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of providing specialized physiological information for each wavelength. Referring to FIG. 19, for example, violet or UV light may be used to measure motion-related aspects of the ear, as violet and UV light may not penetrate greatly through the skin of the ear. Green, red, and IR wavelengths may have deeper penetration and provide information on the blood vessels and blood analyte levels. Blue wavelengths may be particularly useful for gauging changes in the size of the blood vessels." LeBoeuf, [0153]; *see also* LeBouef, [0163]. For example, **Poeze** teaches "the emitter 504 of the data collection device 112 can emit, in certain embodiments, combinations of optical radiation in various bands of interest. For example, in some embodiments, for analytes like glucose, the emitter 504 can emit optical radiation at three (3) or more wavelengths between about 1600 nm to about 1700 nm. In particular, the emitter 504 can emit optical radiation at or about 1610 nm, about 1640 nm, and about 1665 nm. In some circumstances, the use of three wavelengths within about 1600 nm to about 1700 nm enable sufficient SNRs of about 100 dB, which can result in a measurement accuracy of about 20 mg/dL or better for analytes like glucose." Poeze, [0109]; *see also* Poeze, [0108], [0110]-[0116]. For example, **Valencell** teaches "collecting light at different wavelengths, and processing these signals collectively, can be used to generate assessments of blood gas levels, such as blood oxygen (SpO2) and carbon dioxide (SpCO2), blood hemoglobin types and levels, or other blood constituents and their respective concentration levels. Multiple wavelengths may be generated by a signal multiwavelength optical emitter, multiple optical emitters, optically filtered optical emitters, or the like. In such case, multiple optical emitters 102 may be located between the two optical filters 715." Valencell, [0130].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide the benefit of increased accuracy in measuring physiological

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parameters. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Six LED References: For example, charted reference **Lamego**, as well as numerous other references such as **LeBoeuf**, **Lisogurski**, and **Pologe** all include teachings related to physiological measurement systems. These references provide numerous means for utilizing a plurality of semiconductor sources comprising six light emitting diodes. For example, **Lamego** teaches a multiwavelength physiological monitor "includ[ing] . . . six . . . LEDs of different wavelengths," and that "adding wave lengths sensitive to additional significant absorbers can help the system compensate for the additional significant absorbers and enable more accurate calculation of the concentration of each absorber and the blood oxygen saturation." Lamego, [0041], [0035]; *see also* Lamego [0033]-[0034], [0036]-[0037]. For example, **LeBoeuf** teaches utilizing "multiple light emitters… of different wavelengths." LeBoeuf, [0163]. For example, **Lisogurski** teaches "that light source 130 may include any number of light sources with any suitable characteristics," and that light source 130 ma include LEDs. Lisogurski, 10:42-11:8. For example, **Pologe** teaches a "main test unit 12 includes: an emitter module 18 having a plurality of emitters 20," and that the "emitters 20 may include…light emitting diodes (LEDs)." Pologe, 4:63-65, 5:16-20.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide the benefit of increased accuracy in measuring physiological parameters. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been

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motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Smartphone/Tablet References: For example, charted reference **Basu**, as well as numerous other references such as **Kassim**, **Kreger**, **Lisogurski**, **Tran**, all include teachings related to physiological measurement systems. These references provide numerous means for a physiological monitoring system to be configured for use with a smart phone or tablet. For example, **Basu** teaches "health ring 44 which can monitor heart rate on a 24 hour basis," and that "combines the sensor with a…wireless transmitter linked to an application running on the user's cell phone." Basu, [0065]-[0066]. For example, **Kassim** teaches "[t]he optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration," and that "the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is not exhaustive by any means." Kassim, 12:5-14. For example, **Kreger** teaches a "biosensor interface apparatus for use with a mobile communication device 10," that "can be any of a number of mobile phones such as an iPhone® or an Android® phone, a personal digital assistant (PDA) such as a Blackberry®, a portable audio playback device such as an MP3 player, a portable media playback device such as an iPod®, or a handheld tablet such as an iPad®." Kreger, 5:40-53; *see also* Kreger, 7:39-46. For example, **Lisogurski** teaches a "monitor [that] may be powered by a battery" with a "[u]ser interface [which] may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device." Lisogurski, 15:19-23, 18:65-67. For example, **Mault** teaches a blood glucose monitoring

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system including an electronic device that "can be a portable electronic device or system carried by the person, or a device or system combining multiple functionalities, such as: … a portable computer; any portable Internet access device; [or] a wireless phone…." Mault [0069]-[0070]. For example, **Poeze** teaches "a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128," where the "personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc." Poeze, [0034]; *see also* Poeze [0010]. **Tran** teaches that while a patient with a wearable device is outside a mesh network range, "the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection." Tran, 34:4-30.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide the benefit of more processing power and more convenient means to flag emergency situations. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other

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references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Synchronize Light Source/Detector References: For example, charted reference **Carlson**, as well as numerous other references such as **Jung**, **Lamego**, **Lisogurski**, and **Poeze** all include teachings related to physiological measurement systems. These references provide numerous methods for utilizing a detection system that is configured to be synchronized to the light source. For example, **Carlson** teaches using "AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent." Carlson, [0064]-[0065]; *see also* Carlson, [0011]-[0020], [0018]-[0020], [0027]. For example, **Jung** discloses a spectrometer system were "three monochrome sources, however, are turned on and off rapidly, synchronous with the spectral measurements being taken at, for example, a rate of 1000 Hz." Jung, 68:13-33. For example, **Lamego** teaches a "digital-to-analog conversion circuit 338" that includes "a synchronizing latch 323" which "accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332." Lamego, [0044]-[0045]; *see also* Lamego [0050]-[0051], [0069]. For example, **Lisogurski** teaches "light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120." Lisogurski, 11:41-12:9; *see also* Lisogurski, 12:52-13:6 9 ("The peaks of detector current waveform 214 may be synchronous with light 'on' periods driving one or more emitters of a light source, such as light

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Source 130 of FIG. 1."). For example, **Poeze** teaches a "data collection device 112" including "a driver 520 that drives the emitter 504," wherein "[t]he driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504." Poeze, [0116]-[0117].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide increased accuracy for monitoring physiological parameters. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Arc References: For example, charted reference **Isaacson**, as well as numerous other references such as **Jung**, and **LeBoeuf** all include teachings related to physiological measurement systems. These references provide numerous methods for utilizing a plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. For example, **Isaacson** teaches emitters 10, 20 and detectors 12, 22 disposed on an arc. Isaacson, 4:64-5:9, Fig. 1. For example, **Jung** teaches "a fiber optic arrangement presented at the forward end of probe tip 1" which "utilizes a single central light source fiber optic…and a plurality of perimeter light receiver fiber optics, denoted as light receivers R1, R2 and R3." Jung, 11:21-50, Fig. 2; *see also* Jung 24:39-48, 24:39-62, 32:66-33:9, 39:41-40:14, Figs. 9, 10A-B, 20, 28A-B. For example, **LeBoeuf** teaches optical emitters 24 and optical detectors 26 configured in an arc. LeBoeuf, [0123]-[1024], Fig. 8B

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A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods provide the benefit of better acquisition of signals from the samples. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix E with any other reference or references listed in Appendix E along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the ’455 Patent.

For example, and without limitation, the Asserted Claims of the ’455 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Lens References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Lens References all of which relate to systems and methods for physiological monitoring. Each of references **Carlson**, **LeBoeuf**, **Poeze**, **Pologe**, and **Valencell** relate to physiological monitoring systems utilizing lenses. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Lens References provide means—not necessarily expressly present in all other references—for a wearable device comprising one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens

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output light to tissue. A POSITA would have understood that the systems and methods for Lens References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for wearable device comprising one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue provide improvements such as focusing output optical light to increase the intensity of the light transmitted to the wearer's tissue thereby reducing the light source's power consumption, reducing the detrimental effects of ambient light, reducing the loss of energy due to scattered light, and increasing signal-to-noise ratio. *E.g.*, Carlson, [0014] (lens system "increase[s] the optical signal power, detected by the pulsoximeter sensor, and thus increase[s] the Signal/Noise-and signal/Background ratio."); LeBoeuf, [0114] ("Lenses 29L are configured to focus inspection light 111 onto a particular region of the ear."). Valencell, [0017] ("The first lens focuses light emitted by the optical emitter…."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement systems would commonly be combined with lens systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of including basic optical components, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Light Intensity References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Light Intensity References all of which relate to systems and methods for physiological

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monitoring. Each of references **Basu, Kassim**, **Lisogurski**, and **Valencell** relate to physiological monitoring systems that utilize increased light intensity of their emitters to increase signal-to-noise ratio of their detection signal. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Light Intensity References provide means—not necessarily expressly present in all other references—for improving signal-to-noise ratio by increasing the intensity of light sources. A POSITA would have understood that the systems and methods for Light Intensity References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for improving signal-to-noise ratio by increasing the intensity of light sources provide improvements such as increasing the accuracy of measured physiological parameters. *E.g.*, Basu, [0058] ("To maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector."); Kassim, 16:27-35 ("[T]he effects of ambient light signals 30 can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation."), Lisogurski 9:46-60 ("[S]ystem may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio."); Valencell, [0123] ("[T]he intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurements systems would commonly be combined with circuity coupled to light sources that allow for the control of the light source's parameters, such as light intensity, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of allowing for the variability of light source parameters to wearable measurement devices that were

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ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Three Wavelength References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Three Wavelength References all of which relate to systems and methods for physiological monitoring. Each of references **Basu**, **Lamego**, **LeBoeuf**, **Poeze**, and **Valencell** relate to physiological monitoring systems utilizing three wavelengths and using one of said wavelengths to improve measurement of at least one of the one or more physiological parameters using the output signal corresponding to the other two optical wavelengths. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Three Wavelength References provide means—not necessarily expressly present in all other references—for using three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters or using one of said wavelengths to improve measurement of at least one of the one or more physiological parameters using the output signal corresponding to the other two optical wavelengths. A POSITA would have understood that the systems and methods for Three Wavelength References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for utilizing three optical wavelengths provide improvements such as the ability to target different physiological absorbers according to their wavelength sensitivity and therefore providing for more accurate measurements. *E.g.*, Basu, [0109] ("It is known that certain factors may render pulse oximetry unreliable because the presence of other components (e.g. methemoglobin or carboxyhemoglobin) in the blood may

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mimic the absorption of oxyhemoglobin at the IR LED frequency so that the reading is falsified. Such errors can be minimized by adding a third LED emitting light of a wavelength at which the component shows a different behavior than oxyhemoglobin and reduced hemoglobin."); Lamego, [0035] ("[A]dding wave lengths sensitive to additional significant absorbers can help the system compensate for the additional significant absorbers and enable more accurate calculation of the concentration of each absorber and the blood oxygen saturation."); Poeze, [0109] ("[T]he use of three wavelengths within about 1600 nm to about 1700 nm enable sufficient SNRs of about 100 dB, which can result in a measurement accuracy of about 20 mg/dL or better for analytes like glucose."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for multiwavelength emitters would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of the variability of light source parameters, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iv) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Six LED References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Six LED References all of which relate to systems and methods for physiological monitoring. Each of references **Lamego**, **LeBoeuf**, **Lisogurski**, and **Pologe** relate to physiological monitoring systems using multiple LEDs as emitters. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Six LED References

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provide means—not necessarily expressly present in all other references—for utilizing six LED optical emitters in a light source. A POSITA would have understood that the systems and methods for Six LED References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for utilizing six LEDs provide improvements such as the ability to target different physiological absorbers according to their wavelength sensitivity and therefore providing for more accurate measurements, increasing intensity of optical output light, and reducing the detrimental effects on ambient light. *E.g.*, Lamego, [0035] ("[A]dding wave lengths sensitive to additional significant absorbers can help the system compensate for the additional significant absorbers and enable more accurate calculation of the concentration of each absorber and the blood oxygen saturation."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical physiological measurement would commonly be combined with multiple LED emitters and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for increasing the number of optical emitters in a light to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(v) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Smartphone/Tablet References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Smartphone/Tablet References all of which relate to systems and methods for physiological monitoring. Each of references **Basu**, **Kassim**, **Kreger**, **Lisogurski**, **Mault**, **Poeze**, and **Tran**

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relate to physiological monitoring systems for use with a smartphone or tablet. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Smartphone/Tablet References provide means—not necessarily expressly present in all other references—for a physiological monitoring system to communicate with a smartphone or tablet. A POSITA would have understood that the systems and methods for Smartphone/Tablet References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for connectivity to smartphones or tablets provide improvements improving the analysis capabilities of measurement systems due to the increased processing power of smartphones and tablets and the additional resources provided by their ability to connect to wireless and cell networks. *E.g.*, Basu, [0066] (physiological monitoring system "combines the sensor with a…wireless transmitter linked to an application running on the user's cell phone."); Kreger, 13:1-3 ("Mobile device smart phone 444 may derive measurements, display plots, transmit medical records of biosensor data, and so forth."); Tran, 34:4-40 ("If the wearable appliance detects a cellphone that is mesh network compatible, the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical physiological measurement would commonly be combined with smartphone and personal computing technology and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of providing for connectivity to smartphone or personal computing devices in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve

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simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

References Lisogurski and Basu Combined with Synchronize Light Source/Detector References

A POSITA would have had reason to combine references **Lisogurski** or **Basu**, or any of the references in Appendix E, with any one of Synchronize Light Source/Detector References all of which relate to systems and methods for physiological monitoring. Each of references **Carlson**, **Jung**, **Lamego**, **Lisogurski**, and **Poeze** relate to physiological monitoring systems that synchronize their detection systems to the their light sources. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Synchronize Light Source/Detector References provide means—not necessarily expressly present in all other references—for synchronizing the sampling of a detector to the output of a light source. A POSITA would have understood that the systems and methods for Synchronize Light Source/Detector References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for synchronizing the sampling of a detector to the output of a light source provide improvements such as increased measurement accuracy. *E.g.*, Carlson, [0065] ("AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent."); Lamego, [0045] ("[D]river circuit," including "synchronizing latch 323 [that] accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332" "is designed to minimize the noise from the emitters 302."); Poeze, [0117] ("The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of

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optical radiation emitted from the emitter 504."). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement would commonly be combined with detector and light source synchronization, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for varying the collection parameters of a detection system and the output parameters of light source in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(vi) Lisogurski, Kassim, Chandrasekar2012, Valencell, Mault, and Basu Combined with Arc References

A POSITA would have had reason to combine references **Lisogurski**, **Kassim**, **Chandrasekar2012**, **Valencell**, **Mault**, or **Basu**, or any of the references in Appendix E, with any one of Arc References all of which relate to systems and methods for physiological monitoring. Each of references **Isaacson**, **Jung**, and **LeBoeuf** relate to physiological monitoring systems with their light sources and/or detectors configured in an arc. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Arc References provide means—not necessarily expressly present in all other references—for configuring the detectors and/or emitters of a physiological measurement system in an arc formation. A POSITA would have understood that the systems and methods for Arc References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for configuring optical detectors and emitters in an arc formation would provide improvements such as increased measurement accuracy due to lessening the negative effects of light scattering and accounting for the contours of the tissue sample that is being measured. A

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POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement would commonly be combined detectors and emitters in an arc formation, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for varying the spatial configurations of emitters and detectors in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits E1 through E18 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-E, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the Lens References, Light Intensity References, Three Wavelength References, Six LED References, Smartphone/Tablet References, Synchronize Light Source/Detector References, and/or Arc References for the reasons discussed above.

6. U.S. Patent No. 12,193,790

Pursuant to P.R. 3-3(a) and (b), OnePlus identifies in Appendix F the prior art references that render obvious the Asserted Claims of the '790 Patent and include below exemplary combinations showing the obviousness of the '790 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix F, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the '790 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any

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one of the anticipatory references described in Appendix F, such reference may be combined with any other references listed in Appendix F for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the '790 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a), the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '790 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix F along with the knowledge of one of ordinary skill in the art to meet the limitations of the '790 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the '790 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. OnePlus may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix F, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

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Reservation of Rights: Moreover, as mentioned above, OnePlus has not yet completed its search or discovery concerning additional prior art. As such, OnePlus's inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and OnePlus reserves the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '790 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. OnePlus further believes that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co*., 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co*., 869 F.3d 1336, 1344 (Fed. Cir. 2017). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, OnePlus identifies motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix F would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same

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way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix F would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '790 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix F is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8)

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the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix F because all of these references relate to the same area of technology and/or are from analogous art. The '790 Patent Asserted Claims are directed to "An optical system comprises a wearable device for measuring one or more physiological parameters." '790 Patent at Abstract. The '790 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the '790 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the '790 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to wearable devices measuring physiological parameters.

Demand and Market Forces: For example, market forces suggested a demand for

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wearable devices measuring physiological parameters, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the '790 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the '790 Patent, there are a finite number of approaches for providing a wearable device for measuring physiological parameters. For example, as of the priority date of the '790 Patent, a POSITA would have been very familiar with basic elements of the '790 Patent's claims such as semiconductors diodes, optical wavelengths, lenses, signal-to-noise ratio, detectors, and analog to digital convertors. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the '790 Patent's claims does not render them novel or non-obvious.

There are significant similarities in subject matter and objectives for each of many references used in these contentions for the '790 Patent.

References disclosing lenses: For example, charted reference Carlson, Poeze, and Soller, as well as numerous other references such as LeBoeuf and Park, all include teachings related to using one or more lenses configured to receive a portion of at least one of the output optical lights and to direct a lens output light to tissue. These references provide numerous methods for using lenses to direct an optical output beam. For example, Carlson teaches "us[ing] a beam-shaping

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element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise—and signal/Background ratio. The increase of the S/B ratio is estimated e.g. to a factor 5." Carlson at [0014]. Poeze teaches "[using] a lens which collects attenuated light exiting the measurement site and focuses onto one or more detectors. The protrusion can advantageously include plastic, including a hard opaque plastic, such as a black or other colored plastic, helpful in reducing light noise." Poeze at 7:52-8:7. Soller teaches "a variety of different collimating elements 56 can be used in sensor 10. Exemplary collimating elements include fiber faceplates (e.g., fiber optic windows), collimating hole devices, gradient index (GRIN) lenses, fiber bundles, lens arrays, optical windows (including shaped optical windows), and other similar devices." Soller at 18:37-56.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with using lenses to direct an optical output beam. These methods are known to be effective in directing an optical output beam using known lens structures. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of directing an optical output beam.

References disclosing techniques for increasing signal-to-noise ratio: For example, charted reference Basu, Lisogurski, and Carlson, as well as numerous other references such as LeBoeuf and Park, all include teachings related to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. These

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references provide numerous methods for increasing a light intensity and increasing a pulse rate of an LED. For example, Basu teaches that "[t]o maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector. In the OPS 10, the LED intensity and modulation frequencies are programmable through the serial interface. In the case of the Vishay VCNL4000, the intensity is programmable from 10-200 mA in 10 mA increments." Basu at [0058]. Lisogurski teaches "that modulation of the light drive signal . . . may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof" and that "[t]he system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio." Lisogurski at 27:44-55, 9:46-60. Carlson teaches that the "frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio." Carlson at [0069]. LeBoeuf teaches that "the intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight" and that "it is important to consider the emitter pulsing frequency and sampling approach" because "choosing a frequency that is too low may result in unsatisfactory subtraction." LeBoeuf at [0123], [0139]. Park teaches that "the light source intensity may be increased to maintain the output signal from the light detector within a desired range of output values." Park at 16:8-20.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with improving signal-to-noise

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ratio in optical measurement systems. These methods are known to be effective in improving the signal-to-noise ratio for such systems, and merely modulate the functioning of the existing LEDs in each system. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of improving signal-to-noise ratio.

References disclosing an analog to digital converter: For example, charted reference Basu, Goodman, Lisogurski, Rulkov, Moon, Poeze, Chandrasekar, Al-Ali, Kreger, and Sakai all include teachings related to an analog to digital converter. These references provide numerous methods for using an analog to digital converter coupled to a detector. For example, Basu discloses "a digital interface for communication with a microcontroller." Basu at [0007]. Goodman discloses "On board analog-to-digital converter A/D 44 (10 bit, 5 channel input) is used to convert the conditioned PPG signals at B and B′ into time sampled digital signals which are then provided to processing device 14. Goodman at 11:66-12:21. Lisogurski discloses a "[f]ront end processing circuitry 150 may perform various analog and digital processing of the detector signal." Lisogurski at 12:42-51. Rulkov discloses that "The microprocessor741 has a LED control715 connected to DAC702 for controlling the intensity of the LEDs737. The signal from the photodetector736 is transmitted to a high pass filter (HPF) 703 which sends it to an analog to digital converter704, and the signal from the photodetector737 is also sent directly to a second analog to digital converter704." Rulkov at 11:39-60. Moon discloses that "[a] filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG." Moon at [0091]. Poeze discloses "[f]ront-end

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interfaces 108 may be implemented using transimpedance amplifiers that are coupled to analog to digital converters in a sigma delta converter." Poeze at 40:15-27. Chandrasekar discloses "In principle, PPGs are considered simple devices; however, in practice, implementation requires a careful design involving optics (multiple paths, alignments, leakage barriers) and mixed signal electronics (transimpedance amplifiers, analog digital conversion, drivers, modulators, filters)." Chandrasekar at 1. Kreger discloses "Biosensor signals may also be received by one or more RF receivers in the dock 246 (not shown) and communicated to the mobile 212 via wired electrical connector 246, for example, to allow the wireless sensor to utilize the features of the wired audio input's anti-alias filters and analog to digital converter as will be explained in detail below." Kreger at 10:14-28. Sakai discloses "A/D converter 2013 d which converts a voltage value of analog signal into 10-bit digital value." Al-Ali discloses "As shown in FIG. 2, the processor board 250 includes a front end signal conditioner 252, an analog-to-digital (A/D) converter 253, a digital signal processor (DSP) 258, a memory reader 256, emitter drivers 254 and digital-to-analog (D/A) converters 255." Al-Ai at [0045].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with incorporating an analog to digital converter into optical measurement systems. These methods are known to be effective in incorporating an analog to digital converter into such systems. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of signal processing.

References disclosing spatially separated detectors: For example, charted references

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Lisogurski, Poeze, Soller, and Terumoto, all include teachings related to using detectors that are spatially separated. These references provide numerous methods for using light detectors. For example, Lisogurski teaches that "[o]ne or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart." Lisogurski at 17:35-45. Poeze discloses that "multiple detectors are employed and arranged in a spatial geometry. This spatial geometry provides a diversity of path lengths among at least some of the detectors and allows for multiple bulk and pulsatile measurements that are robust." Poeze at 9:18-27. Soller discloses "a plurality of spectral detectors attached to the circuit board, each spectral detector being configured to analyze radiation derived from the radiation source" and depicts the detectors as spatially separated. Soller at 3:16-27; Fig. 34. Terumoto discloses "[t]he light sensor portions 101-1 to 101-n are located equally spaced from one another and to go round the armlet type housing 107 same as the fourth to sixth implementations." Terumoto at [0152].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that detect light. These methods provide using detectors that are spatially separated. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological parameters.

References disclosing detection system is synchronized to the light source: For example, charted reference Lisogurski, Carlson, Poeze, Kreger, and Sakai all include teachings

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related to detection system is synchronized to the light source. These references provide numerous methods for synchronizing detection system with the light source. For example, Lisogurski discloses "he front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals." Lisogurski at 11:33-49. Carlson discloses "[t]he basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3." Carlson at [0065]. Poeze teaches that "[a] control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 104. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 104 to follow a precise timing and consistent pattern." Poeze at 15:27-48. Kreger discloses "Thus, it is another object to provide compatible signals to the mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise and drift, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth." Kreger at 3:17-23. Sakai discloses "he A/D converter 14 operates in synchronization with the light emission timing of the driver 12, to thereby convert the pulse wave detection signal detected upon light emission from the green LED 11 a and the body motion detection signal detected upon light emission from the infrared LED 11 b into digital data, and provides these digital data, as biological

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information, to the information processor 20." Sakai at 5:66-6:9.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with measuring physiological parameters. These methods are known to be effective in incorporating synchronizing detection system with the light source. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of signal processing.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix C with any other reference or references listed in Appendix C along with the knowledge of one of ordinary skill in the art to arrive at the inventions claims in the '790 Patent.

For example, and without limitation, the Asserted Claims of the '790 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) Rulkov, Basu, Goodman, Chandersekar, Kassim, Lisogurski, Moon, Terumoto, Al-Ali, Kreger, and Sakai combined with References disclosing lenses

A POSITA would have had reason to combine references Rulkov, Basu, Goodman, Kassim, Lisogurski, Moon, Terumoto, Al-Ali, Kreger, and Sakai with any one of References disclosing lenses, all of which relate to systems and methods for using lenses to direct an optical output beam. Each of References disclosing lenses relate to using one or more lenses configured to receive a portion of at least one of the output optical lights and to direct a lens output light to tissue. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing lenses provide means—not necessarily

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expressly present in all other references—for using lenses to direct an optical output beam. A POSITA would have understood that the systems and methods for References disclosing lenses were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using lenses provide improvements such as disrecting the light to tissue. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using lenses to direct an optical output beam would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using lenses to direct an optical output beam, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ii) Kassim, Rulkov, Goodman, Moon, Chandersekar, Poeze, Soller, Terumoto, Al-Ali, Kreger, and Sakai combined with References disclosing techniques for increasing signal-to-noise ratio

A POSITA would have had reason to combine Kassim, Rulkov, Goodman, Moon, Poeze, Soller, Terumoto, Al-Ali, Kreger, and Sakai with any one of References disclosing techniques for increasing signal-to-noise ratio, all of which relate to systems and methods for increasing a light intensity and increasing a pulse rate of an LED. Each of References disclosing techniques for increasing signal-to-noise ratio relate to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing techniques for increasing signal-to-noise ratio provide means—not necessarily expressly present in all other references—for increasing signal-to-noise ratio relate to

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increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. A POSITA would have understood that the systems and methods for References disclosing techniques for increasing signal-to-noise ratio were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for increasing a light intensity and increasing a pulse rate of an LED provide improvements such as increasing signal-to-noise ratio. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for increasing signal-to-noise ratio would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for increasing signal-to-noise ratio, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iii) Carlson, Kassim, Soller, Chandersekar, and Terumoto combined with References disclosing an analog to digital converter

A POSITA would have had reason to combine references Carlson, Kassim, Soller, and Terumoto with any one of References disclosing an analog to digital converter, all of which relate to systems and methods for using an analog to digital converter coupled to a detector. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing an analog to digital converter provide means—not necessarily expressly present in all other references—for using an analog to digital converter coupled to a detector. A POSITA would have understood that the systems and methods for References disclosing an analog to digital converter were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using an analog

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to digital converter provide improvements such as ability to process a signal digitally. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using an analog to digital converter would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using an analog to digital converter, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iv) Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Al-Ali, Kreger, and Sakai combined with References disclosing spatially separated detectors

A POSITA would have had reason to combine references Carlson, Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Al-Ali, Kreger, and Sakai with any one of References disclosing spatially separated detectors all of which relate to systems and methods for using spatially separated detectors. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing spatially separated detectors provide means—not necessarily expressly present in all other references—for using spatially separated detectors. A POSITA would have understood that the systems and methods for References disclosing spatially separated detectors were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for spatially separated detectors provide improvements such as improved detection quality. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with spatially separated detectors, and thus a POSITA would have been motivated to combine the teachings of

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these references. The combination would apply known techniques for using spatially separated detectors, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(v) Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Soller, Terumoto, and Al-Ali combined with References disclosing detection system is synchronized to the light source

A POSITA would have had reason to combine references Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Soller, Terumoto, and Al-Ali with any one of References disclosing detection system is synchronized to the light source, all of which relate to systems and methods for synchronizing a detection system with a light source. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing detection system is synchronized to the light source provide means—not necessarily expressly present in all other references—for synchronizing a detection system with a light source. A POSITA would have understood that the systems and methods for References disclosing detection system is synchronized to the light source were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for synchronizing a detection system with a light source provide improvements such as improved detection. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with techniques for synchronizing a detection system with a light source, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for synchronizing a detection system with a light source, to wearable

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measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits F1 through F14 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-F, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the References disclosing lenses, References disclosing techniques for increasing signal-to-noise ratio, References disclosing an analog to digital converter, References disclosing spatially separated detectors, References disclosing detection system is synchronized to the light source, for the reasons discussed above.

7. U.S. Patent No. 12,268,475

Pursuant to P.R. 3-3(a) and (b), OnePlus identifies in Appendix G the prior art references that render obvious the Asserted Claims of the '475 Patent and include below exemplary combinations showing the obviousness of the '475 Patent Asserted Claims in view of the prior art. To the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix G, the limitation would have been obvious in light of the disclosures within the reference and the knowledge of one of ordinary skill in the art at the time of the '475 Patent. Moreover, to the extent Plaintiff contends that an element is not disclosed in any one of the anticipatory references described in Appendix G, such reference may be combined with any other references listed in Appendix G for such element, thereby rendering the claims invalid for obviousness. To the extent a finder of fact determines that a limitation of any of the '475 Patent Asserted Claims is not disclosed by one of the references identified above pursuant to P.R. 3-3(a),

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the claim is nevertheless unpatentable as obvious because they contain nothing that constitutes a patentable innovation. To the extent a finder of fact determines that a limitation of the '475 Patent Asserted Claims is not anticipated, it does not go beyond combining familiar elements according to known methods to achieve predictable results or does more than choose between clear alternatives known to those of ordinary skill in the art.

a. Obviousness Rationale and Motivations to Combine

Obviousness: For at least the reasons described in these contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any combination of those prior art references identified in Appendix G along with the knowledge of one of ordinary skill in the art to meet the limitations of the '475 Patent Asserted Claims. As a result, the references identified herein render one or more Asserted Claims of the '475 Patent obvious when the references are read in combination with each other, and/or when read in view of the state of the art and knowledge of those skilled in the art. Each and every reference identified is also relevant to the state of the art at the time of the alleged invention. Any of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. OnePlus may rely upon a subset of the identified references or all of the references identified herein, including all references in Appendix G, for purposes of obviousness depending on the Court's claim construction, positions taken by Omni during this litigation, and further investigation and discovery.

Reservation of Rights: Moreover, as mentioned above, OnePlus has not yet completed its search or discovery concerning additional prior art, including prior art systems that may anticipate and/or render obvious the Asserted Claims (e.g., System Art). As such, OnePlus's inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations

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as appropriate, and OnePlus reserves the right to identify additional specific combinations as well as to detail and explain such combinations.

No More Than Ordinary Variations of Prior Art; No Unexpected Results: To the extent not anticipated, the '475 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. OnePlus further believes that no showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415-16 (2007) (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach); *Apple Inc. v. Samsung Elecs. Co*., 839 F.3d 1034, 1058 (Fed. Cir. 2016); *Intercontinental Great Brands LLC v. Kellogg N. Am. Co*., 869 F.3d 1336, 1344 (Fed. Cir. 2017). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420-21. Nevertheless, in addition to the information contained elsewhere in these contentions, OnePlus identifies motivation and reason to combine the cited art.

Predictable Results; Obvious to Try: One or more combinations of the prior art references identified in Appendix G would have been obvious because these references would have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references identified above because there were

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only a finite number of predictable solutions and/or because known work in one field of endeavor prompted variations based on predictable design incentives and/or market forces either in the same field or a different one. Further, the combinations of the prior art references identified in Appendix G would have been obvious because the combinations represent known potential options with a reasonable expectation of success.

Interrelated Teachings: Additional evidence that there would have been a motivation to combine the prior art references identified above includes the interrelated teachings of multiple prior art references; common authorship; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution encompassed by the '475 Patent Asserted Claims; the existence of a known need or problem in the field of the endeavor at the time of the alleged invention(s); and the background knowledge that would have been possessed by a person having ordinary skill in the art.

Summary of Motivations to Combine: Thus, the motivation to combine the teachings of the prior art references disclosed in Appendix G is found in the references themselves and also in: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces.

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Same Area of Technology: Additionally, it would be obvious to one of ordinary skill in the art to consult and/or combine any of the prior art listed in Appendix G because all of these references relate to the same area of technology and/or are from analogous art. The '475 Patent Asserted Claims are directed to "[a] wearable device to measure a user's physiological parameters." '475 Patent at Abstract. The '475 Patent Asserted Claims merely unite old elements, well known in the field, with no change in their respective function or result. Given the interrelated teachings of the prior art, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art, it would have been obvious for one of ordinary skill in the art to combine these familiar elements, disclosed and/or embodied in the prior art listed above to practice the '475 Patent Asserted Claims.

Same Technical Issues: A person of ordinary skill would have been motivated to combine the above prior art based on his/her knowledge, the nature of the problem to be solved, and the teachings of the prior art. The identified prior art addresses the same or similar technical issues and suggests the same or similar solutions to those issues. Moreover, some of the prior art refer to or discuss other prior art, illustrating the close technical relationship among the prior art. For the '475 Patent, one of ordinary skill in the art would have been motivated to combine known prior art solutions described in these references relating to wearable devices measuring physiological parameters.

Demand and Market Forces: For example, market forces suggested a demand for wearable devices measuring physiological parameters, and thus one of skill in the art would have thought to combine or modify references that described known methods that one of skill in the art would have recognized as offering improvements to solutions of that time.

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Known Elements; Obvious to Try: Moreover, many of the claim elements were already known as admitted by the applicant in the patent specification. These elements represented design choices available to a person of ordinary skill. When there is a design need or market pressure to solve a problem such as identified previously and/or described in the '475 Patent, and there are a finite number of identified, predictable solutions, a person of ordinary skill would be motivated to combine the known options that are within his or her technical grasp. For the '475 Patent, there are a finite number of approaches for providing a wearable device for measuring physiological parameters. For example, as of the priority date of the '475 Patent, a POSITA would have been very familiar with basic elements of the '475 Patent's claims such as biosensors, semiconductors, light emitting diodes, optical wavelengths, lenses, signal-to-noise ratio, detectors, processors, and analog to digital convertors. Such elements were within the knowledge of a POSITA, whether or not disclosed in any particular reference, and the inclusion of such elements in the '475 Patent's claims does not render them novel or non-obvious.

There are significant similarities in subject matter and objectives for each of many references used in these contentions for the '475 Patent.

References disclosing lenses: For example, charted references Carlson, Poeze, LeBoeuf, Basu and Soller, as well as numerous other references, all include teachings related to using one or more lenses configured to receive a portion of at least one of the output optical lights and to direct a lens output light to tissue comprising skin. These references provide numerous methods for using lenses to direct an optical output beam. For example, Carlson teaches "us[ing] a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing

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the Signal/Noise—and signal/Background ratio. The increase of the S/B ratio is estimated e.g. to a factor 5." Carlson at [0014]. Poeze teaches "[using] a lens which collects attenuated light exiting the measurement site and focuses onto one or more detectors. The protrusion can advantageously include plastic, including a hard opaque plastic, such as a black or other colored plastic, helpful in reducing light noise." Poeze at 7:52-8:7. LeBoeuf teaches that "the at least one sensor module include a lens positioned above at least one of the optical emitter and filter. The lens may include respective first and second portions configured to matingly engage respective first and second apertures in the light-opaque material." LeBoeuf at [0022]. Basu teaches that "[e]ach of the LEDs is separated from the photo detector by an optical barrier." Basu at [0087]. Soller teaches "a variety of different collimating elements 56 can be used in sensor 10. Exemplary collimating elements include fiber faceplates (e.g., fiber optic windows), collimating hole devices, gradient index (GRIN) lenses, fiber bundles, lens arrays, optical windows (including shaped optical windows), and other similar devices." Soller at 18:37-56.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with using lenses to direct an optical output beam. These methods are known to be effective in directing an optical output beam using known lens structures. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of directing an optical output beam.

References disclosing techniques for increasing signal-to-noise ratio: For example, charted reference Basu, Lisogurski, LeBeouf, Tran, Kassim, and Carlson, as well as numerous other references, all include teachings related to increasing the signal-to-noise ratio of optical

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measurement systems by increasing a light intensity and increasing a pulse rate of an LED. These references provide numerous methods for increasing a light intensity and increasing a pulse rate of an LED. For example, Basu teaches that "[t]o maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible without saturating the detector. In the OPS 10, the LED intensity and modulation frequencies are programmable through the serial interface. In the case of the Vishay VCNL4000, the intensity is programmable from 10-200 mA in 10 mA increments." Basu at [0058]. Lisogurski teaches "that modulation of the light drive signal . . . may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof" and that "[t]he system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio." Lisogurski at 27:44-55, 9:46-60. Carlson teaches that the "frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio." Carlson at [0069]. LeBoeuf teaches that "the intensity of the optical emitter 102 may be increased to increase the ratio of physiological optical scatter 111 from blood vessels with respect to unwanted sunlight" and that "it is important to consider the emitter pulsing frequency and sampling approach" because "choosing a frequency that is too low may result in unsatisfactory subtraction." LeBoeuf at [0123], [0139]. Tran teaches obtaining "differential measurement[s]" by processing "electrode output signals" from a patient, thereby "enhancing the signal to noise ratio." Tran at 37:28–29. Kassim teaches the "removal of ambient noise signal from an optical measurement." Kassim, 23:11-21.

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A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with improving signal-to-noise ratio in optical measurement systems. These methods are known to be effective in improving the signal-to-noise ratio for such systems, and merely modulate the functioning of the existing LEDs in each system. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of improving signal-to-noise ratio.

References disclosing an analog to digital converter: For example, charted reference Basu, Goodman, Lisogurski, Rulkov, Moon, Poeze, Addison-788, and Al-Ali all include teachings related to an analog to digital converter. These references provide numerous methods for using an analog to digital converter coupled to a detector. For example, Basu discloses "a digital interface for communication with a microcontroller." Basu at [0007]. Goodman discloses "On board analog-to-digital converter A/D 44 (10 bit, 5 channel input) is used to convert the conditioned PPG signals at B and B′ into time sampled digital signals which are then provided to processing device 14. Goodman at 11:66-12:21. Lisogurski discloses a "[f]ront end processing circuitry 150 may perform various analog and digital processing of the detector signal." Lisogurski at 12:42-51. Rulkov discloses that "The microprocessor741 has a LED control715 connected to DAC702 for controlling the intensity of the LEDs737. The signal from the photodetector736 is transmitted to a high pass filter (HPF) 703 which sends it to an analog to digital converter704, and the signal from the photodetector737 is also sent directly to a second analog to digital converter704." Rulkov at 11:39-60. Moon discloses that "[a] filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized

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with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG." Moon at [0091]. Poeze discloses "[f]ront-end interfaces 108 may be implemented using transimpedance amplifiers that are coupled to analog to digital converters in a sigma delta converter." Poeze at 40:15-27. Addison-788 teaches that the "processing equipment may be configured to amplify, filter, sample, and digitize input signal 416, (e.g., using an analog-to-digital converter), and calculate physiological information from the digitized signal." Addison-788 at 17:7–12. Ali-Ali teaches that a "processor board 250 includes . . . an analog-to-digital (A/D) converter 253." Al-Ali at [0045].

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with incorporating an analog to digital converter into optical measurement systems. These methods are known to be effective in incorporating an analog to digital converter into such systems. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of signal processing.

References disclosing spatially separated detectors: For example, charted references Lisogurski, Poeze, Soller, Terumoto, and Tran all include teachings related to using detectors that are spatially separated. These references provide numerous methods for using light detectors. For example, Lisogurski teaches that "[o]ne or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart." Lisogurski

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at 17:35-45. Poeze discloses that "multiple detectors are employed and arranged in a spatial geometry. This spatial geometry provides a diversity of path lengths among at least some of the detectors and allows for multiple bulk and pulsatile measurements that are robust." Poeze at 9:18-27. Soller discloses "a plurality of spectral detectors attached to the circuit board, each spectral detector being configured to analyze radiation derived from the radiation source" and depicts the detectors as spatially separated. Soller at 3:16-27; Fig. 34. Terumoto discloses "[t]he light sensor portions 101-1 to 101-n are located equally spaced from one another and to go round the armlet type housing 107 same as the fourth to sixth implementations." Terumoto at [0152]. Tran discloses "[t]he electrode array sensor can be a geometric array of discrete electrodes having an equally-spaced geometry of multiple nodes that are capable of functioning as sense and reference electrodes. In a typical tomography application the electrodes are equally-spaced in a circular configuration. Alternatively, the electrodes can have non-equal spacing and/or can be in rectangular or other configurations in one circuit or multiple circuits." Tran at 50:61-51:8.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that detect light. These methods provide using detectors that are spatially separated. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological parameters.

References disclosing detection system is synchronized to the light source: For example, charted reference Lisogurski, Carlson, Addison-788, and Poeze all include teachings related to detection system is synchronized to the light source. These references provide numerous

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methods for synchronizing detection system with the light source. For example, Lisogurski discloses "the front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals." Lisogurski at 11:33-49. Carlson discloses "[t]he basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3." Carlson at [0065]. Poeze teaches that "[a] control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 104. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 104 to follow a precise timing and consistent pattern." Poeze at 15:27-48. Addison-788 teaches the "front end processing circuitry 150 may use the timing control signals of control circuitry 110 to operate synchronously with light drive circuitry 120." Addison-788 at 7:63–65.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that are concerned with measuring physiological parameters. These methods are known to be effective in incorporating synchronizing detection system with the light source. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other

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references in order to better achieve their common goals of signal processing.

"Worn By a User" References. For example, charted reference Lisogurski and Addison-788, teaches a wearable sensor for monitoring physiological conditions that is configured to determine whether the sensor is being worn by a user. For example, Addison-788 teaches a "physiological monitoring system," including a "pulse oximeter," that may "determine a probe-off condition" when the sensor is "fully or partially detached or moved from the desired target area of the subject," including when the sensor has "loosened, shifted, slid, moved, detached, repositioned in any other unsuitable arrangement, or any combination thereof." Addison-788 at 2:10–50. For example, Lisogurski discloses that its system "detect[s] a signal indicative of a system error such as a physiologically impossible value" and "a probe-off signal." Lisogurski at 36:66-37:2.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for measuring physiological parameters. These methods determining whether a wearable system for measuring physiological parameters is being worn by the user. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological parameters.

References disclosing artificial intelligence: For example, charted reference Tran, as well as other references such as Quy, include teachings related to using artificial intelligence. For example, Tran teaches "Various mathematical techniques and Artificial Intelligence (AI) analyzer can be applied. … AI approaches towards signal recognition include Artificial Neural Networks (ANN), dynamic recurrent neural networks (DRNN), fuzzy logic system, Genetic Algorithm (GA),

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and Hidden Markov Model (HMM)." Tran at 94:49-65. Quy teaches "[a]pplication 62 may include an algorithm 63 for analyzing data from the HMD, and either application 62 or algorithm 63 may optionally access data from an external data source 74 and may further consult an artificial intelligence system 76." Quy at 8:9-14.

A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems for measuring physiological parameters. These methods provide using artificial intelligence. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of measuring physiological parameters.

Smartphone/Tablet References: For example, charted references Basu, Lisogurski, Kassim, Addison-788, and Tran, as well as numerous other references such as Kreger, all include teachings related to physiological measurement systems. These references provide numerous means for a physiological monitoring system to be configured for use with a smart phone or tablet. For example, Basu teaches "health ring 44 which can monitor heart rate on a 24 hour basis," and that "combines the sensor with a…wireless transmitter linked to an application running on the user's cell phone." Basu, [0065]-[0066]. For example, Kassim teaches "[t]he optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration," and that "the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is not exhaustive by any means." Kassim, 12:5-14. For example, Kreger teaches a "biosensor

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interface apparatus for use with a mobile communication device 10," that "can be any of a number of mobile phones such as an iPhone® or an Android® phone, a personal digital assistant (PDA) such as a Blackberry®, a portable audio playback device such as an MP3 player, a portable media playback device such as an iPod®, or a handheld tablet such as an iPad®." Kreger, 5:40-53; *see also* Kreger, 7:39-46. For example, Lisogurski teaches a "monitor [that] may be powered by a battery" with a "[u]ser interface [which] may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device." Lisogurski, 15:19-23, 18:65-67. For example, Poeze teaches "a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128," where the "personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc." Poeze, [0034]; *see also* Poeze [0010]. Tran teaches that while a patient with a wearable device is outside a mesh network range, "the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection." Tran, 34:4-30. Addison-788 teaches that its system "may be embedded in a small, compact object carried with or attached to the subject (e.g., a watch, other piece of jewelry, or a smart phone." Addison-788, at 16:33-36.

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A person of skill in the art would understand that the functionality taught in these references could be added to other methods and systems that concern physiological monitoring. These methods and systems provide the benefit of more processing power and more convenient means to flag emergency situations. Moreover, to the extent that any of these references includes a feature not expressly disclosed in one or more other references, a POSITA would have naturally looked to, and been motivated to combine, any one of these references with one or more of the other references in order to better achieve their common goals of more accurate and efficient physiological monitoring.

Arc References: For example, charted reference LeBoeuf, as well as numerous other references such as Jung, and Isaacson all include teachings related to physiological measurement systems. These references provide numerous methods for utilizing a plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. For example, LeBoeuf teaches optical emitters 24 and optical detectors 26 configured in an arc. LeBoeuf, [0123]-[1024], Fig. 8B. For example, Isaacson teaches emitters 10, 20 and detectors 12, 22 disposed on an arc. Isaacson, 4:64-5:9, Fig. 1. For example, Jung teaches "a fiber optic arrangement presented at the forward end of probe tip 1" which "utilizes a single central light source fiber optic…and a plurality of perimeter light receiver fiber optics, denoted as light receivers R1, R2 and R3." Jung, 11:21-50, Fig. 2; *see also* Jung 24:39-48, 24:39-62, 32:66-33:9, 39:41-40:14, Figs. 9, 10A-B, 20, 28A-B.

b. Combinations

For at least the reasons described above, it would have been obvious to one of ordinary skill in the art to combine each prior art reference listed in Appendix G with any other reference or references listed in Appendix G, along with the knowledge of one of ordinary skill in the art to

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arrive at the inventions claims in the ’475 Patent.

For example, and without limitation, the Asserted Claims of the ’475 Patent would have been obvious to one of ordinary skill in the art in view of the following combinations:

(i) Rulkov, Basu, Goodman, Kassim, Lisogurski, Moon, Terumoto, Tran, Addison-788 and Al-Ali combined with References disclosing lenses

A POSITA would have had reason to combine references Rulkov, Basu, Goodman, Kassim, Lisogurski, Moon, Terumoto, Tran, Addison-788, and Al-Ali with any one of References disclosing lenses, all of which relate to systems and methods for using lenses to direct an optical output beam. Each of References disclosing lenses relate to using one or more lenses configured to receive a portion of at least one of the output optical lights and to direct a lens output light to tissue comprising skin. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing lenses provide means—not necessarily expressly present in all other references—for using lenses to direct an optical output beam. A POSITA would have understood that the systems and methods for References disclosing lenses were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using lenses provide improvements such as directing the light to tissue comprising skin. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using lenses to direct an optical output beam would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using lenses to direct an optical output beam, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be “obvious to try,” because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

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(ii) Kassim, Rulkov, Goodman, Moon, Poeze, Soller, Terumoto, Addison-788, and Al-Ali, combined with References disclosing techniques for increasing signal-to-noise ratio

A POSITA would have had reason to combine Kassim, Rulkov, Goodman, Moon, Poeze, Soller, Terumoto, Addison-788, and Al-Ali with any one of References disclosing techniques for increasing signal-to-noise ratio, all of which relate to systems and methods for increasing a light intensity and increasing a pulse rate of an LED. Each of References disclosing techniques for increasing signal-to-noise ratio relate to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing techniques for increasing signal-to-noise ratio provide means—not necessarily expressly present in all other references—for increasing signal-to-noise ratio relate to increasing the signal-to-noise ratio of optical measurement systems by increasing a light intensity and increasing a pulse rate of an LED. A POSITA would have understood that the systems and methods for References disclosing techniques for increasing signal-to-noise ratio were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for increasing a light intensity and increasing a pulse rate of an LED provide improvements such as increasing signal-to-noise ratio. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for increasing signal-to-noise ratio would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for increasing signal-to-noise ratio, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

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(iii) Carlson, Kassim, Soller, LeBeouf, Tran, and Terumoto combined with References disclosing an analog to digital converter

A POSITA would have had reason to combine references Carlson, Kassim, Soller, LeBeouf, Tran, and Terumoto with any one of References disclosing an analog to digital converter, all of which relate to systems and methods for using an analog to digital converter coupled to a detector. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing an analog to digital converter provide means—not necessarily expressly present in all other references—for using an analog to digital converter coupled to a detector. A POSITA would have understood that the systems and methods for References disclosing an analog to digital converter were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for using an analog to digital converter provide improvements such as ability to process a signal digitally. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for using an analog to digital converter would commonly be combined with optical measurement systems, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using an analog to digital converter, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(iv) Carlson, Rulkov, Basu, Goodman, Kassim, Moon, Al-Ali, LeBeouf, and Addison-788 combined with References disclosing spatially separated detectors

A POSITA would have had reason to combine references Carlson, Rulkov, Chandersekar, Carlson, Rulkov, Basu, Goodman, Kassim, Moon, Al-Ali, LeBeouf, and Addison-788 with any

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one of References disclosing spatially separated detectors all of which relate to systems and methods for using spatially separated detectors. Indeed, such components and/or processes were conventional as of the time these references were known. Each of References disclosing spatially separated detectors provide means—not necessarily expressly present in all other references—for using spatially separated detectors. A POSITA would have understood that the systems and methods for References disclosing spatially separated detectors were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for spatially separated detectors provide improvements such as improved detection quality. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with spatially separated detectors, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for using spatially separated detectors, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(v) Rulkov, Basu, Goodman, Kassim, Moon, Soller, Terumoto, Tran, Addison-788, and Al-Ali combined with References disclosing detection system is synchronized to the light source

A POSITA would have had reason to combine references Rulkov, Chandersekar, Basu, Goodman, Kassim, Moon, Soller, Terumoto, Tran, Addison-788, and Al-Ali with any one of References disclosing detection system is synchronized to the light source, all of which relate to systems and methods for synchronizing a detection system with a light source. Indeed, such components and/or processes were conventional as of the time these references were known. Each

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of References disclosing detection system is synchronized to the light source provide means—not necessarily expressly present in all other references—for synchronizing a detection system with a light source. A POSITA would have understood that the systems and methods for References disclosing detection system is synchronized to the light source were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for synchronizing a detection system with a light source provide improvements such as improved detection. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with techniques for synchronizing a detection system with a light source, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for synchronizing a detection system with a light source, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits G1 through G14 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-G, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the References disclosing lenses, References disclosing techniques for increasing signal-to-noise ratio, References disclosing an analog to digital converter, References disclosing spatially separated detectors, References disclosing detection system is synchronized to the light source, for the reasons discussed above.

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(vi) Lisogurski, Basu, Goodman, Kassim, Soller, Poeze, Terumoto, Rulkov, Moon, Carlson, Al-Ali, LeBeouf, and Tran combined with References disclosing determining whether a wearable sensor is being worn by a user

Lisogurski, Basu, Goodman, Kassim, Soller, Poeze, Terumoto, Rulkov, Moon, Carlson, Al-Ali, LeBeouf, and Tran, with any one of References disclosing an apparatus configured to determine, based in part on the output signal, that an apparatus is being worn by the user, all of which relate to systems and methods for determining that a wearable device is being worn by the user. Indeed, such components and/or processes were conventional as of the time these references were known. A POSITA would have understood that the systems and methods for References disclosing an apparatus configured to determine whether the apparatus is being worn by a user, based in part on the optical output signal, were intended to be incorporated into wearable measurement devices. A POSITA would understand that an apparatus configured to determine, based in part on the output signal, that an apparatus is being worn by the user would provide improvements to wearable sensors such as improved detection and monitoring of physiological parameters. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for measuring physiological parameters would commonly be combined with techniques for configuring an apparatus to determine whether the apparatus was being worn by a user, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for configuring an apparatus to determine, based in part on an optical output signal, that the apparatus is being worn by a user, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

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(vii) Lisogurski, Basu, Goodman, Kassim, Soller, Poeze, Terumoto, Rulkov, Moon, Carlson, Al-Ali, LeBeouf, and Addison-788 Combined with Artificial Intelligence References

A POSITA would have had reason to combine references Lisogurski, Basu, Goodman, Kassim, Soller, Poeze, Terumoto, Rulkov, Moon, Carlson, Al-Ali, LeBeouf, and Addison-788 with any one of the Artificial Intelligence References all of which relate to systems and methods for physiological monitoring. Each of references Tran and Quy relate to physiological monitoring systems which use artificial intelligence or multivariate techniques to improve their measurements. Indeed, such components and/or processes were conventional as of the time these references were known. Each of the Artificial Intelligence References provide means—not necessarily expressly present in all other references—for improving a system's decision-making and the SNR of a measured signal. A POSITA would have understood that the systems and methods for the Artificial Intelligence References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for incorporating the artificial intelligence techniques into physiological measurement systems provide improvements such as improving the system's ability to effectively make decisions and make accurate measurements with minimal noise interference. *E.g.*, Tran, 5:57-65 ("For example, the system can perform patient behavior analysis such as eating/drinking/smoke habits and medication compliance, among others"). A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement systems would commonly be combined with artificial intelligence techniques, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of using known artificial intelligence models, to wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because

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it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(viii) Goodman, Soller, Poeze, Terumoto, Rulkov, Moon, Carlson, Al-Ali, and LeBeouf Combined with Smartphone/Tablet References

A POSITA would have had reason to combine references Goodman, Soller, Poeze, Terumoto, Rulkov, Moon, Carlson, Al-Ali, and LeBeouf with any one of Smartphone/Tablet References all of which relate to systems and methods for physiological monitoring. Each of references Basu, Lisogurski, Kassim, Addison-788, Kreger, and Tran relate to physiological monitoring systems for use with a smartphone or tablet. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Smartphone/Tablet References provide means—not necessarily expressly present in all other references—for a physiological monitoring system to communicate with a smartphone or tablet. A POSITA would have understood that the systems and methods for Smartphone/Tablet References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for connectivity to smartphones or tablets provide improvements improving the analysis capabilities of measurement systems due to the increased processing power of smartphones and tablets and the additional resources provided by their ability to connect to wireless and cell networks. *E.g.*, Basu, [0066] (physiological monitoring system "combines the sensor with a…wireless transmitter linked to an application running on the user's cell phone."); Kreger, 13:1-3 ("Mobile device smart phone 444 may derive measurements, display plots, transmit medical records of biosensor data, and so forth."); Tran, 34:4-40 ("If the wearable appliance detects a cellphone that is mesh network compatible, the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection."). A POSITA would further understand that in order to implement a wearable measurement device, the

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systems and methods for optical physiological measurement would commonly be combined with smartphone and personal computing technology and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques of providing for connectivity to smartphone or personal computing devices in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

(ix) Lisogurski, Basu, Goodman, Kassim, Soller, Poeze, Terumoto, Rulkov, Moon, Carlson, Al-Ali, Tran, and Addison-788 Combined with Arc References

A POSITA would have had reason to combine references Lisogurski, Basu, Goodman, Kassim, Soller, Poeze, Terumoto, Rulkov, Moon, Carlson, Al-Ali, Tran, and Addison-788, with any one of Arc References all of which relate to systems and methods for physiological monitoring. Each of references Isaacson, Jung, and LeBoeuf relate to physiological monitoring systems with their light sources and/or detectors configured in an arc. Indeed, such components and/or processes were conventional as of the time these references were known. Each of Arc References provide means—not necessarily expressly present in all other references—for configuring the detectors and/or emitters of a physiological measurement system in an arc formation. A POSITA would have understood that the systems and methods for Arc References were intended to be incorporated into wearable measurement devices. A POSITA would understand that systems and methods for configuring optical detectors and emitters in an arc formation would provide improvements such as increased measurement accuracy due to lessening the negative effects of light scattering and accounting for the contours of the tissue sample that is being measured. A POSITA would further understand that in order to implement a wearable measurement device, the systems and methods for optical measurement would commonly be combined detectors and

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emitters in an arc formation, and thus a POSITA would have been motivated to combine the teachings of these references. The combination would apply known techniques for varying the spatial configurations of emitters and detectors in wearable measurement devices that were ready for improvement, in order to yield predictable results. The combination would further be "obvious to try," because it would involve simple design choices from a finite number of identified, predictable solutions, with a reasonable expectation of success.

Furthermore, to the extent any limitation of an Asserted Claim is deemed not to be exactly disclosed by an item of prior art, then the claim is rendered obvious by combination of the prior art in Exhibits G1 through G14 standing alone, in combination with the reference(s) in any other claim chart, in combination with any system art identified in Table 2-G, in combination with Applicant's Admitted Prior Art, in view of the knowledge of a person of ordinary skill in the art, and/or in view of the References disclosing lenses, References disclosing techniques for increasing signal-to-noise ratio, References disclosing an analog to digital converter, References disclosing spatially separated detectors, References disclosing detection system is synchronized to the light source, References disclosing determining whether an apparatus is being worn by a user, References disclosing smartphones/tablets, References disclosing artificial intelligence, and/or References disclosing arcs, for the reasons discussed above.

V. P.R. 3-3(c) – Claim Charts

Pursuant to Rule 3-3(c), OnePlus identifies invalidity claim charts identifying disclosures in the references identified in Sections III-IV supra as to the Asserted Claims of the Asserted Patents are provided in attached Appendix A ('868 Patent), Appendix B ('533 Patent), Appendix C ('484 Patent), Appendix D ('304 Patent), Appendix E ('455 Patent), Appendix F ('790 Patent), and Appendix G ('475 Patent).

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OnePlus has identified relevant portions and/or features of the prior art. However, the identified prior art may contain additional descriptions of or alternative support for the claim limitations. OnePlus may rely on uncited portions or features of the identified prior art, other documents, and expert testimony, to provide context or to aid in understanding the identified prior art and the state of the art. Citations to a particular figure in a reference include the caption and description of the figure and any text relating to the figure. Similarly, citations to particular text referring to a figure include the figure and caption as well. Portions relevant to dependent claims incorporate by reference the citations to the chain of claims from which that dependent claim derives. Likewise, portions related to subsequent limitations that refer to claim elements identified, described, and/or cited to in earlier limitations may rely on the citations related to those portions of the claim chart that identify and/or describe these elements.

Throughout the invalidity claim charts in Appendices A-G, OnePlus provides exemplary citations showing where references disclose subject matter recited in preambles of the Asserted Claims, regardless of whether the preambles limit the claims. OnePlus reserves the right to argue that the preambles are or are not limitations. Further, where an entry in a claim chart corresponding to a given limitation refers back to the discussion of another claim, the entry incorporates all evidence cited for the other claim.

As noted above, the asserted claims have not yet been construed. Additional portions of the references may become relevant after claim construction. Further, to the extent that any claim term is governed by 35 U.S.C. § 112 ¶ 6, the claim charts identify, by the citations provided, the structure(s), act(s), or material(s) in each reference performing the claimed function for each limitation of the asserted claims. Plaintiffs' claim construction positions, expert analysis and testimony, and additional discovery could all inform which portions of the references disclose a

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limitation, including under 35 U.S.C. § 112 ¶ 6, and whether any particular limitation is governed by 35 U.S.C. § 112 ¶ 6. OnePlus's contentions are based on the information presently available, and OnePlus reserves all rights to provide their claim construction positions in accordance with the Docket Control Order in this case.

VI. P. R. 3-3(d) – Other Grounds for Invalidity

A. U.S. Patent No. 9,055,868

Pursuant to Rule 3-3(d), OnePlus hereby identifies grounds of invalidity for the '868 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by OnePlus in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent OnePlus from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. OnePlus's invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '868 Patent Asserted Claims. Consequently, OnePlus only identifies the issues under 35 U.S.C. § 112 of which it is presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '868 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '868 Patent Asserted Claims at the time the '868 Patent was filed, at least as plaintiff appears to be asserting those limitations.

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Ariad Pharms., Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '868 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '868 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '868 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '868 Patent fail to sufficiently enable the limitations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '868 Patent fails to sufficiently describe or enable them as required by 35 U.S.C. § 112, ¶ 1:[9]

Term	Relevant Claim(s)
"a software application capable of generating data"	7
"a status of the user"	7
"at least a portion of the status or associated information"	7
"a multiplexer capable of combining the plurality of semiconductor diodes"	8

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity

[9] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '868 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '868 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '868 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc*., 572 U.S. 898, 901 (2014). Several of the '868 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '868 Patent Asserted Claims are indefinite in whole, in part or in combination:[10]

Term	Relevant Claim(s)
"a part of a user's body comprising blood"	7
"physiological information associated with the user"	7

[10] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
"wireless data"	7
"voice input signals and manually entered input signals"	7
"at least a portion of the status or associated information"	7
"a multiplexer capable of combining the plurality of semiconductor diodes"	8
"generating the input light beam comprising one or more wavelengths"	8
"adapted for use in a diagnostics"	9
"a plurality of associated wavelengths transmitted or reflected from the blood"	9

B. U.S. Patent No. 9,651,533

Pursuant to Rule 3-3(d), OnePlus hereby identifies grounds of invalidity for the '533 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by OnePlus in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent OnePlus from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. OnePlus's invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '533 Patent Asserted Claims. Consequently, OnePlus only identifies the issues under 35 U.S.C. § 112 of which it is presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '533 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '533 Patent Asserted Claims

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at the time the '533 Patent was filed, at least as plaintiff appears to be asserting those limitations. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '533 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '533 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '533 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '533 Patent fail to sufficiently enable the limitations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '533 Patent fails to sufficiently describe or enable them as required by 35 U.S.C. § 112, ¶ 1:[11]

Term	Relevant Claim(s)
"the light emitting diodes configured to generate an output optical beam with one or more optical wavelengths"	5
"the processed output signal"	5
"one of more detectors"	11
"to select a fraction of the one or more optical wavelengths"	11

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity

[11] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '533 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '533 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '533 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc*., 572 U.S. 898, 901 (2014). Several of the '533 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '533 Patent Asserted Claims are indefinite in whole, in part or in combination:[12]

Term	Relevant Claim(s)
"the light emitting diodes configured to generate an output optical beam with one or more optical wavelengths"	5

[12] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
"the processed output signal"	5
"one of more detectors"	11
"to select a fraction of the one or more optical wavelengths"	11

C. U.S. Patent No. 10,517,484

Pursuant to Rule 3-3(d), OnePlus hereby identifies grounds of invalidity for the '484 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by OnePlus in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent OnePlus from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. OnePlus's invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '484 Patent Asserted Claims. Consequently, OnePlus only identifies the issues under 35 U.S.C. § 112 of which it is presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '484 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '484 Patent Asserted Claims at the time the '484 Patent was filed, at least as plaintiff appears to be asserting those limitations. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to

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those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '484 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '484 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '484 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '484 Patent fail to sufficiently enable the limitations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '484 Patent fails to sufficiently describe or enable them as required by 35 U.S.C. § 112, ¶ 1:[13]

Term	Relevant Claim(s)
"wherein the output signal is indicative of one or more of the physiological parameters"	7-10
"increase the signal-to-noise ratio by comparing the first signal and the second signal"	7-10
"a property of at least some of the output signal is compared by at least one of the wearable device, the smart phone or tablet to a threshold"	8-10
"wherein the wearable device is at least in part configured to identify an object"	8-10
"wherein the wearable device is configured to use artificial intelligence to process at least a portion of the output signal"	10

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity

[13] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '484 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '484 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '484 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc*., 572 U.S. 898, 901 (2014). Several of the '484 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '484 Patent Asserted Claims are indefinite in whole, in part or in combination:[14]

Term	Relevant Claim(s)
"spatially separated detectors"	7-10

[14] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
"increase the signal-to-noise ratio by comparing the first signal and the second signal"	7-10
"wherein the detection system is configured to be synchronized to the light source"	7-10
"a cloud configured to receive over the wireless transmission link an output status"	7-10
"wherein the wearable device is at least in part configured to identify an object"	8-10
"gain configured to improve detection sensitivity"	9-10
"wherein the wearable device is configured to use artificial intelligence"	10

D. U.S. Patent No. 10,874,304

Pursuant to Rule 3-3(d), OnePlus hereby identifies grounds of invalidity for the '304 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by OnePlus in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent OnePlus from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. OnePlus's invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '304 Patent Asserted Claims. Consequently, OnePlus only identifies the issues under 35 U.S.C. § 112 of which it is presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '304 Patent does not provide sufficient written description to establish that the

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inventors were in possession of the alleged inventions recited in the '304 Patent Asserted Claims at the time the '304 Patent was filed, at least as plaintiff appears to be asserting those limitations. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '304 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '304 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '304 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '304 Patent fail to sufficiently enable the limitations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '304 Patent fails to sufficiently describe or enable them as required by 35 U.S.C. § 112, ¶ 1:[15]

Term	Relevant Claim(s)
a cloud configured to receive over the wireless transmission link an output status comprising the at least a portion of the processed output signal, to process the received output status to generate processed data and to store the processed data, and wherein the cloud is capable of storing a history of at least a portion of the received output status over a specified period of time.	11
the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources	11

[15] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal	11
wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate	13
the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	15, 21
wherein the first arc and the second arc are concentric	16, 22
the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by: differencing the first signal and the second signal, and increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources	19
a measurement device including a light source comprising a plurality of semiconductor sources for measuring one or more physiological parameters	19
wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate	20

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '304 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '304 Patent's written

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description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '304 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc*., 572 U.S. 898, 901 (2014). Several of the '304 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '304 Patent Asserted Claims are indefinite in whole, in part or in combination:[16]

Term	Relevant Claim(s)
a receiver configured to: … synchronize to the light source	11
the light source configured to increase signal-to-noise ratio by increasing a light intensity relative to an initial light intensity from at least one of the plurality of semiconductor sources	11
wherein the measurement system is at least in part configured for selection or identification of an object	12
wherein the measurement system is configured to use artificial intelligence in making decisions	12
wherein the light source is configured to further increase the signal-to-noise ratio by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate	13
the receiver comprises a plurality of detectors arranged along a first arc, and wherein the plurality of semiconductor sources are arranged along a second arc that is offset from the first arc.	15, 21
wherein the first arc and the second arc are concentric	16, 22
a receiver configured to: … synchronize to the modulation of the at least one of the semiconductor sources	19
the measurement device further configured to improve a signal-to-noise ratio of the input optical beam reflected from the tissue by:	19

[16] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
differencing the first signal and the second signal, and increasing the light intensity relative to the initial light intensity from at least one of the semiconductor sources	
wherein the light source is configured to further improve the signal-to-noise ratio of the input optical beam reflected from the tissue by increasing a pulse rate of at least one of the plurality of semiconductor sources from an initial non-zero pulse rate	20

E. U.S. Patent No. 11,160,455

Pursuant to Rule 3-3(d), OnePlus hereby identifies grounds of invalidity for the '455 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by OnePlus in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent OnePlus from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. OnePlus's invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '455 Patent Asserted Claims. Consequently, OnePlus only identifies the issues under 35 U.S.C. § 112 of which it is presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '455 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '455 Patent Asserted Claims at the time the '455 Patent was filed, at least as plaintiff appears to be asserting those limitations.

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Ariad Pharms., Inc. v. Eli Lilly & Co., 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '455 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '455 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '455 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '455 Patent fail to sufficiently enable the limitations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '455 Patent fails to sufficiently describe or enable them as required by 35 U.S.C. § 112, ¶ 1:[17]

Term	Relevant Claim(s)
A system for measuring one or more physiological parameters	1, 8, 15
the processed output signal	1, 8, 15
wherein the output signal is indicative of one or more of the physiological parameters	1, 8, 15
the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the [plurality of] semiconductor sources from an initial light intensity	1, 8, 15
increase the signal-to-noise ratio by comparing the first signal and the second signal	1, 8, 15
at least a portion of the one or more of the physiological parameters	1, 10
the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths	1

[17] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs	2, 9, 15
the light emitting diodes configured to generate an output optical light having one or more optical wavelengths	8, 15

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '455 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '455 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '455 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc*., 572 U.S. 898, 901 (2014). Several of the '455 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art

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about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '455 Patent Asserted Claims are indefinite in whole, in part or in combination:[18]

Term	Relevant Claim(s)
spatially separated detectors	1, 2, 8, 9, 15
a plurality of detectors that are spatially separated from each other	1, 8, 15
wherein the detection system is configured to be synchronized to the light source	1, 8, 15
increase the signal-to-noise ratio by comparing the first signal and the second signal	1, 8, 15
the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths	1
the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the semiconductor sources from an initial light intensity	1
the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs	2, 9, 15
the light emitting diodes configured to generate an output optical light having one or more optical wavelengths	8, 15

F. U.S. Patent No. 12,193,790

Pursuant to Rule 3-3(d), OnePlus hereby identifies grounds of invalidity for the '790 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by OnePlus in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent OnePlus from advancing claim construction and/or non-infringement positions in lieu of, or in addition to, invalidity positions. Further, these contentions shall not be construed as an admission of or

[18] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. OnePlus's invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '790 Patent Asserted Claims. Consequently, OnePlus only identifies the issues under 35 U.S.C. § 112 of which it is presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '790 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '790 Patent Asserted Claims at the time the '790 Patent was filed, at least as plaintiff appears to be asserting those limitations. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '790 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '790 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '790 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '790 Patent fail to sufficiently enable the limitations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '790 Patent fails to sufficiently describe or enable them as required by

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35 U.S.C. § 112, ¶ 1:[19]

Term	Relevant Claim(s)
"a wearable device for measuring one or more physiological parameters"	7
"signal is indicative of one or more of the physiological parameters"	7
"wherein the wearable device is at least in part configured to identify an object"	7

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '790 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '790 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '790 Patent's invention based on the specification.

[19] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc*., 572 U.S. 898, 901 (2014). Several of the '790 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '790 Patent Asserted Claims are indefinite in whole, in part or in combination:[20]

Term	Relevant Claim(s)
"a plurality of detectors that are spatially separated from each other"	7
"increase the signal-to-noise ratio by comparing the first signal and the second signal"	7
"wherein the wearable device is at least in part configured to identify an object"	7
"wherein the detection system is configured to be synchronized to the light source"	7

G. U.S. Patent No. 12,268,475

Pursuant to Rule 3-3(d), OnePlus hereby identifies grounds of invalidity for the '475 Patent based on lack of written description under 35 U.S.C. § 112, first paragraph; lack of enablement under 35 U.S.C. § 112, first paragraph; indefiniteness under 35 U.S.C. § 112, second paragraph; and indefiniteness under 35 U.S.C. § 112, sixth paragraph. These contentions shall not be construed as an admission that any claim construction advanced by OnePlus in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent OnePlus from advancing claim construction and/or non-infringement positions in lieu of, or in addition to,

[20] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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invalidity positions. Further, these contentions shall not be construed as an admission of or acquiescence to Plaintiff's purported construction of the claim language or of other positions advanced by Plaintiff during the course of this litigation. OnePlus's invalidity contentions under 35 U.S.C. § 112 may depend, in part, on the Court's claim construction, as well as Plaintiff's alleged scope of the '475 Patent Asserted Claims. Consequently, OnePlus only identifies the issues under 35 U.S.C. § 112 of which it is presently aware.

1. Lack of Written Description and/or Enablement Under 35 U.S.C. § 112, ¶ 1

The '475 Patent does not provide sufficient written description to establish that the inventors were in possession of the alleged inventions recited in the '475 Patent Asserted Claims at the time the '475 Patent was filed, at least as plaintiff appears to be asserting those limitations. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the applicants did not describe their purported inventions in a manner that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* One of ordinary skill in the art would not have understood that the inventors were in possession of the full scope of the claimed apparatus and methods, at least as plaintiff appears to be asserting the claims. For example, the claims of the '475 Patent do not provide sufficient written description of the limitations listed below.

The specification of the '475 Patent also does not enable one of ordinary skill in the art to make and/or use certain recited elements of the '475 Patent Asserted Claims without undue experimentation, at least as plaintiff appears to be asserting those limitations. For example, the claims of the '475 Patent fail to sufficiently enable the limitations listed below.

To the extent the following limitations are definite (under 35 U.S.C. § 112, ¶ 2), the application that became the '475 Patent fails to sufficiently describe or enable them as required by

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35 U.S.C. § 112, ¶ 1:[21]

Term	Relevant Claim(s)
"an apparatus adapted to be worn by a user"	1
"one or more biosensors adapted to be placed on the user"	1
"wherein measuring of the one or more physiological parameters comprises a differential measurement"	1
"the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,"	1, 8
"generate a second signal responsive to light received while at least one of the light emitting diodes is on, and"	1, 8
"increase the signal-to-noise ratio by comparing the first signal and the second signal; and"	1, 8
"signal is indicative of one or more of the physiological parameters"	1, 12
"wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user"	1, 8
"configured to use artificial intelligence in making decisions associated with at least a portion of the output signal"	5
"wherein the detection system comprises the plurality of detectors arranged along an arc."	6
"wearable device configured to be worn by a user"	8
"lens positioned to direct at least a portion of the output light towards a bodily tissue of the user"	8
"generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the use"	8
the processor is further configured to modulate the light source with a modulation frequency.	13

2. Invalidity Under 35 U.S.C. § 112, ¶ 2

"[T]he second paragraph of § 112 contains two requirements: first, the claim must set forth what the applicant regards as his invention, and second, it must do so with sufficient particularity and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus.,*

[21] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

Inc., 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotation marks and alteration omitted). "Where it would be apparent to one of skill in the art, based on the specification, that the invention set forth in a claim is not what the patentee regarded as his invention," the claim is "invalid under § 112, paragraph 2." *Id.* at 1349. Several of the '475 Patent Asserted Claims are invalid because it would be apparent to one of skill in the art, based on the specification, that the invention set forth in these claims are not what the patentee regarded as his invention, at least as the claims are being asserted by the Plaintiff. *Id.* These claims are invalid under the "applicant regards" prong of § 112 at least because they contain elements that differ from and/or conflict with the '475 Patent's written description of the invention, at least as the claim elements are being asserted by Plaintiff, or because they omit elements that one of skill in the art would understand as part of the '475 Patent's invention based on the specification.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc*., 572 U.S. 898, 901 (2014). Several of the '475 Patent Asserted Claims are also invalid as indefinite under § 112, ¶ 2 because they fail to inform those skilled in the art about the scope of the invention with reasonable certainty and are indefinite.

The following limitations recited in the '475 Patent Asserted Claims are indefinite in whole, in part or in combination:[22]

Term	Relevant Claim(s)
"differential measurement"	1
"a plurality of detectors that are spatially separated from each other"	1

[22] Listed claims also include all Asserted Claims dependent thereon, even if those claims are not individually listed.

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Term	Relevant Claim(s)
"differential measurement"	1
"increase the signal-to-noise ratio by comparing the first signal and the second signal"	1
"wherein the detection system is configured to be synchronized to the light source"	1
"configured to use artificial intelligence in making decisions associated with at least a portion of the output signal"	5
"plurality of detectors arranged along an arc"	6

VII. Subject Matter Eligibility

Pursuant to the court's Standing Order Regarding Subject Matter Eligibility Contentions Applicable to All Patent Infringement Cases Assigned to Chief District Judge Rodney Gilstrap ("Order Regarding Eligibility"), Samsung provides the following Eligibility Contentions.

As described below, in Appendices A-G, and in Exhibits A101, B101, C101, D101, E101, F101, G101 (collectively "Appendix 101"), which are hereby incorporated by reference as if fully set forth herein, OnePlus contends that the Asserted Claims of the Asserted Patents are drawn to subject matter that is not patentable under 35 U.S.C. § 101. Pursuant to section (a)(1) of the Order Regarding Eligibility, Appendix 101 contains a chart for each Asserted Patent identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. Pursuant to section (a)(2)(A) of the Order Regarding Eligibility the charts of Appendix 101, read in conjunction with the discussion herein and in Appendices A-G, and together with the material described, referenced, or cited in the charts, further provide a description of the industry, at the relevant time, in which the Challenged Claims are alleged to be well understood, routine, and conventional, and the factual and legal basis therefor. Further, pursuant to sections (a)(2)(B) and (a)(3) of the Order Regarding Eligibility the charts of Appendix 101, read in conjunction with the discussion herein, and together with the material described, referenced, or cited in the charts, further provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or

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conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Additionally, pursuant to section (b) of the Order Regarding Eligibility, OnePlus is concurrently producing or making available for inspection and copying the materials on which OnePlus presently seeks to rely for subject-matter eligibility purposes. These prior art references and other materials are cited herein or in Appendices 101, A-G. For the avoidance of doubt, OnePlus may rely on the materials identified in Section III, above. Without concession that expert testimony is necessary to resolve the subject matter eligibility of the Asserted Claims, OnePlus reserves the right to further rely on expert testimony to be disclosed in accordance with the Docket Control Order. OnePlus's search for prior art references, additional documentation, and/or corroborating evidence concerning prior art systems and devices is ongoing. Accordingly, OnePlus reserves the right to supplement its production as OnePlus obtains additional prior art references, documentation, and/or corroborating evidence concerning subject matter eligibility during the course of discovery.

OnePlus reserves the right to supplement their document production pursuant to section (b) of the Order Regarding Eligibility as authorized by the Patent Local Rules, the Order Regarding Eligibility, or any other order of the Court.

A. U.S. Patent No. 9,055,868

Each of the Asserted Claims of the '868 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The '868 Patent Asserted Claims are unpatentable for failure to recite patent eligible subject matter.

The '868 Patent Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice Corp. Pty. Ltd. v. CLS Bank Intern.*, 573 U.S.

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208, 216 (2014). By way of example, the Asserted Claims of the '868 Patent are generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for diagnostics. Although the Asserted Claims recite concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, '868 Patent at Figs. 1, 2, 4, 5 (illustrating exemplary embodiments via generic technology and functional language). This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting, processing, and storing light-based physiological data. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of diagnostic technique. Thus, under *Alice* Step 1, the Asserted Claims of the '868 Patent are directed to one or more ineligible concepts.

Under *Alice* Step 2, the '868 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a "handful of generic computer components configured to implement" the abstract idea. *See Alice*, 573 U.S. at 226. Semiconductor diodes and the claimed lens system have long been used in optical sensing; touchscreens, location sensors, applications, and wireless transceivers are common in smartphones; and terms like "host," "digital file," and "control logic" represent generic computer components. Optical systems, phone applications, and remote storage are well-known, and their combination follows the general trend toward interconnectivity. *See Chamberlain Grp., Inc. v. Techtronic Indus. Co.*, 935 F.3d 1341, 1347–48 (Fed. Cir. 2019) (noting the ability to "transmit[] data wirelessly" is "not a technological improvement, but rather simply a feature of wireless communication"). The '868 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. *See Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d

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1350, 1354 (Fed. Cir. 2016) ("We have repeatedly held that such invocation of computers and networks that are not even arguably inventive are insufficient to pass the test of an inventive concept in the application of an abstract idea." (cleaned up)). Instead, the '868 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g., Intell. Ventures I LLC v. Cap. Fin. Corp.*, 850 F.3d 1332, 1342 (Fed. Cir. 2017). The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit A101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit A101 each Challenged Claim of the '868 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Exhibit A101 also identifies claim 7 as representative of the other Challenged Claims for purposes of the eligibility inquiry. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit A101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, OnePlus provides the following description of the relevant industry at the relevant time. As of the alleged priority date for the '868 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the '868 Patent were conventional, routine, and well known in the medical device and wearable health tech industries. *See generally* Appendix A. As shown in the

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accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the '868 Patent. Instead, these concepts had been known for years and were the subject of many published articles and/or patents from around the world. The '868 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding OnePlus's contentions that the Asserted Claims of the '868 Patent do not qualify as patent-eligible subject matter are contained in Exhibit A101.

B. U.S. Patent No. 9,651,533

Each of the Asserted Claims of the '533 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The '533 Patent Asserted Claims are unpatentable for failure to recite patent eligible subject matter.

The '533 Patent Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice*, 573 U.S. at 216. By way of example, the Asserted Claims of the '533 Patent are generally directed to the abstract idea of collecting, processing, and storing light-based data for analysis. Although the Asserted Claims recite concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, '533 Patent at 9:34-38, 2:26-29, 26:49-27:2. This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting, processing, and storing light-based data. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of measurement technique. Thus, under *Alice* Step 1, the Asserted Claims of the '533 Patent are directed to one or more ineligible concepts.

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Under *Alice* Step 2, the ’533 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a “handful of generic computer components configured to implement” the abstract idea. *See Alice*, 573 U.S. at 226. Semiconductor diodes, filters, and lenses have long been used in optical sensing; touchscreens, receivers, and transmitters are common in smartphones; and a “remote device” represents a conventional computer or storage unit. Optical systems, phone applications, and remote storage are well-known, and their combination follows the general trend toward interconnectivity. *See Chamberlain*, 935 F.3d at 1347–48. The ’533 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. Instead, the ’533 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g., Intell. Ventures*, 850 F.3d at 1342. The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit B101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit B101, each Challenged Claim of the ’533 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Exhibit B101 also identifies claim 11 as representative of the other Challenged Claims for purposes of the eligibility inquiry. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit B101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible

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for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, OnePlus provides the following description of the relevant industry at the relevant time. As of the alleged priority date for the '533 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the '533 Patent were conventional, routine, and well known in the optoelectronics and laboratory analytical instrumentation industries. *See generally* Appendix B. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the '533 Patent. Instead, these concepts had been known for years and were the subject of many published articles and/or patents from around the world. The '533 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding OnePlus's contentions that the Asserted Claims of the '533 Patent do not qualify as patent-eligible subject matter are contained in Exhibit B101.

C. U.S. Patent No. 10,517,484

Each of the Asserted Claims of the '484 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The '484 Patent Asserted Claims are unpatentable for failure to recite patent eligible subject matter.

The '484 Patent Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice*, 573 U.S. at 216. By way of example, the Asserted Claims of the '484 Patent are generally directed to the abstract ideas of collecting, processing, and storing light-based physiological data for analysis. Although the Asserted Claims recite concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*,

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’484 Patent at 11:3-6, 32:45-65. This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting, processing, and storing light-based data. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of measurement technique. Thus, under *Alice* Step 1, the Asserted Claims of the ’484 Patent are directed to one or more ineligible concepts.

Under *Alice* Step 2, the ’484 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a “handful of generic computer components configured to implement” the abstract idea. *See Alice*, 573 U.S. at 226. Semiconductor diodes, detectors, and lenses have long been used in optical sensing; touchscreens, receivers, and transmitters are common in smartphones; and the cloud is ubiquitous with modern computing. Optical systems, phone applications, and remote storage are well-known, and their combination follows the general trend toward interconnectivity. *See Chamberlain*, 935 F.3d at 1347–48. The ’484 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. Instead, the ’484 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g., Intell. Ventures*, 850 F.3d at 1342. The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit C101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit C101, each Challenged Claim of the ’484 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Exhibit C101 also identifies claim 8 as representative of the other Challenged Claims for purposes of the eligibility inquiry. Also, pursuant to section

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(a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit C101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, OnePlus provides the following description of the relevant industry at the relevant time. As of the alleged priority date for the '484 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the '484 Patent were conventional, routine, and well known in the medical device and wearable health tech industries. *See generally* Appendix C. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the '484 Patent. Instead, these concepts had been known for years and were the subject of many published articles and/or patents from around the world. The '484 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding OnePlus's contentions that the Asserted Claims of the '484 Patent do not qualify as patent-eligible subject matter are contained in Exhibit C101.

D. U.S. Patent No. 10,874,304

Each of the Asserted Claims of the '304 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The '304 Patent Asserted Claims are unpatentable for failure to recite patent eligible subject matter.

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The ’304 Patent Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice*, 573 U.S. at 216. By way of example, the Asserted Claims of the ’304 Patent are generally directed to the abstract ideas of collecting, processing, and storing light-based physiological data for analysis. Although the Asserted Claims recite concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, ’304 Patent at 13:21-25, 33:45-64. This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting, processing, and storing light-based physiological data. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of measurement technique. Thus, under *Alice* Step 1, the Asserted Claims of the ’304 Patent are directed to one or more ineligible concepts.

Under *Alice* Step 2, the ’304 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a “handful of generic computer components configured to implement” the abstract idea. *See Alice*, 573 U.S. at 226. Semiconductor diodes and receivers have long been used in optical sensing; touchscreens, receivers, and transmitters are common in smartphones; and the cloud is ubiquitous with modern computing. Optical systems, phone applications, and remote storage are well-known, and their combination follows the general trend toward interconnectivity. *See Chamberlain*, 935 F.3d at 1347–48. The ’304 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. Instead, the ’484 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g., Intell. Ventures*, 850 F.3d at 1342. The law requires more.

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Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit D101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit D101 each Challenged Claim of the '304 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Exhibit D101 also identifies claim 11 as representative of the other Challenged Claims for purposes of the eligibility inquiry. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit D101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, OnePlus provides the following description of the relevant industry at the relevant time. As of the alleged priority date for the '304 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the '304 Patent were conventional, routine, and well known in the medical device and wearable health tech industries. *See generally* Appendix D. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the '304 Patent. Instead, these concepts had been known for years and were the subject of many published articles and/or patents from around the world. The '304 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding OnePlus's contentions that the Asserted Claims of the '304 Patent

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do not qualify as patent-eligible subject matter are contained in Exhibit D101.

E. U.S. Patent No. 11,160,455

Each of the Asserted Claims of the ’455 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The ’455 Patent Asserted Claims are unpatentable for failure to recite patent eligible subject matter.

The ’455 Patent Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice*, 573 U.S. at 216. By way of example, the Asserted Claims of the ’455 Patent are generally directed to the abstract ideas of collecting, processing, and storing light-based physiological data for analysis. Although the Asserted Claims recite concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, ’455 Patent at 16:66-17:3, 45:43-62. This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting, processing, and storing light-based physiological data. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of measurement technique. Thus, under *Alice* Step 1, the Asserted Claims of the ’455 Patent are directed to one or more ineligible concepts.

Under *Alice* Step 2, the ’455 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a “handful of generic computer components configured to implement” the abstract idea. *See Alice*, 573 U.S. at 226. Semiconductor sources, lenses, and detectors have long been used in optical sensing; touchscreens, receivers, and transmitters are common in smartphones; and the combination of optical systems and smartphones follows the general trend toward interconnectivity. *See*

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Chamberlain, 935 F.3d at 1347–48. The ’455 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. Instead, the ’455 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g.*, *Intell. Ventures*, 850 F.3d at 1342. The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit E101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit E101 each Challenged Claim of the ’455 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Exhibit E101 also identifies claim 1 as representative of the other Challenged Claims for purposes of the eligibility inquiry. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit E101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, OnePlus provides the following description of the relevant industry at the relevant time. As of the alleged priority date for the ’455 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the ’455 Patent were conventional, routine, and well known in the medical device and wearable health tech industries. *See generally* Appendix E. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the ’455 Patent. Instead, these concepts had been

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known for years and were the subject of many published articles and/or patents from around the world. The ’455 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding OnePlus’s contentions that the Asserted Claims of the ’455 Patent do not qualify as patent-eligible subject matter are contained in Exhibit E101.

F. U.S. Patent No. 12,193,790

The Asserted Claim of the ’790 Patent is drawn to subject matter that is not patentable under 35 U.S.C. § 101. The ’790 Patent Asserted Claim is unpatentable for failure to recite patent eligible subject matter.

The ’790 Patent Asserted Claim is directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice*, 573 U.S. at 216. By way of example, the Asserted Claim of the ’790 Patent is generally directed to the abstract idea of collecting and processing light-based data to determine physiological parameters. Although the Asserted Claim recites concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, ’790 Patent at 7:50-55, 84:63-67, 32:28-67. This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting and processing natural phenomena. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of measurement technique. Thus, under *Alice* Step 1, the Asserted Claim of the ’790 Patent is directed to one or more ineligible concepts.

Under *Alice* Step 2, the ’790 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a “handful of

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generic computer components configured to implement" the abstract idea. *See Alice*, 573 U.S. at 226. The claimed light source (e.g., LEDs), semiconductor diodes, lenses, detection system, detectors, and analog-to-digital converters are conventional and perform their ordinary, expected functions. The claimed enhancement of signal-to-noise ratio by increasing light intensity or by subtracting background signal is a well-known technique in signal processing and does not constitute an unconventional arrangement or improvement in technology. The '790 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. Instead, the '790 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g.*, *Intell. Ventures*, 850 F.3d at 1342. The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit F101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit F101 each Challenged Claim of the '790 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit F101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, OnePlus provides the following description of the relevant industry at the relevant time. As of the alleged priority date for the '790 Patent, the relevant industry was well-developed. All individual elements

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disclosed and recited in the ’790 Patent were conventional, routine, and well known in the medical device and wearable health tech industries. *See generally* Appendix F. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the ’790 Patent. Instead, these concepts had been known for years and were the subject of many published articles and/or patents from around the world. The ’790 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period.

Further detail regarding OnePlus’s contentions that the Asserted Claims of the ’790 Patent do not qualify as patent-eligible subject matter are contained in Exhibit F101.

G. U.S. Patent No. 12,268,475

The Asserted Claims of the ’475 Patent are drawn to subject matter that is not patentable under 35 U.S.C. § 101. The ’475 Patent Asserted Claims are unpatentable for failure to recite patent eligible subject matter.

The ’475 Patent Asserted Claims are directed to abstract ideas and therefore not eligible subject matter under 35 U.S.C. § 101. *E.g.*, *Alice*, 573 U.S. at 216. By way of example, the Asserted Claims of the ’475 Patent are generally directed to the abstract idea of collecting and processing light-based data to determine physiological parameters. Although the Asserted Claims recite concrete, tangible components, the specification provides no technical details but instead describes them—both individually and collectively—in generic and functional terms. *See, e.g.*, ’475 Patent at 3:18–19, 3:37–51, 15:20–21, 20:65–21:13. This confirms that the recited physical components merely provide a generic environment in which to carry out the abstract idea of collecting and processing natural phenomena. Indeed, the patent does not purport to have invented or improved signal generation or processing; data transmission or remote storage; or any sort of

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measurement technique. Thus, under *Alice* Step 1, the Asserted Claims of the '475 Patent are directed to one or more ineligible concepts.

Under *Alice* Step 2, the '475 Patent does not add an inventive step to the general abstract idea. The claimed elements, individually and as an ordered combination, recite only a "handful of generic computer components configured to implement" the abstract idea. *See Alice*, 573 U.S. at 226. The claimed light source (e.g., LEDs), semiconductor diodes, lenses, detection system, detectors, and analog-to-digital converters are conventional and perform their ordinary, expected functions. The claimed enhancement of signal-to-noise ratio by increasing light intensity or by subtracting background signal is a well-known technique in signal processing and does not constitute an unconventional arrangement or improvement in technology. The '475 Patent, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. Instead, the '475 Patent recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g.*, *Intell. Ventures*, 850 F.3d at 1342. The law requires more.

Pursuant to section (a)(1) of the Order Regarding Eligibility, Exhibit G101 contains a chart identifying each exception to eligibility to which each Challenged Claim is directed and the factual and legal basis therefor. For avoidance of doubt, and as set forth above and in Exhibit G101 each Challenged Claim of the '475 Patent is directed to one or more abstract ideas and therefore is not directed to patent eligible subject matter. Also, pursuant to section (a)(2)(B) and (a)(3) of the Order regarding Eligibility, Exhibit G101, read in conjunction with the preceding paragraphs herein provides: (i) a description of how each element of each Challenged Claim, both individually and in combination with the other elements of that claim, was well understood, routine, and/or conventional in the relevant industry at the relevant time and (ii) an identification of the factual or

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legal basis for how the Challenged Claims are otherwise ineligible for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, OnePlus provides the following description of the relevant industry at the relevant time. As of the alleged priority date for the '475 Patent, the relevant industry was well-developed. All individual elements disclosed and recited in the '475 Patent were conventional, routine, and well known in the medical device and wearable health tech industries. *See generally* Appendix G. As shown in the accompanying claim charts, none of the claimed concepts were new or merely on the verge of development as of the alleged priority date of the '475 Patent. Instead, these concepts had been known for years and were the subject of many published articles and/or patents from around the world. The '475 Patent contributed nothing beyond what was already conventional, routine, well-known technology as of the relevant time period. Further detail regarding OnePlus's contentions that the Asserted Claims of the '475 Patent do not qualify as patent-eligible subject matter are contained in Exhibit G101.

VIII. P. R. 3-4 – Productions

Pursuant to P.R. 3-4(a), each OnePlus is concurrently producing and/or making available for inspection certain documents and other materials sufficient to show the operation of any aspects or elements of the Accused Products identified by Plaintiff in its P.R. 3-1(c) charts. OnePlus notes that, as of the service date of these Invalidity Contentions, no Protective Order has been agreed to between OnePlus and Omni and entered by the Court as to those parties.

Additionally, and pursuant to P.R. 3-4(b), OnePlus hereby incorporates by reference the prior document productions previously made by the co-defendants in this matter in connection with their Invalidity Contentions served on Plaintiff on June 3, 2025 and July 18, 2025. Specifically, OnePlus relies upon and references the documents previously produced by the co-

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defendants bearing Bates numbers DEFS-PA_0000001 – DEFS-PA_0009759, and any other/supplemental prior art production similarly bates-labeled with the prefix "DEFS-PA." To avoid unnecessary duplication, OnePlus is not re-producing these materials, but affirms that they form part of its supporting documentation under P.R. 3-4(a). These prior art references and corroborating evidence are cited in attached invalidity claim charts in Appendices 101, A-G. OnePlus will also make available for inspection any prior art systems or devices upon request to the extent OnePlus acquires such systems or devices. References that were cited during prosecution of the Asserted Patents may not be contained in OnePlus's production as they are not required to be under the local patent rules. OnePlus's search for prior art references, additional documentation, and/or corroborating evidence concerning prior art systems and devices is ongoing. Accordingly, OnePlus reserves the right to supplement its production as OnePlus obtains additional prior art references, documentation, and/or corroborating evidence concerning invalidity during the course of discovery.

OnePlus reserves the right to supplement their P. R. 3-4 document production pursuant to the Patent Local Rules and the orders of the Court.

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Dated: September 30, 2025

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the above and foregoing document has been served on counsel of record for Plaintiff via electronic mail on this 30th day of September 2025.

/s/ Brett Mangrum
Brett Mangrum

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Preliminary Eligibility Contentions for U.S. Patent No. 12,268,475

Based on Omni's apparent positions, as best they can be deciphered, as to the scope of asserted claims of U.S. Patent No. 12,268,475, the chart below provides Defendants' current contentions regarding the patent ineligibility of each asserted claim.

This disclosure is not an admission that Defendants concede any claim construction implied or suggested by Omni's apparent positions as to the scope of the patent's claims, nor is it an admission by Defendants that any of their products are covered by or infringe the patent's claims, particularly when they are properly construed and applied. Defendants are not taking any claim construction positions through this disclosure, including whether the preamble is a limitation.

Defendants reserve the right to rely on additional citations or sources of evidence that also may be applicable, or that may become applicable in light of claim construction, changes in Omni's infringement contentions, and/or information obtained during discovery as the case progresses. Defendants further reserve the right to amend or supplement this claim chart at a later date as more fully set forth in the Invalidity and Subject Matter Eligibility Contentions.

The asserted claims 1, 5-8 and 11-13 are drawn to patent-ineligible subject matter under 35 U.S.C. § 101. The asserted claims are generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. And none of the claims provides an "'inventive concept' . . . sufficient to ensure that the patent in practice amounts to *significantly more* than a patent upon the ineligible concept itself." *See Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 573 U.S. 208, 217–18 (2014) (emphasis added).

Claim 1 of the '455 patent is representative.

Claim 1 may be treated as representative for purposes of § 101 because the asserted claims are "substantially similar and linked to the same abstract idea." *See Content Extraction & Transmission LLC v. Wells Fargo Bank, Nat'l Ass'n*, 776 F.3d 1343, 1348–49 (Fed. Cir. 2014). Claim 1, the broadest of the asserted claims, embodies the core inventive concept and encompasses the limitations of all the other asserted claims either explicitly or by implication. It essentially recites a system for collecting, processing, and storing light-based physiological data for analysis. *See* '475 patent at cl. 1.

The other asserted claims fail to add any meaningful limitations for purposes of § 101 and remain directed to the same abstract idea: collecting, processing, and storing light-based data. For example, claim 5 merely narrows claim 1. Claim 5 recites that the system includes a "processor" coupled to a "non-transitory computer readable medium," and that the processor is configured to "make decisions" using artificial intelligence, but provides no inventive concept or unconventional components to the claimed system of claim 1. *Id.* at cl. 5. Claim 6 and 7 also recites additional limitations including the number of light emitting diodes, arrangement of detectors

along an arc, and configuration to communicate with a smart phone or tablet, but provide no inventive concept or unconventional components to the claimed system of claim 1. Claim 8 largely restates claim 1, *id.*, at cl. 8, and claims 11–13 narrow claim 8 to add minor limitations, including (i) a wavelength range for the "output light" (700 to 2500 nm), *id.* at cl. 11; (ii) that the measured physiological parameter is a "blood constituent or blood flow of the user," *id.* at cl. 12, and (iii) that the processor is further configured to modulate the light source with a modulation frequency, *id.* at cl. 13. None of those limitations provides an inventive concept or recites an unconventional component.

Because none of the limitations outside of Claim 1 are meaningful for purposes of § 101, none requires separate evaluation. *See, e.g., Content Extraction*, 776 F.3d at 1348–49 (explaining that "well-known, routine, and conventional" features are not meaningful limitations because they cannot provide an "inventive concept"); *Cleveland Clinic Found. v. True Health Diagnostics LLC*, 859 F.3d 1352, 1360 (Fed. Cir. 2017) (holding that the recitation of "known methods of detecting" physiological parameters does not provide an inventive concept); *Clear with Computers, LLC v. Dick's Sporting Goods, Inc.*, 21 F. Supp. 3d 758, 763 (E.D. Tex. 2014) ("Nor is a claim meaningfully limited if it contains only insignificant or token pre- or post-solution activity—such as identifying a relevant audience, a category of use, field of use, or technological environment." (cleaned up)).

Accordingly, Claim 1 may be treated as representative for purposes of § 101. *See PPS Data, LLC v. Jack Henry & Assocs., Inc.*, 404 F. Supp. 3d 1021, 1031–32 (E.D. Tex. 2019) (explaining that a defendant can make out a "prima facie case demonstrating representativeness" through "an analysis tethered to the claim language" showing "that there are no legally relevant distinctions between the claim identified as representative and the remaining asserted claims").

***Alice* Step One: Claim 1 (and thus all asserted claims) is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis.**

The *Alice* test requires the Court to look at the "focus of the claimed advance over the prior art to determine if the claim's character as a whole is directed to excluded subject matter." *Affinity Labs of Tex., LLC v. DIRECTV, LLC*, 838 F.3d 1253, 1257 (Fed. Cir. 2016) (cleaned up). The '475 patent alleges an unmet need for "non-invasive monitoring of blood constituents or blood analytes," including glucose and HbA1c, with "adequate sensitivity and selectivity, along with repeatability of the results." *See* '475 patent at 3:18–19, 15:20–21. The '475 patent alleged that, readings from near-infrared spectroscopy, a common method of non-invasive blood monitoring, are often inaccurate due to either a weak signal or interference (noise). *Id.* at 3:11–17. The '475 patent purports to address this shortcoming in two ways: (1) by adjusting the light intensity to increase signal levels for purposes of data collection and (2) by using "mathematical modeling and signal processing methodologies" to reduce interference. *Id.* at 3:37–51, 20:65–21:13. This purported "advance" relates to the abstract idea of collecting and processing light-based physiological data for analysis through a series of abstract steps, namely generating and processing optical light signals.

Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. *Id.* at cl. 1; *Content Extraction*, 776 F.3d at 1347 ("The concept of data collection [and] recognition … is undisputedly well-known."); *Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1353–54 (Fed. Cir. 2016) ("information collection and analysis" are "abstract processes"); *Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 788 F.3d 1371, 1376 (Fed. Cir. 2015) (holding that claims "generally directed to detecting the presence of a naturally occurring thing" are abstract). The claimed system is configured to first collect a property of a physiological parameter by observing its relationship to light—specifically, it measures the correlation between two naturally occurring phenomena, an abstract natural law. '475 patent, cl. 7; *see also Cleveland Clinic Found. v. True Health Diagnostics LLC*, 859 F.3d 1352, 1361 (Fed. Cir. 2017) (holding claims directed to measuring the relationship between naturally occurring phenomena are directed to an abstract natural law). The system then supposedly improves signal-to-noise ratio by providing a stronger signal ("increasing light intensity") and using basic, conventional math to filter out noise ("comparing the first signal and the second signal"). '475 patent, cl. 1.

This amounts to nothing more than a compilation of abstract ideas. Indeed, the patent does not purport to have invented or improved signal generation or processing. The "use of a mathematical calculation, even one that yields different or better results, does not render patent eligible subject matter." *In re Bd. of Trs. of Leland Stanford Junior Univ.*, 991 F.3d 1245, 1251 (Fed. Cir. 2021). Nor does "[a]dding one abstract idea (math) to another abstract idea" (measuring natural phenomena). *See RecogniCorp, LLC v. Nintendo Co., Ltd.*, 855 F.3d 1322, 1327 (Fed. Cir. 2017). And although Claim 1 requires concrete, tangible components such as a "light source," "biosensors," "lenses," a "detection system," "detectors," and an "analog to digital converter," "the specification makes clear that the recited physical components merely provide a generic environment in which to carry out the abstract idea" of collecting and processing natural phenomena. *See In re TLI Commc'ns LLC Pat. Litig.*, 823 F.3d 607, 611–12 (Fed. Cir. 2016) (finding claims "directed to the use of conventional or generic technology in a nascent but well-known environment" to be abstract). In fact, the specification provides no technical details for the tangible components, but instead describes them—both individually and collectively—in generic and functional terms. *See infra*, *Alice* Step Two. So instead of providing any new or useful system, Claim 1 recites the abstract idea of collecting and processing light-based physiological data for analysis. *See In re Gopalan*, 809 F. App'x 942, 945–46 (Fed. Cir. 2020).

***Alice* Step Two: Claim 1 does not contain a transformative inventive concept.**

Claim 1 likewise contains no inventive concept that transforms the abstract idea into patent-eligible subject matter.

The claimed elements, individually and as an ordered combination, recite only a "handful of generic computer components configured to implement" the abstract idea. *See Alice*, 573 U.S. at 226. The claimed light source (e.g., LEDs), biosensors, lenses, detection system, detectors, and analog-to-digital converters are conventional and perform their ordinary, expected functions. The claimed enhancement of signal-to-noise ratio by increasing light intensity or by subtracting background signal is a well-known technique

in signal processing and does not constitute an unconventional arrangement or improvement in technology. Ex. G1-G14; Cover Pleading at § III.G.

The specification confirms that each of the result-oriented claim elements can be carried out by generic hardware operating in a conventional fashion. *See, e.g.*, '475 patent at 7:57–61 ("[O]ptical instruments tend to be portable and more cost effective as compared to other instrumentation that is conventionally used for medical diagnosis. This can be particularly true, if the mature technologies for telecommunications and fiber optics are exploited."); *id.* at 16:25–31 ("In one embodiment, the 'optical light' and/or 'optical beam' and/or 'light beam' may originate from a fiber, a fiber laser, a laser, a light emitting diodes, a lamp, a pump laser, or a light source."); *id.* at 6:54–61 ("In particular embodiments, the detection system may be a dispersive spectrometer, a Fourier transform infrared spectrometer, or a hyper-spectral imaging detector or camera."); *id.* at 35:32–36:3 (reciting generic technologies, including "a transmitter," "a processor," "wireless technologies such as Bluetooth," and recognizing that "other devices could be used and are included in the scope of this disclosure"). In other words, the claim does not offer any specific technological solution to improve the functioning of the sensors or hardware, but merely applies conventional signal-processing techniques to achieve the functional goal of enhanced signal quality, without any improvement to the claimed "wearable device," "light source," "semiconductor diodes," "lenses," "detection system," "detectors," or "analog to digital converter."

At bottom, Claim 1 recites functional, result-oriented language that fails to transform the claimed abstract idea beyond routine and conventional tasks. *See, e.g., Intell. Ventures I LLC v. Cap. Fin. Corp.*, 850 F.3d 1332, 1342 (Fed. Cir. 2017) ("[T]he claim language here provides only a result-oriented solution, with insufficient detail for how a computer accomplishes it. Our law demands more.").

'475 Patent – Claim 1	**Subject Matter Eligibility Contentions**
1[pre]. An apparatus adapted to be worn by a user comprising:	Claim 1 of the '475 is directed to an abstract idea. And it contains no inventive concept sufficient to ensure that the claim amounts to significantly more than the patent-ineligible concept itself. Claim 1 of the '475 patent is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. *See, e.g.*, *AI Visualize, Inc. v. Nuance Commc'ns, Inc.*, 97 F.4th 1371, 1378–79 (Fed. Cir. 2024); *In re TLI*

	Commc'ns LLC Patent Litig., 823 F.3d 607, 611–13 (Fed. Cir. 2016); *Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1353–54 (Fed. Cir. 2016); *Intell. Ventures I LLC v. Cap. Fin. Corp.*, 850 F.3d 1332, 1340–41 (Fed. Cir. 2017); *Univ. of Fla. Rsch. Found., Inc. v. Gen. Elec. Co.*, 916 F.3d 1363, 1367–68 (Fed. Cir. 2019); *CardioNet, LLC v. InfoBionic, Inc.*, 816 F. App'x 471, 475–77 (Fed. Cir. 2020); *In re Bd. of Trs. Of Leland Stanford Junior Univ.*, 991 F.3d 1245, 1250–51 (Fed. Cir. 2021); *Audio Evolution Diagnostics, Inc. v. United States*, 160 Fed. Cl. 513, 526–27 (2022), *aff'd*, No. 2023-1096, 2024 WL 2143376 (Fed. Cir. May 14, 2024); *Braemar Mfg., LLC v. ScottCare Corp.*, 816 F. App'x 465, 470 (Fed. Cir. 2020); *Philips N. Am. LLC v. Fitbit LLC*, 626 F. Supp. 3d 292, 306–09 (D. Mass. 2022); *Two-Way Media Ltd. v. Comcast Cable Commc'ns, LLC*, 874 F.3d 1329, 1337–39 (Fed. Cir. 2017); *In re Gopalan*, 809 F. App'x 942, 945–46 (Fed. Cir. 2020); *Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 788 F.3d 1371, 1376 (Fed. Cir. 2015); *Cleveland Clinic Found. v. True Health Diagnostics LLC*, 859 F.3d 1352, 1361 (Fed. Cir. 2017); *RecogniCorp, LLC v. Nintendo Co., Ltd.*, 855 F.3d 1322, 1327 (Fed. Cir. 2017); *Chamberlain Grp., Inc. v. Techtronic Indus. Co.*, 935 F.3d 1341, 1346–48 (Fed. Cir. 2019); *Content Extraction & Transmission LLC v. Wells Fargo Bank, Nat'l Ass'n*, 776 F.3d 1343, 1347 (Fed. Cir. 2014). Claim 1 also contains no inventive concept. At the time of the alleged invention, the elements of Claim 1 were well-understood, routine, and/or conventional in wearable diagnostics devices. Claim 1 employs well-known components or functionality, as shown for example in Defendants' invalidity contentions, which is not enough to impart patent eligibility. *See,*

	e.g., Ex. G1-G14 at all disclosures for [1pre]; Cover Pleading at § III.G.
1[a]. one or more biosensors adapted to be placed on the user,	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1a]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1b]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1c]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14

	at all disclosures for [1d]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1e]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[f]. wherein the detection system is configured to be synchronized to the light source,	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1f]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1g]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis.

	At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1h]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1i]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1j]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1k]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis.

	At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1l]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	As explained above, Claim 1 is generally directed to the abstract idea of collecting and processing light-based physiological data for analysis. At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. G1-G14 at all disclosures for [1m]; Cover Pleading at § III.G; '475 patent at 2:66–8:35 (describing prior art as background).

U.S. Pat. No. 12,268,475 in view of U.S. Pat. No. 9,241,676 to Daniel Lisogurski ("Lisogurski")

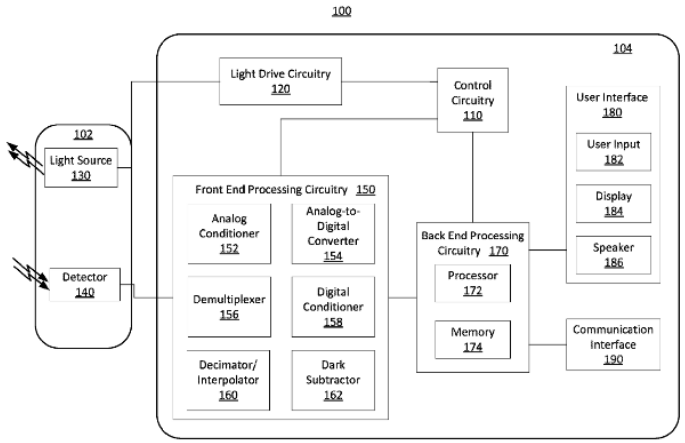
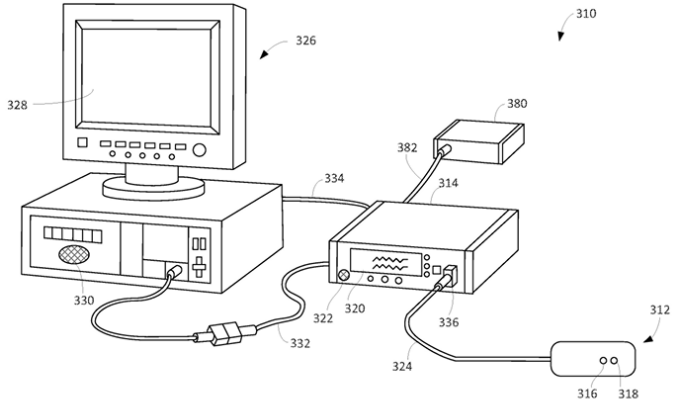
As described in detail below, Lisogurski (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Lisogurski. The cited portions of Lisogurski are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Lisogurski. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Lisogurski "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Lisogurski does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Lisogurski (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Lisogurski anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

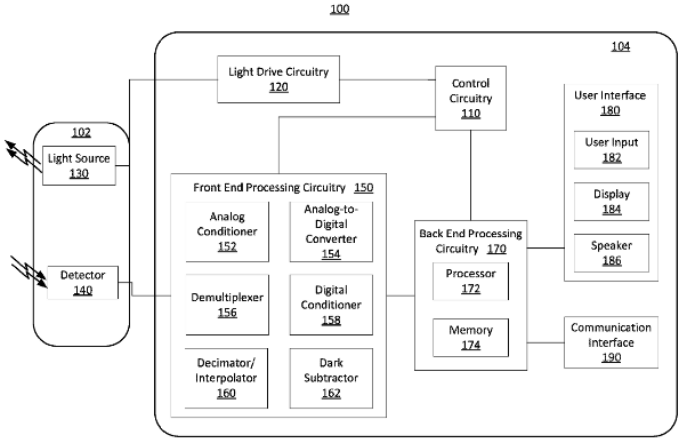
’475 Patent	Lisogurski
Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lisogurski discloses or renders obvious an apparatus adapted to be worn by a user. **An oximeter may include a light sensor that is placed at a site on a patient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot**. The oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically understood to be optimal for pulse oximetry serve as suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional suitable sensor locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patient's thigh to monitor femoral artery pulsatile flow, the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. Suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. In all suitable locations, for example, the oximeter may measure the intensity of light that is received at the light sensor as a function of time. The oximeter may also include sensors at multiple locations. A signal representing light intensity versus time or a mathematical manipulation of this signal (e.g., a scaled version thereof; a logarithm taken thereof, a scaled version of a logarithm taken thereof; a derivative taken thereof, a difference taken thereof, etc.) may be referred to as the photoplethysmograph (PPG) signal. In addition, the term “PPG signal,” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue), a transmission signal (i.e., representing the amount of light received from the tissue), any suitable mathematical manipulation thereof; or any combination thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs. Lisogurski at 4:6-41 FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter.

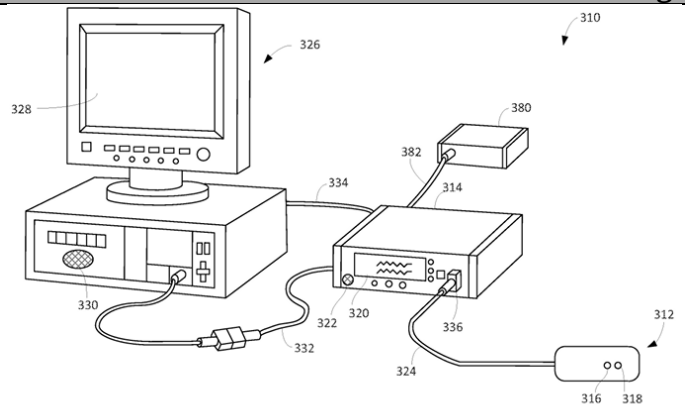
’475 Patent	Lisogurski
	Lisogurski at 10:42-47 FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. System 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two different locations on a subject's body. Lisogurski at 17:30-53

’475 Patent	Lisogurski
	 FIG. 1  FIG. 3 Lisogurski at Figs.1 & 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	Lisogurski discloses or renders obvious one or more biosensors adapted to be placed on the user. **An oximeter may include a light sensor that is placed at a site on a patient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot**. The oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically understood to be optimal for pulse oximetry serve as suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional suitable sensor locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patient's thigh to monitor femoral artery pulsatile flow, the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. Suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. In all suitable locations, for example, the oximeter may measure the intensity of light that is received at the light sensor as a function of time. The oximeter may also include sensors at multiple locations. A signal representing light intensity versus time or a mathematical manipulation of this signal (e.g., a scaled version thereof; a logarithm taken thereof, a scaled version of a logarithm taken thereof; a derivative taken thereof, a difference taken thereof, etc.) may be referred to as the photoplethysmograph (PPG) signal. In addition, the term “PPG signal,” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue), a transmission signal (i.e., representing the amount of light received from the tissue), any suitable mathematical manipulation thereof; or any combination thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs. Lisogurski at 4:6-41 FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104

’475 Patent	Lisogurski
	for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Lisogurski at 10:42-47 Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Lisogurski at 10:48-64 Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Lisogurski at 11:33-49

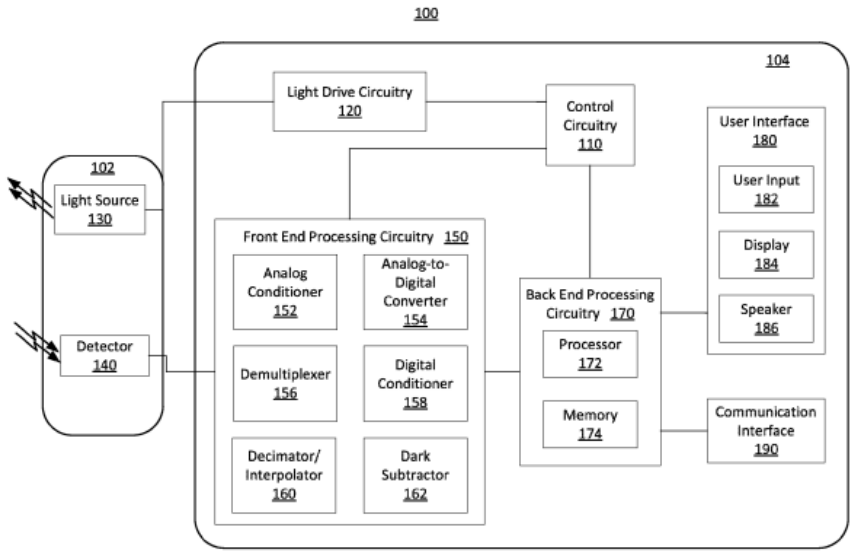
’475 Patent	Lisogurski
	FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. **In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue**. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. **In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. System 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312**. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two different locations on a subject's body. Lisogurski at 17:30-53  FIG. 1

’475 Patent	Lisogurski
	 FIG. 3 Lisogurski at Figs.1 & 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate	Lisogurski discloses or renders obvious wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. **A physiological monitoring system may use photonic signals to determine physiological parameters**. The system may vary parameters of a light drive signal used to generate the photonic signal from a light source such that power consumption is reduced or optimized. Parameters may include light intensity, firing rate, duty cycle, other suitable parameters, or any combination thereof. In some embodiments, the system may use information from a first light source to generate a light drive signal for a second light source. **In some embodiments, the system may vary parameters in a way**

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monitoring and a blood flow measurement;	**substantially synchronous with physiological pulses, for example, cardiac pulses. In some embodiments, the system may vary parameters in response to an external trigger**. Lisogurski at [Abstract] **Systems and methods are provided for optimizing power consumption in an optical physiological monitoring system**. The system may vary light drive signal parameters to reduce power consumption or vary power use. **The system may vary parameters in a technique correlated to cardiac pulse cycles**. In some embodiments, reducing power consumption may allow for increased battery life in portable systems or increased portability. In some embodiments, varying light output during a cardiac cycle may reduce heating effects of the emitters. **Parameters that may be varied include light intensity, firing rate, duty cycle, other suitable parameters, or any combination thereof. The generated signals may be used to determined physiological parameters such as blood oxygen saturation, hemoglobin, blood pressure, pulse rate, other suitable parameters, or any combination thereof**. In some embodiments, the system may use information from a first light source to control a second light source. The system may generate a first light drive signal for activating a first light source to emit a first photonic signal. The first light source and second light source may each include one or more emitters. The system may receive a light signal attenuated by the subject, wherein the light signal comprises a component corresponding to the first photonic signal. The system may analyze the component of the light signal to determine when to activate a second light source. The system may generate a second light drive signal, based on the analysis of the first component, for activating the second light source to emit one or more second photonic signals. The system may determine one or more physiological parameters based on the light signals. In some embodiments, the system may vary a light drive signal in a way substantially synchronous with physiological pulses, for example, cardiac pulses. The system may generate a light drive signal for activating a light source to emit a photonic signal, wherein at least one parameter of the light drive signal is configured to vary substantially synchronously with physiological pulses of the subject. The system may receive a light signal attenuated by the subject, wherein the signal comprises a component corresponding to the emitted photonic signal. The system may determine physiological parameters based on the signal. Lisogurski at 1:10-52

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	The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. The system may include, for example, a light source and a photosensitive detector. Providing a light drive signal to the light source may account for a significant portion of the system's total power consumption. Thus, it may be desirable to reduce the power consumption of the light source, while still enabling high quality physiological parameters to be determined. The system may reduce the power consumption by modulating parameters associated with the light drive signal in techniques correlated to the cardiac cycle or other cyclical physiological activity. For example, the system may decrease brightness during a particular portion of the cardiac cycle. It may also be desirable to reduce the power consumption by the light drive signal to reduce heating effects caused by an emitter. An oximeter is a medical device that may determine the oxygen saturation of an analyzed tissue. One common type of oximeter is a pulse oximeter, which may non-invasively measure the oxygen saturation of a patient's blood (as opposed to measuring oxygen saturation directly by analyzing a blood sample taken from the patient). **Pulse oximeters may be included in patient monitoring systems that measure and display various blood flow characteristics including, but not limited to, the oxygen saturation of hemoglobin in arterial blood. Such patient monitoring systems may also measure and display additional physiological parameters, such as a patient's pulse rate and blood pressure**. **An oximeter may include a light sensor that is placed at a site on a patient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot. The oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically understood to be optimal for pulse oximetry serve as suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional suitable sensor locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patient's thigh to monitor femoral artery pulsatile flow, the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. Suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. In all suitable locations, for example, the oximeter may measure the intensity of light that is received at the light sensor as a function of time. The oximeter may also include sensors at multiple locations**. **A signal representing light intensity versus time or a mathematical manipulation of this signal (e.g., a scaled version thereof; a logarithm taken thereof, a scaled version of a logarithm taken thereof; a derivative taken thereof, a difference taken thereof, etc.) may be referred to as the photoplethysmograph (PPG) signal. In addition, the term**

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	“PPG signal,” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue), a transmission signal (i.e., representing the amount of light received from the tissue), any suitable mathematical manipulation thereof; or any combination thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs. In some applications, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Red and infrared (IR) wavelengths may be used because it has been observed that highly oxygenated blood will absorb relatively less red light and more IR light than blood with a lower oxygen saturation. By comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen saturation of hemoglobin in arterial blood. The system may process data to determine physiological parameters using techniques well known in the art. For example, the system may determine blood oxygen saturation using two wavelengths of light and a ratio-of-ratios calculation. The system also may identify pulses and determine pulse amplitude, respiration, blood pressure, other suitable parameters, or any combination thereof, using any suitable calculation techniques. In some embodiments, the system may use information from external sources (e.g., tabulated data, secondary sensor devices) to determine physiological parameters. Lisogurski at 3:43-4:62 In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the ambient light detected by the detector during the “dark” period and then subtract this ambient contribution from the signals received during the first and second “on” periods. In some embodiments, drive cycle modulation may be implemented using time division multiplexing as described above, code division multiplexing, carrier frequency multiplexing, phase division multiplexing, feedback circuitry, DC restoration circuitry, any other suitable technique, or any combination thereof. For example, the system may use frequency division multiplexing in a drive cycle modulation technique. The cardiac cycle modulation may represent a lower frequency envelope function on the higher frequency drive cycle. For

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	example, cardiac cycle modulation may be an envelope on the order of 1 Hz superimposed on a 1 kHz sine wave drive cycle modulation. Lisogurski at 6:7-31  FIG. 1 Lisogurski at Fig. 1 **FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter**. Lisogurski at 10:42-47 Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g.,

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	Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Lisogurski at 10:48-64 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:9-27 Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue at certain oxygen saturations. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. Lisogurski at 12:9-16

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	Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Lisogurski at 12:42-48 FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below. Lisogurski at 12:52-13:6 The conditioned analog signal may be processed by analog-to-digital converter 154, which may convert the conditioned analog signal into a digital signal. Analog-to-digital converter 154 may operate under the control of control circuitry 110. Analog-to-digital converter 154 may use timing control signals from control circuitry 110 to determine when to sample the analog signal. Analog-to-digital converter 154 may be any suitable type of analog-to-digital converter of sufficient resolution to enable a physiological monitor to accurately determine physiological parameters. Demultiplexer 156 may operate on the analog or digital form of the detector signal to separate out different components of the signal. For example, detector current waveform 214 of FIG. 2B includes a Red component, an IR component, and at least one dark component. Demultiplexer 156 may operate on detector current waveform 214 of FIG. 2B to generate a Red signal, an IR signal, a first dark signal (e.g.,

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	corresponding to the dark component that occurs immediately after the Red component), and a second dark signal (e.g., corresponding to the dark component that occurs immediately after the IR component). Demultiplexer 156 may operate under the control of control circuitry 110. For example, demultiplexer 156 may use timing control signals from control circuitry 110 to identify and separate out the different components of the detector signal. Lisogurski at 13:21-45 Dark subtractor 162 may operate on the digital signal. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red “on” period 202 may be adjusted by determining the amount of dark signal during the “off” period 220 preceding red “on” period 202. The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red “on” period 202. Alternatively, the “off” period 220 after red “on” period 202 may be used to correct red “on” period 202 rather than the “off” period 220 preceding it. Additionally, an average of the “off” periods 220 before and after red “on” period 202 may be used. Lisogurski at 13:60-14:10 However, if the contribution of ambient light is large relative to the contribution of light from a light source, the total analog gain applied to the detection current may need to be reduced to avoid saturating analog-to-digital converter 154. When the analog gain is reduced, the portion of the signal corresponding to the light source may map to a smaller number of analog-to-digital conversion bits. Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Back end processing circuitry 170 may include processor 172 and memory 174. Processor 172 may be adapted to execute software, which may include an operating system and one or more applications, as

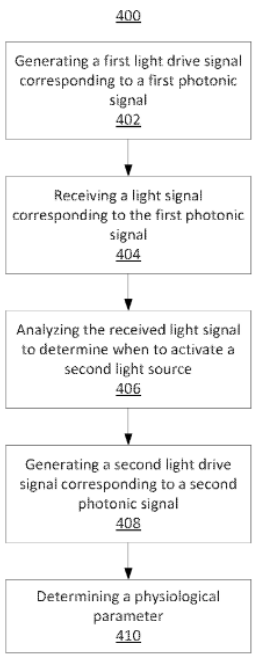
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	part of performing the functions described herein. Processor 172 may receive and process physiological signals received from front end processing circuitry 150. For example, processor 172 may determine one or more physiological parameters based on the received physiological signals. Lisogurski at 14:40-64 Additionally, display 184 may display, for example, an estimate of a subject's blood oxygen saturation generated by monitor 104 (referred to as an “SpO2” measurement), pulse rate information, respiration rate information, blood pressure, any other parameters, and any combination thereof. Lisogurski at 15:30-35 Region 256 of plot 250 indicates an interval of the timing diagram where both red light modulation 252 and IR light modulation 254 are in an “on” portion of the cardiac cycle modulation. Plot 270 shows an illustrative portion of region 256, where the system is employing a cardiac cycle modulation in addition to the drive cycle modulation. Plot 250 may include a drive cycle modulation technique with a period of time interval 272. The time scale of plot 270 may be significantly shorter than the time scale of plot 250, such that time interval 272 is significantly shorter than time interval 260. For example, time interval 260 (i.e., the period of the cardiac cycle modulation) may be on the order of 1 second, while time interval 272 (i.e., the period of the drive cycle modulation) may be on the order of 1 ms. Time interval 272 may include a sequence of red “on” portion 274, a first “off” portion 276, IR “on” portion 278, and a second “off” portion 280. The first “off” portion 276 and second “off” portion 280 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 274 and IR “on” period 278. Lisogurski at 16:33-54 The system may subtract the background or dark level from the levels received during red “on” portion 274 and IR “on” period 278. Lisogurski at 17:8-10

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	FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. System 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two different locations on a subject's body. In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and acoustic detection received from one or more sensor units such as sensor unit 312. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxygenated, and/or total), any other suitable physiological parameters, or any combination thereof. In some embodiments, calculations may be performed on the sensor units or an intermediate device and the result of the calculations may be passed to monitor 314. Further, monitor 314 may include display 320 configured to display the physiological parameters or other information about the system. In the embodiment shown, monitor 314 may also include a speaker 322 to provide an audible sound that may be used in various other embodiments, such as for example, sounding an audible alarm in the event that a subject's physiological parameters are not within a predefined normal range. In some embodiments, the system 310 includes a stand-alone monitor in communication with the monitor 314 via a cable or a wireless network link. In some embodiments, monitor 314 may be implemented as monitor 104 of FIG. 1. Lisogurski at 17:30-18:15

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	Multi-parameter physiological monitor 326 may be configured to calculate physiological parameters and to provide a display 328 for information from monitor 314 and from other medical monitoring devices or systems (not shown). Lisogurski at 18:49-53 In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. In some embodiments, any of the processing components and/or circuits, or portions thereof, of FIGS. 1 and 3 may be referred to collectively as processing equipment. For example, processing equipment may be configured to generate light drive signals, amplify, filter, sample and digitize detector signals, and calculate physiological information from the digitized signal. In some embodiments, all or some of the components of the processing equipment may be referred to as a processing module. **FIG. 4 is flow diagram 400 showing illustrative steps for determining a physiological parameter in accordance with some embodiments of the present disclosur**e. In some embodiments, the system may emit a photonic signal from a first light source and use information from the related attenuated signal to generate a light drive signal for a second light source. In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. **In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulatio**n. **For example, the first light drive signal may be configured to activate one LED to emit a photonic signal and not activate other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated.** In step 404, the system may receive a light signal. The light may be received using a sensor, for example, detector 140 of FIG. 1 or detector 318 of FIG. 3. The light signal may be attenuated by the subject. The received light signal may in part include light from the first photonic signal. For example, the system

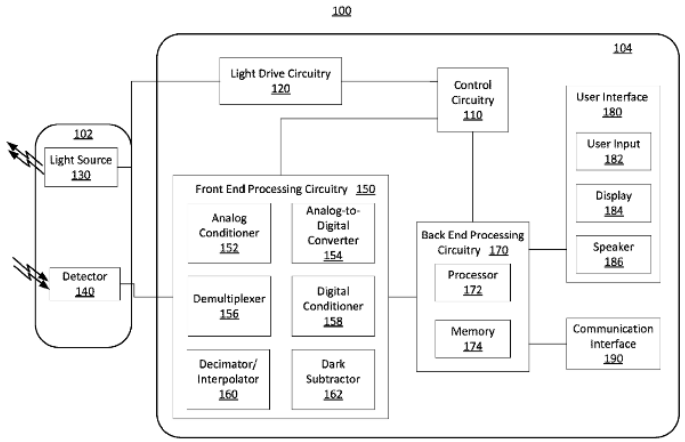
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	may emit light that is reflected by the subject or transmitted through the subject. The interaction of the emitted light with the subject may cause the light to become attenuated. In some embodiments, the attenuation of the light may depend on the wavelength of the light and the tissue with which the light interacts. For example, particular wavelengths of light may be attenuated more strongly by oxyhemoglobin than other wavelengths. In some embodiments, the system may amplify the received signal using front end processor circuitry. In some embodiments, the gain may be modulated using a technique correlated to the cardiac cycle modulation. The gain of the amplifier may be adjusted based on the emitted light brightness, historical information related to the brightness of prior received attenuated signals, other suitable information, or any combination thereof, so that the amplified signal matches the range of the analog-to-digital converter and thus increases resolution. In some embodiments, the system may account for the gain using hardware, software, or any combination thereof, such that the original intensity information is retained. In step 406, the system may analyze the received light signal to determine when to activate a second light source and/or parameters of a second photonic signal In some embodiments, the second light source may include one or more emitters. In some embodiments, the system may identify peaks, valleys, inflection points, slope changes, fiducial points, other suitable elements, or any combination thereof in the received light source. In some embodiments, the system may use information determined from analyzing the first light source in addition to other information. **Other information may include, for example, historical analysis of prior cardiac cycles and information from external sensors. For example, the system may determine an average pulse period from a number of prior pulse cycles**. Statistical information such as the standard deviation may also be calculated to in part determine a confidence parameter for the historical information. In some embodiments, the system may use a respiration rate. For example, the system may determine a respiration rate from an external sensor and use information from the respiration rate to determine a modulation technique. In some embodiments, the cardiac cycle modulation applied to the second light drive signal may be varied based on the historical and statistical information. In some embodiments, the system may determine to turn on a second light source with a time offset to the element of interest in the cardiac cycle. For example, the system may turn on the second light source a certain number of milliseconds prior to the peak (or expected peak) of a pulse signal. In a further example, the system may wait a certain number of milliseconds following a peak in an ECG signal. In some embodiments, the time offsets may be adjusted based on prior signal analysis, adjusted by user input, adjusted by predetermined values, adjusted by any other suitable technique, or any combination thereof. In some embodiments, parameters of the second photonic signal, for example duty cycle, decimation ratio, and brightness, may be determined based on analysis of the received light signal.

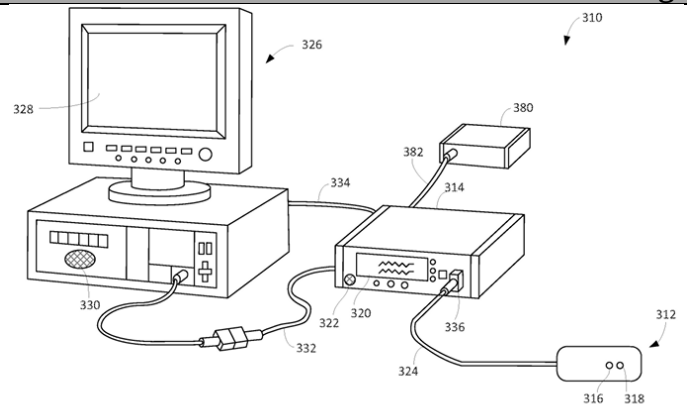
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	In step 408, the system may generate a second light drive signal. The second light drive signal may be configured to activate a second light source or a different emitter from the first light source to emit a second photonic signal. For example, in a cardiac cycle modulation where a first light source remains on at a constant level (e.g., in a drive cycle modulation) and a second light source is turned on and off to optimize power consumption, the second light drive signal may cause a second light source to emit light at a particular time or times in the cardiac cycle. Light from the second photonic signal may be attenuated by the subject and received by a sensor. In some embodiments, the system may adjust the second light drive signal based on historical data. For example, the system may use information from prior pulse cycles to determine an optimal emitter brightness. **In step 410, the system may determine a physiological parameter using information from the attenuated photonic signals. The physiological parameter may be determined using any suitable hardware technique, software technique, or combination thereof**. In some embodiments, processing equipment remote to the system may be used to determine physiological parameters. The system may display the determined physiological parameter using a local display (e.g., display 320 of FIG. 3 or display 328 of FIG. 3), display them on a remote display, publish the data to a server or website, make the parameters available to a user by any other suitable technique, or any combination thereof. Lisogurski at 19:1-20:60

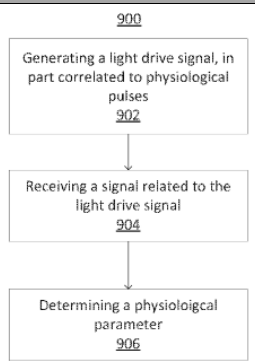
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	 FIG. 4 Lisogurski at Fig. 4 **It will be understood that selection and/or switching of the first and second light sources may depend on the blood oxygen saturation as well as additional physiological parameters and system parameters. For example, a red wavelength LED may consume more power than an IR LED, and thus it may be desired to use the lowest power consuming technique possible. In some embodiments, the system may select the light source capable of detecting the greatest pulsatile amplitude per unit of power consumed. In some other embodiments, the system may select the**

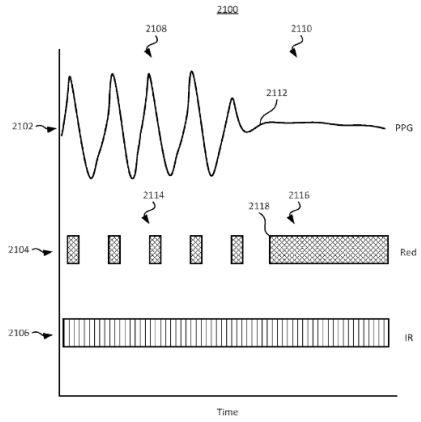
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	light source capable of detecting the greatest pulsatile amplitude. It will also be understood that in some embodiments, a decreasing blood oxygen saturation or other physiological parameter may result in the system not using a cardiac cycle modulation technique in order to attain the highest possible quality physiological information. This will be discussed below, for example with relation to FIG. 21. **FIG. 9 is flow diagram 900 showing illustrative steps for determining a physiological parameter in accordance with some embodiments of the present disclosure. In some embodiments, the system may emit a photonic signal correlated to physiological pulses from a light source, and use information from the related attenuated signal to determine physiological parameters. In some embodiments, varying parameters of the light drive signal may reduce, optimize, or otherwise suitably alter the power consumption of the system.** **In step 902, the system may generate a light drive signal, in part correlated to physiological** pulses. The system may generate a light drive signal used by a light source to emit a photonic signal. The light source may be one or more emitters of one or more wavelengths, and they may emit one or more photonic signals. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR LED. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. **The system may generate the light drive signal such that a parameter of the emitted one or more photonic signals varies substantially synchronously with physiological pulses of the subject. For example, the system may generate a light drive signal that varies with a period the same as or closely related to the period of the cardiac cycle, thus generating a cardiac cycle modulation**. The system may vary parameters related to the light drive signal including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof. In some embodiments, the system may use a cardiac cycle modulation that spans several cardiac cycles (e.g., emitting light from a light source during the first one of every five cycles). In some embodiments, the system may generate a light drive signal that modulates parameters of more than one light source using more than one modulation technique. It will be understood that the system may apply this cardiac cycle modulation to the light drive signal in addition to a drive cycle modulation, as illustrated in FIG. 2C, and conventional servo algorithms.

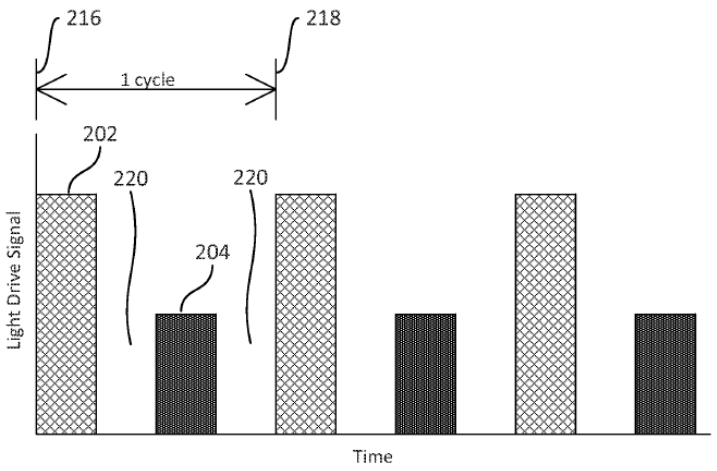
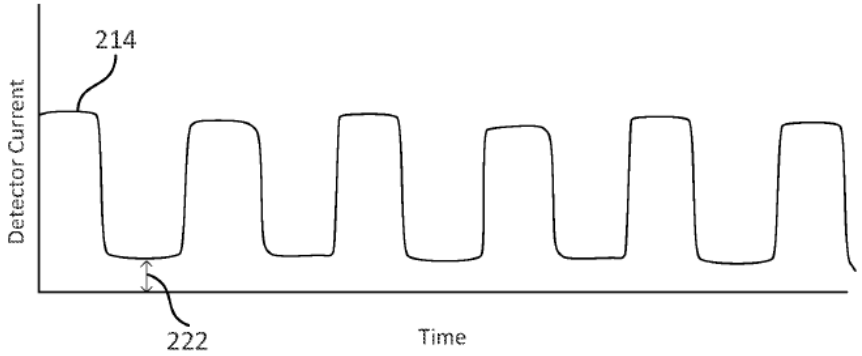
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	In some embodiments, physiological pulses may be cardiac pulses, respiratory pulses, muscular pulses, any other suitable pulses, or any combination thereof. Where physiological pulses are respiratory pulses, they may relate to respiration rate, inspiration, expiration, ventilator parameters, changes in a respiratory pressure signals, any other suitable parameter, or any combination thereof. In some embodiments, particular segments of a respiratory cycle may provide an increased signal to noise ratio, increased signal strength, increased physiological parameter accuracy, increased physiological parameter precision, any other suitable parameters, or any combination thereof. In some embodiments, respiration may cause variations in photoplethysmography data, and thus it may be desired to correlate a modulation technique with respiration variations or both respiration variations and cardiac pulses. **In some embodiments, the system may use information to determine the cardiac cycle modulation. Information may include, for example, historical analysis of prior cardiac cycles and information from external sensors. For example, the system may determine an average pulse period from a number of prior pulse cycles. Statistical information such as the standard deviation may also be calculated to in part determine a confidence parameter for the historical information. In some embodiments, the cardiac cycle modulation applied to the light drive signal may be varied based on the historical and statistical information**. **In step 904, the system may receive a light signal. The light may be received using a sensor, for example, detector 140 of FIG. 1 or detector 318 of FIG. 3. The light signal may be attenuated by the subject. The received light signal may in part include light from the photonic signal. For example, the system may emit light that is reflected by the subject or transmitted through the subject. Interactions of the emitted light with the subject may cause the light to become attenuated. In some embodiments, the attenuation of the light may depend on the wavelength of the light and the tissue with which the light interacts. For example, particular wavelengths of light may be attenuated more strongly by oxyhemoglobin than other wavelengths. In some embodiments, the system may amplify the received signal using front end processor circuitry.** The gain of the amplifier may be adjusted based on the emitted light brightness, historical information related to the brightness of prior received attenuated signals, other suitable information, or any combination thereof, so that the amplified signal matches the range of the analog-to-digital converter and thus increases resolution. In some embodiments, the system may account for the gain using hardware, software, or any combination thereof, such that the original intensity information is retained. **In step 906, the system may determine a physiological parameter using information from the attenuated photonic signals**. The physiological parameter may be determined using any suitable

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	hardware technique, software technique, or combination thereof. In some embodiments, processing equipment remote to the system may be used to determine physiological parameters. The system may display the determined physiological parameter using a local display (e.g., display 320 of FIG. 3 or display 328 of FIG. 3), display them on a remote display, publish the data to a server or website, make the parameters available to a user by any other suitable technique, or any combination thereof. Lisogurski at 25:6-26:60  FIG. 1

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	 FIG. 3 Lisogurski at Fig.1 & 3

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	 FIG. 9

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	 FIG. 21 Lisogurski at Figs. 9 & 21

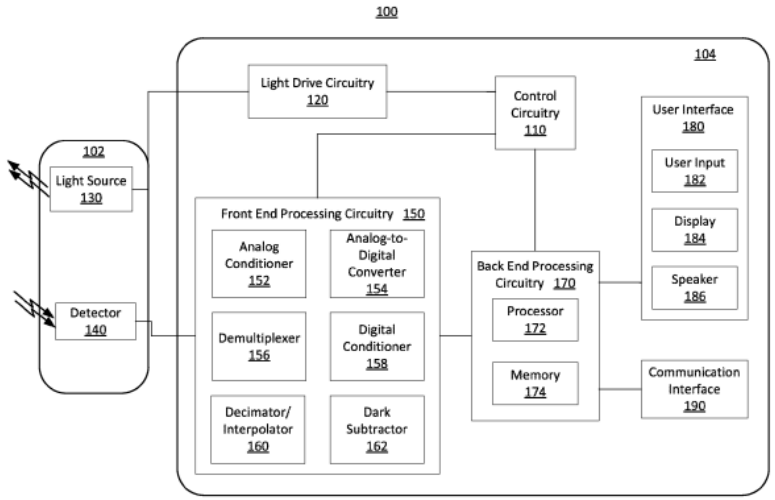
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	 FIG. 2A Lisogurski at Fig. 2A  FIG. 2B Lisogurski at Fig. 2B

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	Lisogurski discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. **In some embodiments, the system may use information from a first light source to control a second light source. The system may generate a first light drive signal for activating a first light source to emit a first photonic signal. The first light source and second light source may each include one or more emitters. The system may receive a light signal attenuated by the subject, wherein the light signal comprises a component corresponding to the first photonic signal. The system may analyze the component of the light signal to determine when to activate a second light source. The system may generate a second light drive signal, based on the analysis of the first component, for activating the second light source to emit one or more second photonic signals. The system may determine one or more physiological parameters based on the light signals**. Lisogurski at 1:26-41 The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. The system may include, for example, a light source and a photosensitive detector. Providing a light drive signal to the light source may account for a significant portion of the system's total power consumption. Thus, it may be desirable to reduce the power consumption of the light source, while still enabling high quality physiological parameters to be determined. The system may reduce the power consumption by modulating parameters associated with the light drive signal in techniques correlated to the cardiac cycle or other cyclical physiological activity. For example, the

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	system may decrease brightness during a particular portion of the cardiac cycle. It may also be desirable to reduce the power consumption by the light drive signal to reduce heating effects caused by an emitter. Lisogurski at 3:43-60 In some applications, **the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration.** Lisogurski at 4:42-45 In some embodiments, it may be desirable to implement techniques to optimize power consumption in an oximeter or other system. For example, in a battery powered system, reducing the power requirements may allow for smaller devices, longer life, or both. In some embodiments, powering the light source may include a large amount of the power load a device may experience. In some embodiments, variation of parameters in the light drive signal may enable a particular amount of power to be used more efficiently. For example, the brightness of a light source may be decreased during a less important period and increased during a more important period. In some embodiments, parameter variation may reduce the impact of heating effects caused by a light source on a subject. Techniques to vary the amount of time a light source is turned on, to vary the brightness of the light source, other techniques, or any combination thereof, may be employed to modify power consumption. **In some embodiments, the brightness of one of more light sources may be modulated in a technique that is related to the cardiac cycle.** The cardiac cycle is the substantially periodic repetition of events that occur, for example, during heartbeats. The cardiac cycle may include a systole period and diastole period. The cardiac cycle may include pressure changes in the ventricles, pressure changes in the atria, volume changes in the ventricles, volume changes in the atria, opening and closing of heart valves, heart sounds, and other cyclic events. In some embodiments, the heart may enter a non-periodic state, for example, in certain types ofarrhythmia and fibrillation. Lisogurski at 4:63-5:24

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	In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a "dark" period, followed by a second light source, followed by a "dark" period. The system may measure the ambient light detected by the detector during the "dark" period and then subtract this ambient contribution from the signals received during the first and second "on" periods. In some embodiments, drive cycle modulation may be implemented using time division multiplexing as described above, code division multiplexing, carrier frequency multiplexing, phase division multiplexing, feedback circuitry, DC restoration circuitry, any other suitable technique, or any combination thereof. For example, the system may use frequency division multiplexing in a drive cycle modulation technique. The cardiac cycle modulation may represent a lower frequency envelope function on the higher frequency drive cycle. For example, cardiac cycle modulation may be an envelope on the order of 1 Hz superimposed on a 1 kHz sine wave drive cycle modulation. In some embodiments, the system may use various cardiac cycle modulation schemes to adjust the brightness of a light source controlled by the light drive signal used in determining physiological parameters. The system may modulate the brightness of the light source using a periodic waveform, for example, a sinusoidal or triangle wave. The period of the waveform may be substantially related to the cardiac pulse rate, for example, in a one-to-one relationship, a two-to-one relationship, any other suitable relationship, or any suitable combination thereof. The system may align the peak of the modulated light drive signal with a particular point in the cardiac cycle to improve the quality of the determined physiological parameter, for example, it may be aligned with the diastolic period, the systolic period, the dicrotic notch, any other suitable point, or any combination thereof. In some embodiments, the system may modulate the light drive signal with a square wave function, such that it is at a low brightness level during a first part of the cardiac cycle and a high brightness level during a second part of the cardiac cycle. In some embodiments, the low brightness level may include turning one or more light sources off. Lisogurski at 6:7-52 In some embodiments of cardiac cycle modulation, the system may modulate multiple light sources using a plurality of modulation techniques. **For example, in a system with two light sources, the system may operate a first light source at full or regular brightness, while operating one or more additional**

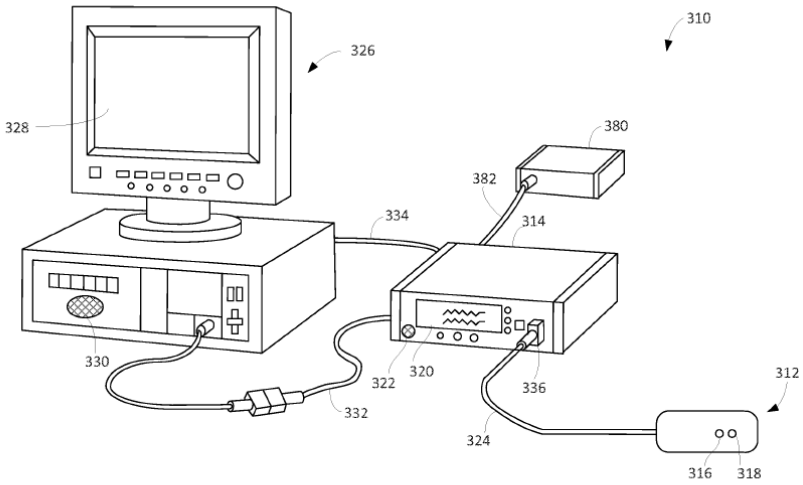
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	light sources in a switched or otherwise modulated mode. In some embodiments, the system may operate a first light source according to a first cardiac cycle modulation technique and a second light source according to a second cardiac modulation technique. The first and second cardiac cycle modulation techniques may be the same, correlated, or unrelated. In some embodiments, the system may use the first light source to determine periods of interest in the cardiac cycle. The system may, according to the periods of interest, **power additional light sources**, alter the modulation of the additional light sources, perform other suitable power optimization techniques, or any combination thereof. In some embodiments, the system may include a first light source (e.g., a light source powered at full or regular brightness) of a type that is a more efficient light source than the one or more additional light sources. **For example, the first light source may be a high efficiency infrared (IR) LED while the one or more additional light sources may be lower efficiency red LEDs or laser diodes. In some embodiments, the first light source may be selected based on efficiency parameters and information from the first light source may be used only to control a second light source. For example, a highly efficient first light source that is not at a wavelength of interest for physiological parameter determination may be used to control one or more second light sources at wavelengths of interest. In this case, the light from the first light source may be used only for controlling the second light source and not for determining physiological parameters**. In some embodiments, the system may use the first light source to determine a pulse rate or identify elements of the cardiac cycle, and the system may use the pulse rate or identified elements in part to control modulation of the light drive signal. Identified elements may include peaks, valleys, troughs, notches, fiducial points, other suitable elements, or any combination thereof. Fiducial points may be related to the zero crossings of first and higher order derivatives of the waveform. In some embodiments, the system may modulate the first light drive signal according to a first cardiac cycle modulation technique and may modulate the one or more additional light drive signal according to a second cardiac cycle modulation technique. For example, the system may operate the first light source at full or regular brightness for a first “on” period, and then “off” for a second period. The system may use the first “on” period to adjust or calibrate a second modulation technique. The system may implement the second modulation technique for the “off” period, using, for example, one or more light sources that may or may not include the first light source. As described above, this cardiac cycle modulation may be implemented in addition to a drive cycle modulation, conventional servo algorithms, or any combination thereof. Lisogurski at 7:38-8:26

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	 FIG. 1 Lisogurski at Fig. 1 FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. **Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be**

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	configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. **It will be understood that, as used herein, the term “light” may refer to energy produced by radiative sources and may include one or more of ultrasound, radio, microwave, millimeter wave, infrared, visible, ultraviolet, gamma ray or X-ray electromagnetic radiation. As used herein, light may also include any wavelength within the radio, microwave, infrared, visible, ultraviolet, or X-ray spectra, and that any suitable wavelength of electromagnetic radiation may be appropriate for use with the present techniques. Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130.** Lisogurski at 10:42-11:8 Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Light drive circuitry 120, as discussed above, may be configured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of when light source 130 is turned on and off. **When light source 130 is configured to emit two or more wavelengths of light, the light drive signal may be configured to control the operation of each wavelength of light. The light drive signal may comprise a single signal or may comprise multiple signals (e.g., one signal for each wavelength of light). An illustrative light drive signal is shown in FIG. 2A.** FIG. 2A shows an illustrative plot of a light drive signal including red light “on” period 202 and IR light “on period” 204 in accordance with some embodiments of the present disclosure. Light “on” periods 202, and 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As

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	used herein, “on” and “off” may refer to switching power or other components, high and low output states, high and low values within a continuous modulation, high and low duty cycles, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red “on” period 202 and IR “on” period 204 to drive red and IR light emitters, respectively, within light source 130. Red “on” period 202 may have a higher amplitude than IR “on” period 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue at certain oxygen saturations. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary, and that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. The light drive signal of FIG. 2A may also include “off” periods 220 between the Red and IR light “on” periods. “Off” periods 220 are periods during which no drive current may be applied to light source 130. “Off” periods 220 may be provided, for example, to prevent overlap of the emitted light, since light source 130 may require time to turn completely on and completely off. The period from time 216 to time 218 may be referred to as a drive cycle, which includes four segments: a Red light “on” periods 202, followed by an “off” period 220, followed by an IR light “on” period 204, and followed by an “off” period 220. After time 218 the drive cycle may be repeated (e.g., as long as a light drive signal is provided to light source 130). It will be understood that the starting point of the drive cycle is merely illustrative and that the drive cycle can start at any location within FIG. 2A, provided the cycle spans two light “on” periods and two “off” periods. Thus, each Red light “on” period 202 and each IR “on” period 204 may be understood to be surrounded by two dark periods 220. Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may

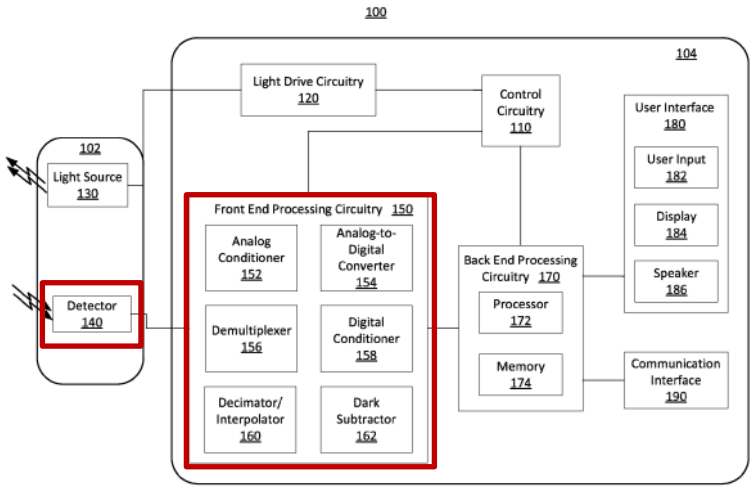
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	represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below Lisogurski at 11:33-13:6 **Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue**. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Lisogurski at 17:37-45 In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. **The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof**. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulation. For example, the first light drive signal may be configured to activate one LED to emit a

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	photonic signal and not activate other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated. Lisogurski at 19:20-39  FIG. 3 Lisogurski at Fig, 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	Lisogurski discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin. In some embodiments of cardiac cycle modulation, the system may modulate multiple light sources using a plurality of modulation techniques. For example, in a system with two light sources, the system may operate a first light source at full or regular brightness, while operating one or more additional light sources in a switched or otherwise modulated mode. In some embodiments, the system may operate a first light source according to a first cardiac cycle modulation technique and a second light source according to a second cardiac modulation technique. The first and second cardiac cycle modulation techniques may be the same, correlated, or unrelated. In some embodiments, the system may use the first light source to determine periods of interest in the cardiac cycle. The system may, according to the periods of interest, power additional light sources, alter the modulation of the additional light sources, perform other suitable power optimization techniques, or any combination thereof. In some embodiments, the system may include a first light source (e.g., a light source powered at full or regular brightness) of a type that is a more efficient light source than the one or more additional light sources. For example, the first light source may be a high efficiency infrared (IR) LED while the one or more additional light sources may be lower efficiency red LEDs or laser diodes. In some embodiments, the first light source may be selected based on efficiency parameters and information from the first light source may be used only to control a second light source. For example, a highly efficient first light source that is not at a wavelength of interest for physiological parameter determination may be used to control one or more second light sources at wavelengths of interest. In this case, the light from the first light source may be used only for controlling the second light source and not for determining physiological parameters. Lisogurski at 7:38-8:3 **Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals**. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source

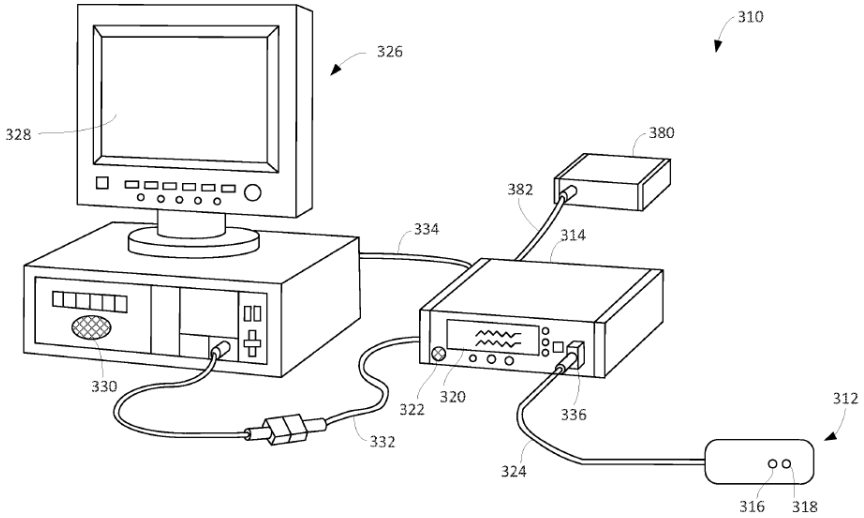
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	130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Lisogurski at 10:48-64 In an embodiment, **the subject may be a medical patient** and display 184 may exhibit a list of values which may generally apply to the patient, such as, for example, age ranges or medication families, which the user may select using user input 182. Lisogurski at 15:26-30 System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. **Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue**. **Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart**. Lisogurski at 17:35-45 In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulation. For example, the first light drive signal may be configured to activate one LED to emit a photonic signal and not activate

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	other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated. Lisogurski at 19:20-39 It will be understood that selection and/or switching of the first and second light sources may depend on the blood oxygen saturation as well as additional physiological parameters and system parameters. For example, a red wavelength LED may consume more power than an IR LED, and thus it may be desired to use the lowest power consuming technique possible. In some embodiments, the system may select the light source capable of detecting the greatest pulsatile amplitude per unit of power consumed. In some other embodiments, the system may select the light source capable of detecting the greatest pulsatile amplitude. It will also be understood that in some embodiments, a decreasing blood oxygen saturation or other physiological parameter may result in the system not using a cardiac cycle modulation technique in order to attain the highest possible quality physiological information. This will be discussed below, for example with relation to FIG. 21. **FIG. 9 is flow diagram 900 showing illustrative steps for determining a physiological parameter in accordance with some embodiments of the present disclosure**. In some embodiments, the system may emit a photonic signal correlated to physiological pulses from a light source, and use information from the related attenuated signal to determine physiological parameters. In some embodiments, varying parameters of the light drive signal may reduce, optimize, or otherwise suitably alter the power consumption of the system. In step 902, the system may generate a light drive signal, in part correlated to physiological pulses. **The system may generate a light drive signal used by a light source to emit a photonic signal. The light source may be one or more emitters of one or more wavelengths, and they may emit one or more photonic signals**. For example, the l**ight source may include light source 130 of FIG. 1 or light source 316 of FIG. 3**. In some embodiments, th**e light source may include LEDs of multiple wavelengths, for example, a red LED and an IR LED**. In some embodiments, t**he light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof**. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. Lisogurski at 25:6-45

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	Lisogurski discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. The present disclosure is directed towards power optimization in a medical device. **A physiological monitoring system** may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. **The system may include**, for example, a light source and **a photosensitive detector**. Lisogurski at 3:43-46  FIG. 1 Lisogurski at Fig. 1

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	FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. **System 100 may include a sensor 102** and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. **Sensor 102 of physiological monitoring system 100 may include** light source 130 and **detector 140**. Lisogurski at 10:42-49 In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the ambient light detected by the detector during the “dark” period and then subtract this ambient contribution from the signals received during the first and second “on” periods. In some embodiments, drive cycle modulation may be implemented using time division multiplexing as described above, code division multiplexing, carrier frequency multiplexing, phase division multiplexing, feedback circuitry, DC restoration circuitry, any other suitable technique, or any combination thereof. For example, the system may use frequency division multiplexing in a drive cycle modulation technique. The cardiac cycle modulation may represent a lower frequency envelope function on the higher frequency drive cycle. For example, cardiac cycle modulation may be an envelope on the order of 1 Hz superimposed on a 1 kHz sine wave drive cycle modulation. Lisogurski at 6:7-19 As used herein, the terms “on” and “off” are merely exemplary and may not necessarily refer to a fully on or off state. **For example, “on” and “off” may refer to switching power or other components, high and low brightness output states, high and low values within a continuous modulation, high and low values of electrical current provided to an emitter, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitter is switched on), any other suitable relatively distinct states, or any combination thereof**. In some embodiments, “on” and “off”

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	states may relate to high and low values of a variable that varies with multiple discrete steps. For example, an emitter brightness may be provided by the system as off, low, medium, and high. In this example, an “off” state may refer to off or low emission and “on” may refer to medium or high. In another example, “off” may refer to an off state and “on” may refer to a low, medium, or high output depending on a second input or system variable. Lisogurski at 8:27-44 In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other suitable reasons, or any combination thereof. **The system may receive, for example, an increased level of background noise in the signal due to patient motion**. **The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio**. In some embodiments, the system may increase brightness throughout the cardiac cycle because the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion. In some embodiments, the system may change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light. Lisogurski at 9:46-60 Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130. Lisogurski at 11:6-8 In some embodiments, **detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths**. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, **light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue**. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where

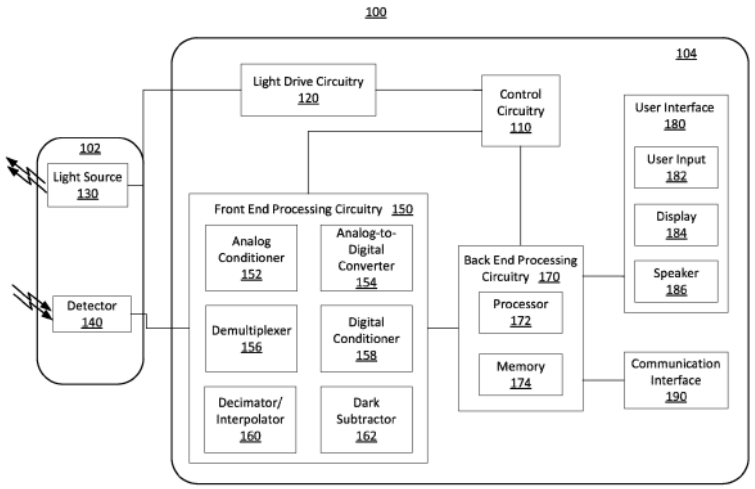
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	the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:9-27  FIG. 3 Lisogurski at Fig. 3. **FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310** in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter**.** Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. **One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue**. Any suitable configuration of light source 316 and

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	detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Lisogurski at 17:30-45 **Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components**. In some embodiments, **control circuitry 110 may be configured to provide timing control signals to coordinate their operation**. For example, **light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120**. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Lisogurski at 11:33-49 Referring back to FIG. 1, **front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140**. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Lisogurski at 12:42-51 FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. **The peaks of detector current waveform 214 may be synchronous**

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	with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below. Lisogurski at 12:52-13:6 However, if the contribution of ambient light is large relative to the contribution of light from a light source, the total analog gain applied to the detection current may need to be reduced to avoid saturating analog-to-digital converter 154. When the analog gain is reduced, the portion of the signal corresponding to the light source may map to a smaller number of analog-to-digital conversion bits. Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Back end processing circuitry 170 may include processor 172 and memory 174. Processor 172 may be adapted to execute software, which may include an operating system and one or more applications, as part of performing the functions described herein. Processor 172 may receive and process physiological signals received from front end processing circuitry 150. Lisogurski at 14:40-62 It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple

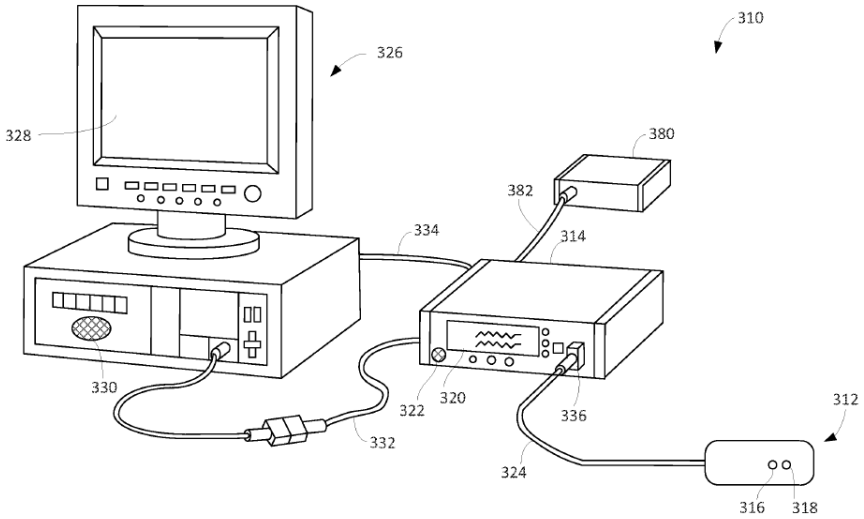
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	components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Lisogurski at 15:66-16:16 System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Lisogurski at 17:35-45 In some embodiments, physiological pulses may be cardiac pulses, respiratory pulses, muscular pulses, any other suitable pulses, or any combination thereof. Where physiological pulses are respiratory pulses, they may relate to respiration rate, inspiration, expiration, ventilator parameters, changes in a respiratory pressure signals, any other 5 suitable parameter, or any combination thereof. In some embodiments, particular segments of a respiratory cycle may provide an increased signal to noise ratio, increased signal strength, increased physiological parameter accuracy, increased physiological parameter precision, any other suitable parameters, or any combination thereof. In some embodiments, respiration may cause variations in photoplethysmography data, and thus it may be desired to correlate a modulation technique with respiration variations or both respiration variations and cardiac pulses. Lisogurski at 25:66-26:14 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Lisogurski discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. In some embodiments, the system may vary a light drive signal based on a received external trigger. The system may receive an external trigger based on a signal other than a light signal received by the physiological monitor. The trigger may include a signal received from an ECG sensor, an ECG sensor configured to detect an R-wave, a blood pressure sensor, a respiration rate sensor, any other suitable sensor, or any combination thereof. The system may, in response to the external trigger, vary the light intensity, duty cycle, light source firing rate, any other suitable parameter, or any combination thereof. Lisogurski at 1:60-2:3 The present disclosure is directed towards power optimization in a medical device. **A physiological monitoring system** may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. **The system may include**, for example, a light source and **a photosensitive detector**. Lisogurski at 3:43-46

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	 FIG. 1 Lisogurski at Fig. 1 **FIG. 1 is a block diagram of an illustrative physiological monitoring system 100** in accordance with some embodiments of the present disclosure. **System 100 may include a sensor 102** and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. **Sensor 102 of physiological monitoring system 100 may include** light source 130 and **detector 140**. Lisogurski at 10:42-49 In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the ambient light detected by the detector during the “dark” period and then subtract this ambient contribution from the signals received during the first and second “on” periods. In some embodiments,

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	drive cycle modulation may be implemented using time division multiplexing as described above, code division multiplexing, carrier frequency multiplexing, phase division multiplexing, feedback circuitry, DC restoration circuitry, any other suitable technique, or any combination thereof. For example, the system may use frequency division multiplexing in a drive cycle modulation technique. The cardiac cycle modulation may represent a lower frequency envelope function on the higher frequency drive cycle. For example, cardiac cycle modulation may be an envelope on the order of 1 Hz superimposed on a 1 kHz sine wave drive cycle modulation. Lisogurski at 6:7-19 As used herein, the terms "on" and "off" are merely exemplary and may not necessarily refer to a fully on or off state. **For example, "on" and "off" may refer to switching power or other components, high and low brightness output states, high and low values within a continuous modulation, high and low values of electrical current provided to an emitter, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitter is switched on), any other suitable relatively distinct states, or any combination thereof**. In some embodiments, "on" and "off" states may relate to high and low values of a variable that varies with multiple discrete steps. For example, an emitter brightness may be provided by the system as off, low, medium, and high. In this example, an "off" state may refer to off or low emission and "on" may refer to medium or high. In another example, "off" may refer to an off state and "on" may refer to a low, medium, or high output depending on a second input or system variable. Lisogurski at 8:27-44 In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other suitable reasons, or any combination thereof. **The system may receive, for example, an increased level of background noise in the signal due to patient motion**. **The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio**. In some embodiments, the system may increase brightness throughout the cardiac cycle because the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion. In some embodiments, the system may change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light.

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	Lisogurski at 9:46-60 Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130. Lisogurski at 11:6-8 In some embodiments, **detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths**. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, **light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue**. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:9-27

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	 FIG. 3 Lisogurski at Fig. 3. **FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310** in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter**.** Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. **One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue**. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Lisogurski at 17:30-45 **Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of**

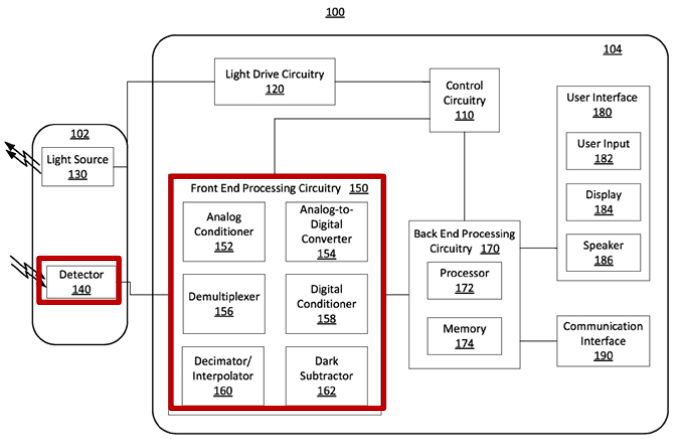
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	these components. In some embodiments, **control circuitry 110 may be configured to provide timing control signals to coordinate their operation**. For example, **light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120**. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Light drive circuitry 120, as discussed above, may be configured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of when light source 130 is turned on and off. When light source 130 is configured to emit two or more wavelengths of light, the light drive signal may be configured to control the operation of each wavelength of light. The light drive signal may comprise a single signal or may comprise multiple signals (e.g., one signal for each wavelength of light). An illustrative light drive signal is shown in FIG. 2A. Lisogurski at 11:33-60 Referring back to FIG. 1, **front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140**. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Lisogurski at 12:42-51 FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. **The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source**

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	being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below. Lisogurski at 12:52-13:6 Processor 172 may receive and process physiological signals received from front end processing circuitry 150. Lisogurski at 14:60-62 It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Lisogurski at 15:66-16:16 Region 256 of plot 250 indicates an interval of the timing diagram where both red light modulation 252 and IR light modulation 254 are in an “on” portion of the cardiac cycle modulation. Plot 270 shows an illustrative portion of region 256, where the system is employing a cardiac cycle modulation in addition to the drive cycle modulation. Plot 250 may include a drive cycle modulation technique with a period of time interval 272. The time scale of plot 270 may be significantly shorter than the time scale of plot 250,

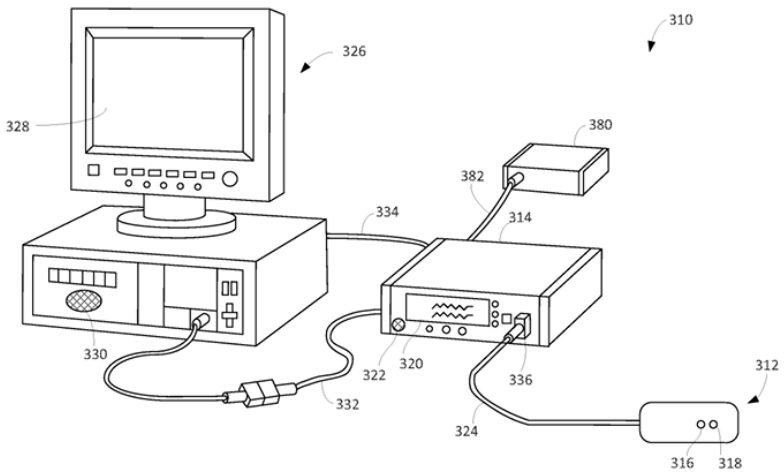
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	such that time interval 272 is significantly shorter than time interval 260. For example, time interval 260 (i.e., the period of the cardiac cycle modulation) may be on the order of 1 second, while time interval 272 (i.e., the period of the drive cycle modulation) may be on the order of 1 ms. Time interval 272 may include a sequence of red “on” portion 274, a first “off” portion 276, IR “on” portion 278, and a second “off” portion 280. The first “off” portion 276 and second “off” portion 280 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 274 and IR “on” period 278. Region 258 of plot 250 indicates an interval of the timing diagram where the red light modulation 252 is in an “off” portion of the cardiac cycle modulation and IR light modulation 254 is in an “on” portion of the cardiac cycle modulation. Plot 282 shows an illustrative portion of region 258, where the system is employing a drive cycle modulation technique in addition to the cardiac cycle modulation. Plot 282 may include a drive cycle modulation technique with a period of time interval 284. The time scale of plot 282 may be significantly shorter than the time scale of plot 250, such that time interval 284 is significantly shorter than time interval 260. In some embodiments, the time scale of plot 282 may be the same as the time scale of plot 270. Time interval 284 may include a sequence of red “on” portion 286, a first “off” portion 288, IR “on” portion 290, and a second “off” portion 292. The red “on” portion 286 may include less red light emitted than during red “on” portion 274, or no red light emitted, as red light modulation 252 is in an “off” phase during region 258. The first “off” portion 288 and second “off” portion 292 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 286 and IR “on” portion 290. Lisogurski at 16:33-17:2 System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Lisogurski at 17:35-45

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	In some embodiments, physiological pulses may be cardiac pulses, respiratory pulses, muscular pulses, any other suitable pulses, or any combination thereof. Where physiological pulses are respiratory pulses, they may relate to respiration rate, inspiration, expiration, ventilator parameters, changes in a respiratory pressure signals, any other 5 suitable parameter, or any combination thereof. In some embodiments, particular segments of a respiratory cycle may provide an increased signal to noise ratio, increased signal strength, increased physiological parameter accuracy, increased physiological parameter precision, any other suitable parameters, or any combination thereof. In some embodiments, respiration may cause variations in photoplethysmography data, and thus it may be desired to correlate a modulation technique with respiration variations or both respiration variations and cardiac pulses. Lisogurski at 25:66-26:14 It will also be understood that modulation of the light drive signal (i.e., the "on" and "off' states illustrated by light drive signal 1010) is merely exemplary and may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof. It will also be understood that the "on" and "off' states are merely exemplary and that the system may use any suitable variations of discrete and/or continuous modulations. Lisogurski at 27:44-52 FIG. 17 is flow diagram 1700 showing illustrative steps for decimating and interpolating a signal in accordance with some embodiments of the present disclosure. In some embodiments, the system may sample a signal at different rates throughout a cardiac cycle. The system may process the sampled signal to produce an output signal with a constant rate. In some embodiments, the system may vary the sampling rate to reduce or optimize power consumption. In some embodiments, sampling rate modulation may be correlated with light drive signal modulation. Varying the sampling rate may reduce power consumption by reducing emitter drive time and lowering utilization of an analog-to-digital converter. In some embodiments, varying the sampling rate may increase the time resolution of identified features. For example, in a continuous non-invasive blood pressure measurement where the pulse transit time is used in calculations, increasing the sampling rate for a portion of the cardiac cycle may result in more accurate and reliable physiological information. In another example, varying the sampling rate around a cardiac pulse cycle feature, such as a peak or notch, may increase the accuracy of determining the location of

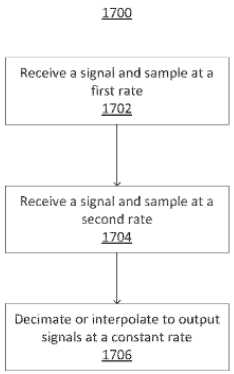
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	that feature in time. In some embodiments, lower frequency or less critical parts of the cardiac pulse cycle may be sampled at a lower rate while maintaining highly accuracy and reliable physiological parameter determination. Lisogurski at 33:40-64 In some embodiments, the sampling rate may represent the number of samples taken during an “on” period of the drive cycle modulation. For example, an “on” period may be “on” period 202 of FIG. 2A. The system may sample that drive cycle modulation “on” period a lower number of times at a low sampling rate, and a greater number of times at a high sampling rate. In this embodiment, the firing rate of the emitters may not be modulated along with the analog-to-digital sampling rate. For example, at a low sampling rate, the system may sample once per “on” period, while at a high sampling rate the system may take several samples per “on” period and average them. In some embodiments, averaging multiple samples for the same “on” period may include oversampling techniques. In some embodiments, the sampling rate may represent the amount of time between “on” periods. For example, the time between “on” periods may be the length of time of “off” period 220 of FIG. 2A. Increasing the duration of the “off” periods (i.e., decreasing the emitter firing rate) relates to a decreased sampling rate. Similarly, decreasing the duration of the “off” periods (i.e., increasing the emitter firing rate) relates to an increased sampling rate. Lisogurski at 35:10-31 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other,	Lisogurski discloses or renders obvious wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors.

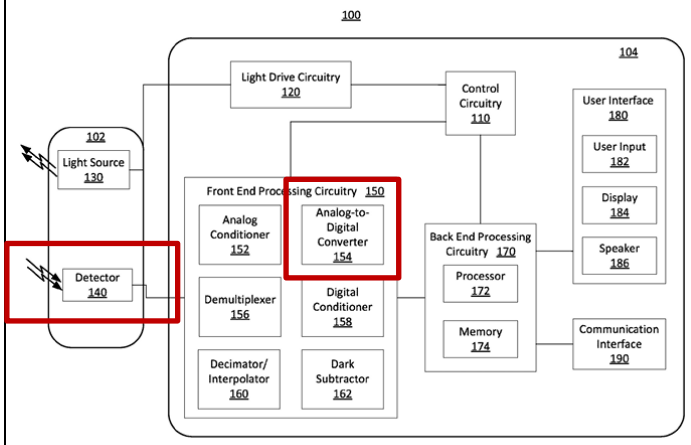
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and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	 FIG. 1 Lisogurski at Fig. 1 **FIG. 1 is a block diagram of an illustrative physiological monitoring system 100** in accordance with some embodiments of the present disclosure. **System 100 may include a sensor 102 and a monitor 104** for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Lisogurski at 10:42-47 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. Lisogurski at 11:9-10 In the embodiment shown, **monitor 104 includes** control circuitry 110, light drive circuitry 120, **front end processing circuitry 150**, back end processing circuitry 170, user interface 180, and communication interface 190. Monitor 104 may be communicatively coupled to sensor 102. Lisogurski at 11:28-32.

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	Referring back to FIG. 1, **front end processing circuitry 150**, which may receive a detection signal, such as detector current waveform 214, may include analog conditioner 152, **analog-to-digital converter 154**, demultiplexer 156, digital conditioner 158, decimator/interpolator 160, and dark subtractor 162. Analog conditioner 152 may perform any suitable analog conditioning of the detector signal. The conditioning performed may include any type of filtering (e.g., low pass, high pass, band pass, notch, or any other suitable filtering), amplifying, performing an operation on the received signal (e.g., taking a derivative, averaging), performing any other suitable signal conditioning (e.g., converting a current signal to a voltage signal), or any combination thereof. **The conditioned analog signal may be processed by analog-to-digital converter 154, which may convert the conditioned analog signal into a digital signal**. Analog-to-digital converter 154 may operate under the control of control circuitry 110. Analog-to-digital converter 154 may use timing control signals from control circuitry 110 to determine when to sample the analog signal. **Analog-to-digital converter 154 may be any suitable type of analog-to-digital converter of sufficient resolution to enable a physiological monitor to accurately determine physiological parameters**. Lisogurski at 13:6-30 The front end processing circuitry 150 may be configured to take advantage of the full dynamic range of analog-to-digital converter 154. This may be achieved by applying gain to the detection signal by analog conditioner 152 to map the expected range of the detection signal to the full or close to full output range of analog-to-digital converter 154. The output value of analog-to-digital converter 154, as a function of the total analog gain applied to the detection signal, may be given as: ADC Value∝Total Analog Gain×[Ambient Light+LED Light]. Ideally, when ambient light is zero and when the light source is off, the analog-to-digital converter 154 will read just above the minimum input value. When the light source is on, the total analog gain may be set such that the output of analog-to-digital converter 154 may read close to the full scale of analog-to-digital converter 154 without saturating. This may allow the full dynamic range of analog-to-digital converter 154 to be used for representing the detection signal, thereby increasing the resolution of the converted signal. In some embodiments, the total analog gain may be reduced by a small amount so that small changes in the light level incident on the detector do not cause saturation of analog-to-digital converter 154.

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	However, if the contribution of ambient light is large relative to the contribution of light from a light source, the total analog gain applied to the detection current may need to be reduced to avoid saturating analog-to-digital converter 154. When the analog gain is reduced, the portion of the signal corresponding to the light source may map to a smaller number of analog-to-digital conversion bits. Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Lisogurski at 14:15-55  FIG. 3 Lisogurski at Fig.3 **System 310 may include sensor unit 312 and monitor 314**. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. **One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's**

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	tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, **sensor unit 312 may include multiple** light sources and detectors, **which may be spaced apart**. Lisogurski at 17:35-45 In step 1702, **the system may receive a signal**. The signal may be sampled at a first rate. **The signal may be sampled using an analog-to-digital converter in the front end processing circuitry. For example, an attenuated light signal may be converted to an analog electronic signal by a detector. The analog electronic signal may be converted to a digital signal at a particular rate by an analog to digital converter**, such that at each sampling point the converter determines the amplitude of the analog signal (e.g., current or voltage) and outputs a digital word related to that amplitude. The rate at which sampling occurs may be controlled by, for example, a timing control signal (e.g., provided by control circuitry 110 of FIG. 1). In some embodiments, the sampling rate may represent the number of samples taken during an “on” period of the drive cycle modulation. In some embodiments, the sampling rate may represent the amount of time between “on” periods. Lisogurski at 33:65-34:13

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	 FIG. 17 Lisogurski at Fig. 17 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	Lisogurski discloses or renders obvious wherein the output signal is indicative of the one or more physiological parameters.

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	 FIG. 1 Lisogurski at Fig. 1 **FIG. 1 is a block diagram of an illustrative physiological monitoring system 100** in accordance with some embodiments of the present disclosure. **System 100 may include a sensor 102** and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. **Sensor 102 of physiological monitoring system 100 may include** light source 130 and **detector 140**. Lisogurski at 10:42-49. **A physiological monitoring system may use photonic signals to determine physiological parameters**. The system may vary parameters of a light drive signal used to generate the photonic signal from a light source such that power consumption is reduced or optimized. Parameters may include light intensity, firing rate, duty cycle, other suitable parameters, or any combination thereof. In some embodiments, the system may use information from a first light source to generate a light drive signal for a second light source. In some embodiments, the system may vary parameters in a way substantially synchronous with physiological pulses, for example, cardiac pulses. In some embodiments, the system may vary parameters in response to an external trigger.

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	Lisogurski at [Abstract] Systems and methods are provided for optimizing power consumption in an **optical physiological monitoring system**. The system may vary light drive signal parameters to reduce power consumption or vary power use. The system may vary parameters in a technique correlated to cardiac pulse cycles. In some embodiments, reducing power consumption may allow for increased battery life in portable systems or increased portability. In some embodiments, varying light output during a cardiac cycle may reduce heating effects of the emitters. Parameters that may be varied include light intensity, firing rate, duty cycle, other suitable parameters, or any combination thereof. **The generated signals may be used to determined physiological parameters such as blood oxygen saturation, hemoglobin, blood pressure, pulse rate, other suitable parameters, or any combination thereof**. In some embodiments, the system may use information from a first light source to control a second light source. The system may generate a first light drive signal for activating a first light source to emit a first photonic signal. The first light source and second light source may each include one or more emitters. The system may receive a light signal attenuated by the subject, wherein the light signal comprises a component corresponding to the first photonic signal. The system may analyze the component of the light signal to determine when to activate a second light source. The system may generate a second light drive signal, based on the analysis of the first component, for activating the second light source to emit one or more second photonic signals. The system may determine one or more physiological parameters based on the light signals. In some embodiments, the system may vary a light drive signal in a way substantially synchronous with physiological pulses, for example, cardiac pulses. The system may generate a light drive signal for activating a light source to emit a photonic signal, wherein at least one parameter of the light drive signal is configured to vary substantially synchronously with physiological pulses of the subject. The system may receive a light signal attenuated by the subject, wherein the signal comprises a component corresponding to the emitted photonic signal. The system may determine physiological parameters based on the signal. Lisogurski at 1:10-52 The present disclosure is directed towards power optimization in a medical device. **A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors**.

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	Lisogurski at 3:43-46 An oximeter is a medical device that may determine the oxygen saturation of an analyzed tissue. One common type of oximeter is a pulse oximeter, which may non-invasively measure the oxygen saturation of a patient's blood (as opposed to measuring oxygen saturation directly by analyzing a blood sample taken from the patient). Pulse oximeters may be included in patient monitoring systems that measure and display various blood flow characteristics including, but not limited to, the oxygen saturation of hemoglobin in arterial blood. Such patient monitoring systems may also measure and display additional physiological parameters, such as a patient's pulse rate and blood pressure. An oximeter may include a light sensor that is placed at a site on a patient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot. The oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically understood to be optimal for pulse oximetry serve as suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional suitable sensor locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patient's thigh to monitor femoral artery pulsatile flow, the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. Suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. In all suitable locations, for example, the oximeter may measure the intensity of light that is received at the light sensor as a function of time. The oximeter may also include sensors at multiple locations. A signal representing light intensity versus time or a mathematical manipulation of this signal (e.g., a scaled version thereof; a logarithm taken thereof, a scaled version of a logarithm taken thereof; a derivative taken thereof, a difference taken thereof, etc.) may be referred to as the photoplethysmograph (PPG) signal. In addition, the term “PPG signal,” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue), a transmission signal (i.e., representing the amount of light received from the tissue), any suitable mathematical manipulation thereof; or any combination thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs.

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	In some applications, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Red and infrared (IR) wavelengths may be used because it has been observed that highly oxygenated blood will absorb relatively less red light and more IR light than blood with a lower oxygen saturation. By comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen saturation of hemoglobin in arterial blood. The system may process data to determine physiological parameters using techniques well known in the art. For example, the system may determine blood oxygen saturation using two wavelengths of light and a ratio-of-ratios calculation. The system also may identify pulses and determine pulse amplitude, respiration, blood pressure, other suitable parameters, or any combination thereof, using any suitable calculation techniques. In some embodiments, the system may use information from external sources (e.g., tabulated data, secondary sensor devices) to determine physiological parameters. Lisogurski at 3:61-4:62 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. **Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue.** That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. **After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104**. Lisogurski at 11:9-27 he light drive signal may be provided to light source 130, including red “on” period 202 and IR “on” period 204 to drive red and IR light emitters, respectively, within light source 130. Red “on” period 202 may have a higher amplitude than IR “on” period 204 since red LEDs may be less efficient than IR LEDs

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	at converting electrical energy into light energy. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue at certain oxygen saturations. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary, and that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. Lisogurski at 12:3-22 Back end processing circuitry 170 may include processor 172 and memory 174. Processor 172 may be adapted to execute software, which may include an operating system and one or more applications, as part of performing the functions described herein. Processor 172 may receive and process physiological signals received from front end processing circuitry 150. For example, processor 172 may determine one or more physiological parameters based on the received physiological signals. Memory 174 may include any suitable computer-readable media capable of storing information that can be interpreted by processor 172. Lisogurski at 14:56-66 In some embodiments, **sensor unit 312 may be connected to monitor 314** as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). **Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and acoustic detection received from one or more sensor units such as sensor unit 312**. **For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxygenated, and/or total), any other suitable physiological parameters, or any combination thereof**. In some embodiments, **calculations may be performed on the sensor units** or an intermediate device and **the result of the calculations may be passed to monitor 314.** Further, monitor 314 may include display 320 configured to display the physiological parameters or other information about the system.

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	Lisogurski at 17:54-18:10 Multi-parameter physiological monitor 326 may be configured to calculate physiological parameters and to provide a display 328 for information from monitor 314 and from other medical monitoring devices or systems (not shown). For example, multi-parameter physiological monitor 326 may be configured to display an estimate of a subject's blood oxygen saturation and hemoglobin concentration generated by monitor 314. Multi-parameter physiological monitor 326 may include a speaker 330. Monitor 314 may be communicatively coupled to multiparameter physiological monitor 326 via a cable 332 or 334 that is coupled to a sensor input port or a digital communications port, respectively and/or may communicate wirelessly (not shown). In addition, monitor 314 and/or multi-parameter physiological monitor 326 may be coupled to a network to enable the sharing of information with servers or other work-stations (not shown). Monitor 314 may be powered by a battery (not shown) or by a conventional power source such as a wall outlet. Lisogurski at 18:49-66 In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. In some embodiments, any of the processing components and/or circuits, or portions thereof, of FIGS. 1 and 3 may be referred to collectively as processing equipment. For example, processing equipment may be configured to generate light drive signals, amplify, filter, sample and digitize detector signals, and calculate physiological information from the digitized signal. In some embodiments, all or some of the components of the processing equipment may be referred to as a processing module. FIG. 4 is flow diagram 400 showing illustrative steps for determining a physiological parameter in accordance with some embodiments of the present disclosure. In some embodiments, the system may emit a photonic signal from a first light source and use information from the related attenuated signal to generate a light drive signal for a second light source. Lisogurski at 19:1-19

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	Other information may include, for example, historical analysis of prior cardiac cycles and information from external sensors. For example, the system may determine an average pulse period from a number of prior pulse cycles. Statistical information such as the standard deviation may also be calculated to in part determine a confidence parameter for the historical information. In some embodiments, the system may use a respiration rate. For example, the system may determine a respiration rate from an external sensor and use information from the respiration rate to determine a modulation technique. In some embodiments, the cardiac cycle modulation applied to the second light drive signal may be varied based on the historical and statistical information. In some embodiments, the system may determine to turn on a second light source with a time offset to the element of interest in the cardiac cycle. For example, the system may turn on the second light source a certain number of milliseconds prior to the peak (or expected peak) of a pulse signal. In a further example, the system may wait a certain number of milliseconds following a peak in an ECG signal. In some embodiments, the time offsets may be adjusted based on prior signal analysis, adjusted by user input, adjusted by predetermined values, adjusted by any other suitable technique, or any combination thereof. In some embodiments, parameters of the second photonic signal, for example duty cycle, decimation ratio, and brightness, may be determined based on analysis of the received light signal. Lisogurski at 20:7-33 In step 410, the system may determine a physiological parameter using information from the attenuated photonic signals. The physiological parameter may be determined using any suitable hardware technique, software technique, or combination thereof. In some embodiments, processing equipment remote to the system may be used to determine physiological parameters. The system may display the determined physiological parameter using a local display (e.g., display 320 of FIG. 3 or display 328 of FIG. 3), display them on a remote display, publish the data to a server or website, make the parameters available to a user by any other suitable technique, or any combination thereof. Lisogurski at 20:49-60 In step 906, the system may determine a physiological parameter using information from the attenuated photonic signals. The physiological parameter may be determined using any suitable hardware technique, software technique, or combination thereof. In some embodiments, processing equipment remote to the system may be used to determine physiological parameters. The system may display the determined

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	physiological parameter using a local display (e.g., display 320 of FIG. 3 or display 328 of FIG. 3), display them on a remote display, publish the data to a server or website, make the parameters available to a user by any other suitable technique, or any combination thereof. Lisogurski at 26:49-60 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Lisogurski discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. **Parameters that may be varied include light intensity**, firing rate, duty cycle, other suitable parameters, or any combination thereof. Lisogurski at 1:19-21 The system may generate a light drive signal for activating a light source to emit a photonic signal, wherein at least one parameter of the light drive signal is configured to vary substantially synchronously with physiological pulses of the subject. Lisogurski at 1:44-48 **The system may, in response to the external trigger, vary the light intensity**, duty cycle, light source firing rate, any other suitable parameter, or any combination thereof. Lisogurski at 1:67-2:3

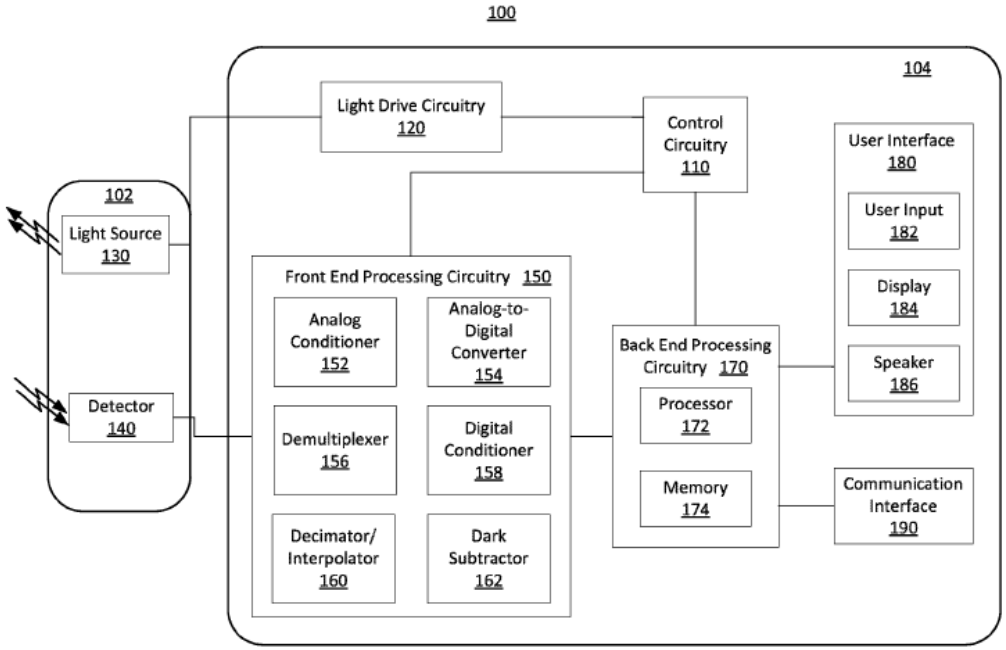
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	As used herein, “drive cycle modulation” (described below) will refer to a relatively higher frequency modulation technique that the system may use to generate one or more wavelengths of intensity signals. Cardiac cycle modulation may have a period of, for example, around 1 second, while drive cycle modulation may have a period around, for example, 1.6 milliseconds. In some embodiments, conventional servo algorithms may be used in addition to any combination of cardiac cycle modulation and drive cycle modulation. Conventional servo algorithms may adjust the light drive signals due to, for example, ambient light changes, emitter and detector spacing changes, sensor positioning, other suitable parameters, or any combination thereof. Generally, conventional servo algorithms vary parameters at a slower rate than cardiac cycle modulation. For example, a conventional servo algorithm may adjust drive signal brightness due to ambient light every several seconds. The system may use conventional servo algorithms in part to keep received signal levels within the range of an analog to digital converter's dynamic range. For example, a signal with amplitudes that are large may saturate an analog to digital convertor. In response to a signal with high amplitudes, the system may reduce emitter brightness. I**n a further example, the quality of a low amplitude signal may be degraded by quantization noise by an analog to digital converter. In response, the system may increase the emitter brightness**. Lisogurski at 5:48-6:6 In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other suitable reasons, or any combination thereof. **The system may receive, for example, an increased level of background noise in the signal due to patient motion**. **The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio**. In some embodiments, the system may increase brightness throughout the cardiac cycle because the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion. In some embodiments, the system may change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light. Lisogurski at 9:46-60

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	FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Lisogurski at 10:42-64 Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Lisogurski at 11:33-49 Light drive circuitry 120, as discussed above, may be configured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of when light source 130 is turned on and off.

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	Lisogurski at 11:50-54 This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Lisogurski at 14:49-55 In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. **The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof**. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. Lisogurski at 19:20-27 In step 404, the system may receive a light signal. **The light may be received using a sensor, for example, detector 140 of FIG. 1 or detector 318 of FIG. 3**. The light signal may be attenuated by the subject. The received light signal may in part include light from the first photonic signal. For example, the system may emit light that is reflected by the subject or transmitted through the subject. The interaction of the emitted light with the subject may cause the light to become attenuated. In some embodiments, the attenuation of the light may depend on the wavelength of the light and the tissue with which the light interacts. For example, particular wavelengths of light may be attenuated more strongly by oxyhemoglobin than other wavelengths. **In some embodiments, the system may amplify the received signal using front end processor circuitry**. In some embodiments, the gain may be modulated using a technique correlated to the cardiac cycle modulation. **The gain of the amplifier may be adjusted based on the emitted light brightness**, historical information related to the brightness of prior received attenuated signals, other suitable information, or any combination thereof, so that the amplified signal matches the range of the analog-to-digital converter and thus increases resolution. In some embodiments, the system may account for the gain using hardware, software, or any combination thereof, such that the original intensity information is retained.

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	Lisogurski at 19:40-64 For example, the system may generate a light drive signal that varies with a period the same as or closely related to the period of the cardiac cycle, thus generating a cardiac cycle modulation. The system may vary parameters related to the light drive signal including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof. Lisogurski at 25:49-55 The system may vary the light drive signal in a way correlated to the cardiac pulse signal of the subject. The system may generate an "on" light drive signal during one or more cardiac cycles and an "off' light drive signal during one or more cardiac cycles. For example, the system may generate an "on" light drive signal during period 1420 concurrent with pulse cycle 1406, an "off' light drive signal during pulse cycles 1408 and 1410, an "on" light drive signal during period 1422 concurrent with pulse cycle 1412, an "off' light drive signal during pulse cycles 1414 and 1416, and an "on" light drive signal during period 1424 concurrent with pulse cycle 1418. It will be understood that this particular modulation is merely exemplary and that any suitable inter-cycle modulation may be used. Lisogurski at 31:11-24 The system may determine the timing of the cardiac cycles using historical information from previous cardiac cycles, from an external sensor, from user input, from measurements made with a different cardiac cycle modulation, by any other suitable technique, or any combination thereof. It will be understood that the system may align modulation with pulses of the heart, pulses of a particular muscle group, other suitable pulses, any other suitable physiological function, or any combination thereof. It will also be understood that modulation of the light drive signal (i.e., the "on" and "off' states illustrated by light drive signal 1110) is merely exemplary and may include modulation of parameters including drive current or light brightness, duty cycle, firing rate, modulation parameters, other suitable parameters, or any combination thereof. It will also be understood that the "on" and "off' states are merely exemplary and that the system may use any suitable number of discrete or continuous modulation variations.

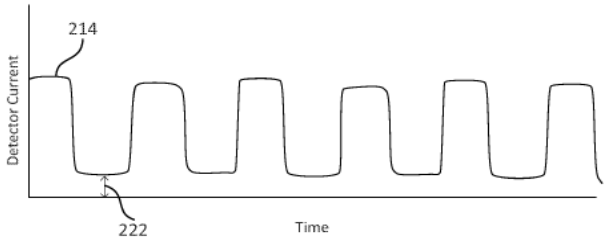
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	Lisogurski at 31:39-55 It will also be understood that sampling rate is one of the components that may be modulated in cardiac cycle modulation as described above. It will also be understood that the earlier described embodiments relating to varying light output may also apply to sampling rate. Lisogurski at 35:5-9 In some embodiments, the system may detect a condition where a second mode is required that is not related to a physiological condition. For example, the system may detect a change in background noise, a change in ambient light, a change in the available power, other suitable changes, or any combination thereof. In some embodiments, an increase in the number ofidentified fiducial points (e.g., zero crossings of the derivatives) may cause the system to vary drive signals. In step 1906, the system may perform a physiological measurement in a second mode. For example, the system may stop cardiac cycle modulation and emit light at a constant brightness. In a further example, the system may increase the emitter intensity used in a cardiac cycle modulation. In a further example, the system may lengthen the "on" periods of a cardiac cycle modulation. In a further example, the system may alter the cardiac cycle modulation technique as described above with relation to FIG. 8B. Lisogurski at 37:6-22

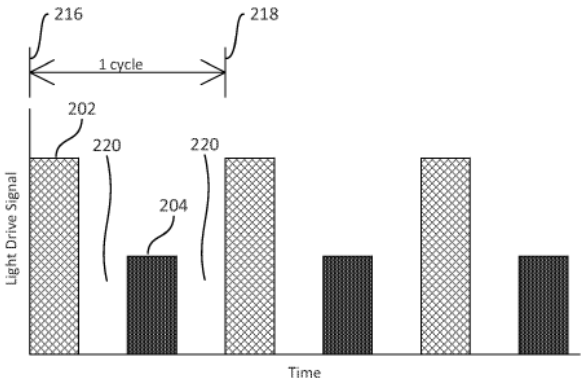
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	 FIG. 1 Lisogurski at Fig. 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received	Lisogurski discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off.

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while the light emitting diodes are off,	In some embodiments, **a technique to remove ambient and background signals may be used** in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, **a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the ambient light detected by the detector during the “dark” period and then subtract this ambient contribution from the signals received during the first and second “on” periods.** Lisogurski at 6:7-19 As used herein, the terms “on” and “off” are merely exemplary and may not necessarily refer to a fully on or off state. **For example, “on” and “off” may refer to** switching power or other components, **high and low brightness output states**, high and low values within a continuous modulation, **high and low values of electrical current provided to an emitter**, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitter is switched on), **any other suitable relatively distinct states, or any combination thereof**. In some embodiments, “on” and “off” states may relate to high and low values of a variable that varies with multiple discrete steps. **For example, an emitter brightness may be provided by the system as off, low, medium, and high. In this example, an “off” state may refer to off or low emission and “on” may refer to medium or high. In another example, “off” may refer to an off state and “on” may refer to a low, medium, or high output** depending on a second input or system variable. Lisogurski at 8:27-44 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the

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	Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. In the embodiment shown, monitor 104 includes control circuitry 110, light drive circuitry 120, front end processing circuitry 150, back end processing circuitry 170, user interface 180, and communication interface 190. Monitor 104 may be communicatively coupled to sensor 102. Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. **For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals**. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Light drive circuitry 120, as discussed above, may be configured to generate a light drive signal that is provided to light source 130 of sensor 102. **The light drive signal may, for example, control the intensity of light source 130 and the timing of when light source 130 is turned on and off**. When light source 130 is configured to emit two or more wavelengths of light, the light drive signal may be configured to control the operation of each wavelength of light. The light drive signal may comprise a single signal or may comprise multiple signals (e.g., one signal for each wavelength of light). An illustrative light drive signal is shown in FIG. 2A. FIG. 2A shows an illustrative plot of a light drive signal including red light “on” period 202 and IR light “on period” 204 in accordance with some embodiments of the present disclosure. Light “on” periods 202, and 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, “on” and “off” may refer to switching power or other components, high and low output states, high and low values within a continuous modulation, high and low duty cycles, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red “on” period 202 and IR “on” period 204 to drive red and IR light emitters,

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	respectively, within light source 130. Red “on” period 202 may have a higher amplitude than IR “on” period 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue at certain oxygen saturations. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary, and that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. The light drive signal of FIG. 2A may also include “off” periods 220 between the Red and IR light “on” periods. **“Off” periods 220 are periods during which no drive current may be applied to light source 130. “Off” periods 220 may be provided, for example, to prevent overlap of the emitted light, since light source 130 may require time to turn completely on and completely off**. The period from time 216 to time 218 may be referred to as a drive cycle, which includes four segments: a Red light “on” periods 202, followed by an “off” period 220, followed by an IR light “on” period 204, and followed by an “off” period 220. After time 218 the drive cycle may be repeated (e.g., as long as a light drive signal is provided to light source 130). It will be understood that the starting point of the drive cycle is merely illustrative and that the drive cycle can start at any location within FIG. 2A, provided the cycle spans two light “on” periods and two “off” periods. Thus, each Red light “on” period 202 and each IR “on” period 204 may be understood to be surrounded by two dark periods 220. Lisogurski at 11:9-12:41

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	 FIG. 2B Lisogurski at Fig. 2B FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A**. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed** as discussed in more detail below. Lisogurski at 12:52-13:6 **Referring back to FIG. 1, front end processing circuitry 150, which may receive a detection signal**, such as detector current waveform 214, **may include** analog conditioner 152, analog-to-digital converter 154, demultiplexer 156, digital conditioner 158, decimator/interpolator 160, and **dark subtractor 162**.

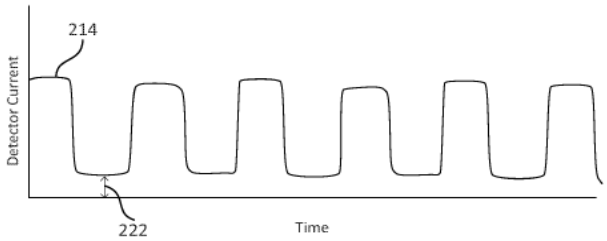
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	Lisogurski at 13:7-12 Demultiplexer 156 may operate on detector current waveform 214 of FIG. 2B to generate a Red signal, an IR signal, a first dark signal (e.g., corresponding to the dark component that occurs immediately after the Red component), and a second dark signal (e.g., corresponding to the dark component that occurs immediately after the IR component). Lisogurski at 13:35-41  FIG. 2A Lisogurski at Fig. 2A **Dark subtractor 162 may operate on the digital signal**. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, **dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak**. For example, in reference to FIG. 2A, **a detection signal peak corresponding to red “on” period 202 may be adjusted by determining the amount of dark signal during the “off” period 220 preceding red “on” period 202**. **The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red “on”**

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	period 202. Alternatively, the “off” period 220 after red “on” period 202 may be used to correct red “on” period 202 rather than the “off” period 220 preceding it. Additionally, an average of the “off” periods 220 before and after red “on” period 202 may be used. Lisogurski at 13:60-14:10 Region 258 of plot 250 indicates an interval of the timing diagram where the red light modulation 252 is in an “off” portion of the cardiac cycle modulation and IR light modulation 254 is in an “on” portion of the cardiac cycle modulation. Plot 282 shows an illustrative portion of region 258, where the system is employing a drive cycle modulation technique in addition to the cardiac cycle modulation. Plot 282 may include a drive cycle modulation technique with a period of time interval 284. The time scale of plot 282 may be significantly shorter than the time scale of plot 250, such that time interval 284 is significantly shorter than time interval 260. In some embodiments, the time scale of plot 282 may be the same as the time scale of plot 270. **Time interval 284 may include a sequence of red “on” portion 286, a first “off” portion 288, IR “on” portion 290, and a second “off” portion 292. The red “on” portion 286 may include less red light emitted than during red “on” portion 274, or no red light emitted, as red light modulation 252 is in an “off” phase during region 258. The first “off” portion 288 and second “off” portion 292 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 286 and IR “on” portion 290**. Red light modulation 252 may be in an “on” portion during region 256 (illustrated in detail in plot 270) and an “off” portion during region 258 (illustrated in detail in plot 282). Thus, the level of red light indicated by red “on” portion 274 is at a high level and the level of red light indicated by red “on” portion 286 is at a low level. This is illustrative of an embodiment where drive cycle modulation occurs together with cardiac cycle modulation. It will be understood that the techniques illustrated by FIG. 2C are merely exemplary and that other suitable techniques may be used for drive cycle modulation, as described above. It will also be understood that other suitable methods may be used to combine the drive cycle modulation and the cardiac cycle modulation. It will also be understood that the combining technique may depend in part on the particular drive cycle modulation and cardiac cycle modulation technique. It will also be understood that conventional servo algorithms may be used in addition to combinations of drive cycle modulation and cardiac cycle modulation.

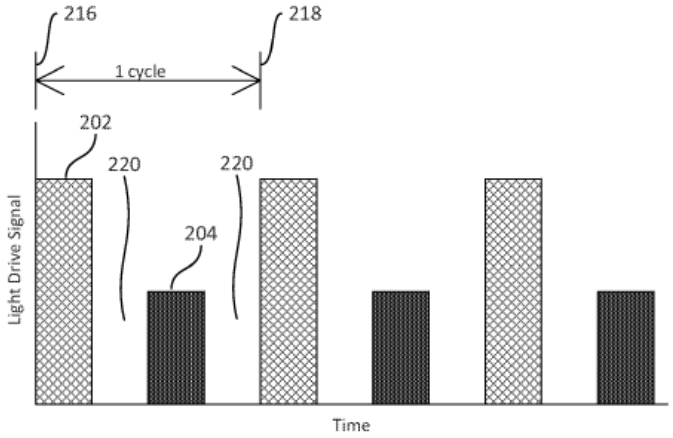
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	Lisogurski at 16:17-17:29 In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. **The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof.** For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. Lisogurski at 19:20-27. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Lisogurski discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. In some embodiments, **a technique to remove ambient and background signals may be used** in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, **a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the ambient light detected by the detector during the “dark” period and then subtract this ambient contribution from the signals received during the first and second “on” periods.** Lisogurski at 6:7-19 As used herein, the terms “on” and “off” are merely exemplary and may not necessarily refer to a fully on or off state. **For example, “on” and “off” may refer to** switching power or other components, **high and low brightness output states**, high and low values within a continuous modulation, **high and low**

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	values of electrical current provided to an emitter, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitter is switched on), **any other suitable relatively distinct states, or any combination thereof**. In some embodiments, “on” and “off” states may relate to high and low values of a variable that varies with multiple discrete steps. **For example, an emitter brightness may be provided by the system as off, low, medium, and high. In this example, an “off” state may refer to off or low emission and “on” may refer to medium or high. In another example, “off” may refer to an off state and “on” may refer to a low, medium, or high output** depending on a second input or system variable. Lisogurski at 8:27-44 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. In the embodiment shown, monitor 104 includes control circuitry 110, light drive circuitry 120, front end processing circuitry 150, back end processing circuitry 170, user interface 180, and communication interface 190. Monitor 104 may be communicatively coupled to sensor 102. Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. **For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals**. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light

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	drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Light drive circuitry 120, as discussed above, may be configured to generate a light drive signal that is provided to light source 130 of sensor 102. **The light drive signal may, for example, control the intensity of light source 130 and the timing of when light source 130 is turned on and off**. When light source 130 is configured to emit two or more wavelengths of light, the light drive signal may be configured to control the operation of each wavelength of light. The light drive signal may comprise a single signal or may comprise multiple signals (e.g., one signal for each wavelength of light). An illustrative light drive signal is shown in FIG. 2A. **FIG. 2A shows an illustrative plot of a light drive signal including red light “on” period 202 and IR light “on period” 204 in accordance with some embodiments of the present disclosure. Light “on” periods 202, and 204 may be generated by light drive circuitry 120 under the control of control circuitry 110.** As used herein, “on” and “off” may refer to switching power or other components, high and low output states, high and low values within a continuous modulation, high and low duty cycles, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red “on” period 202 and IR “on” period 204 to drive red and IR light emitters, respectively, within light source 130. Red “on” period 202 may have a higher amplitude than IR “on” period 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue at certain oxygen saturations. **When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters**. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary, and that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. The light drive signal of FIG. 2A may also include “off” periods 220 between the Red and IR light “on” periods. **“**Off” periods 220 are periods during which no drive current may be applied to light source 130.

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	“Off” periods 220 may be provided, for example, to prevent overlap of the emitted light, since light source 130 may require time to turn completely on and completely off. The period from time 216 to time 218 may be referred to as a drive cycle, which includes four segments: a Red light “on” periods 202, followed by an “off” period 220, followed by an IR light “on” period 204, and followed by an “off” period 220. After time 218 the drive cycle may be repeated (e.g., as long as a light drive signal is provided to light source 130). It will be understood that the starting point of the drive cycle is merely illustrative and that the drive cycle can start at any location within FIG. 2A, provided the cycle spans two light “on” periods and two “off” periods. Thus, each Red light “on” period 202 and each IR “on” period 204 may be understood to be surrounded by two dark periods 220. Lisogurski at 11:9-12:41  FIG. 2B Lisogurski at Fig. 2B FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. **The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source**

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	being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below. Lisogurski at 12:52-13:6 **Referring back to FIG. 1, front end processing circuitry 150, which may receive a detection signal**, such as detector current waveform 214, **may include** analog conditioner 152, analog-to-digital converter 154, demultiplexer 156, digital conditioner 158, decimator/interpolator 160, and **dark subtractor 162**. Lisogurski at 13:7-12 Demultiplexer 156 may operate on detector current waveform 214 of FIG. 2B to generate a Red signal, an IR signal, a first dark signal (e.g., corresponding to the dark component that occurs immediately after the Red component), and a second dark signal (e.g., corresponding to the dark component that occurs immediately after the IR component). Lisogurski at 13:35-41

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	 FIG. 2A Lisogurski at Fig. 2A **Dark subtractor 162 may operate on the digital signal**. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, **dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak**. For example, in reference to FIG. 2A, **a detection signal peak corresponding to red “on” period 202 may be adjusted by determining the amount of dark signal during the “off” period 220 preceding red “on” period 202**. **The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red “on” period 202. Alternatively, the “off” period 220 after red “on” period 202 may be used to correct red “on” period 202 rather than the “off” period 220 preceding it. Additionally, an average of the “off” periods 220 before and after red “on” period 202 may be used**. Lisogurski at 13:60-14:10 FIG. 2C shows illustrative timing diagrams of drive cycle modulation and cardiac cycle modulation in accordance with some embodiments of the present disclosure. Plot 250 may include a timing diagram of an exemplary cardiac cycle modulation, including red light modulation 252 and IR light modulation 254.

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	In the embodiment illustrated in plot 250, the IR light remains at a constant level and the red light is “on” only during the diastole period. The period of the modulation cycle may correspond to time interval 260. In a further embodiment, the system may replace some or all of the “off” periods with “on” periods of lower light intensity, shorter duty cycles, any other suitable parameter variations, or a combination thereof. It will be understood that the aforementioned cardiac cycle modulation technique is merely exemplary and that the system may use any suitable cardiac cycle modulation technique. Region 256 of plot 250 indicates an interval of the timing diagram where both red light modulation 252 and IR light modulation 254 are in an “on” portion of the cardiac cycle modulation. Plot 270 shows an illustrative portion of region 256, where the system is employing a cardiac cycle modulation in addition to the drive cycle modulation. Plot 250 may include a drive cycle modulation technique with a period of time interval 272. The time scale of plot 270 may be significantly shorter than the time scale of plot 250, such that time interval 272 is significantly shorter than time interval 260. For example, time interval 260 (i.e., the period of the cardiac cycle modulation) may be on the order of 1 second, while time interval 272 (i.e., the period of the drive cycle modulation) may be on the order of 1 ms. **Time interval 272 may include a sequence of red “on” portion 274, a first “off” portion 276, IR “on” portion 278, and a second “off” portion 280. The first “off” portion 276 and second “off” portion 280 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 274 and IR “on” period 278.** Region 258 of plot 250 indicates an interval of the timing diagram where the red light modulation 252 is in an “off” portion of the cardiac cycle modulation and IR light modulation 254 is in an “on” portion of the cardiac cycle modulation. Plot 282 shows an illustrative portion of region 258, where the system is employing a drive cycle modulation technique in addition to the cardiac cycle modulation. Plot 282 may include a drive cycle modulation technique with a period of time interval 284. The time scale of plot 282 may be significantly shorter than the time scale of plot 250, such that time interval 284 is significantly shorter than time interval 260. In some embodiments, the time scale of plot 282 may be the same as the time scale of plot 270. **Time interval 284 may include a sequence of red “on” portion 286, a first “off” portion 288, IR “on” portion 290, and a second “off” portion 292. The red “on” portion 286 may include less red light emitted than during red “on” portion 274, or no red light emitted, as red light modulation 252 is in an “off” phase during region 258. The first “off” portion 288 and second “off” portion 292 may be used to determine the level of ambient light, noise, dark current, other**

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	suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 286 and IR “on” portion 290. Red light modulation 252 may be in an “on” portion during region 256 (illustrated in detail in plot 270) and an “off” portion during region 258 (illustrated in detail in plot 282). Thus, the level of red light indicated by red “on” portion 274 is at a high level and the level of red light indicated by red “on” portion 286 is at a low level. This is illustrative of an embodiment where drive cycle modulation occurs together with cardiac cycle modulation. It will be understood that the techniques illustrated by FIG. 2C are merely exemplary and that other suitable techniques may be used for drive cycle modulation, as described above. It will also be understood that other suitable methods may be used to combine the drive cycle modulation and the cardiac cycle modulation. It will also be understood that the combining technique may depend in part on the particular drive cycle modulation and cardiac cycle modulation technique. It will also be understood that conventional servo algorithms may be used in addition to combinations of drive cycle modulation and cardiac cycle modulation. Lisogurski at 16:17-17:29 One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. Lisogurski at 17:39-43 In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. **The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof.** For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. Lisogurski at 19:20-27 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Lisogurski discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. In some embodiments, **a technique to remove ambient and background signals may be used** in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, **a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the ambient light detected by the detector during the “dark” period and then subtract this ambient contribution from the signals received during the first and second “on” periods.** Lisogurski at 6:7-19 As used herein, the terms “on” and “off” are merely exemplary and may not necessarily refer to a fully on or off state. **For example, “on” and “off” may refer to** switching power or other components, **high and low brightness output states**, high and low values within a continuous modulation, **high and low values of electrical current provided to an emitter**, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitter is switched on), **any other suitable relatively distinct states, or any combination thereof**. In some embodiments, “on” and “off” states may relate to high and low values of a variable that varies with multiple discrete steps. **For example, an emitter brightness may be provided by the system as off, low, medium, and high. In this example, an “off” state may refer to off or low emission and “on” may refer to medium or high. In another example, “off” may refer to an off state and “on” may refer to a low, medium, or high output** depending on a second input or system variable. Lisogurski at 8:27-44

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	In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other suitable reasons, or any combination thereof. **The system may receive, for example, an increased level of background noise in the signal due to patient motion**. **The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio**. In some embodiments, the system may increase brightness throughout the cardiac cycle because the system may require increased signal amplitudes to differentiate between fiducial and other points of interest related to physiological parameters and those related to noise or motion. In some embodiments, the system may change from a modulated light output to a constant light output in response to noise, patient motion, or ambient light. Lisogurski at 9:46-60 **Referring back to FIG. 1, front end processing circuitry 150, which may receive a detection signal**, such as detector current waveform 214, **may include** analog conditioner 152, analog-to-digital converter 154, demultiplexer 156, digital conditioner 158, decimator/interpolator 160, and **dark subtractor 162**. Lisogurski at 13:7-12. **Dark subtractor 162 may operate on the digital signal**. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, **dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak**. For example, in reference to FIG. 2A, **a detection signal peak corresponding to red "on" period 202 may be adjusted by determining the amount of dark signal during the "off" period 220 preceding red "on" period 202**. **The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red "on" period 202. Alternatively, the "off" period 220 after red "on" period 202 may be used to correct red "on" period 202 rather than the "off" period 220 preceding it. Additionally, an average of the "off" periods 220 before and after red "on" period 202 may be used**. Lisogurski at 13:60-14:10

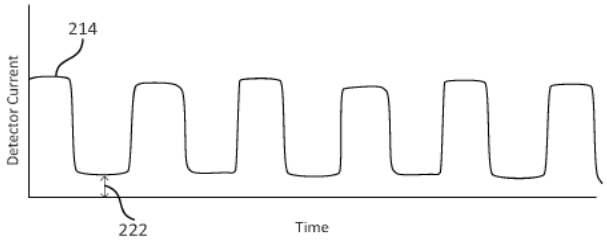
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	Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Lisogurski at 14:46-55 FIG. 2C shows illustrative timing diagrams of drive cycle modulation and cardiac cycle modulation in accordance with some embodiments of the present disclosure. Plot 250 may include a timing diagram of an exemplary cardiac cycle modulation, including red light modulation 252 and IR light modulation 254. In the embodiment illustrated in plot 250, the IR light remains at a constant level and the red light is “on” only during the diastole period. The period of the modulation cycle may correspond to time interval 260. In a further embodiment, the system may replace some or all of the “off” periods with “on” periods of lower light intensity, shorter duty cycles, any other suitable parameter variations, or a combination thereof. It will be understood that the aforementioned cardiac cycle modulation technique is merely exemplary and that the system may use any suitable cardiac cycle modulation technique. Region 256 of plot 250 indicates an interval of the timing diagram where both red light modulation 252 and IR light modulation 254 are in an “on” portion of the cardiac cycle modulation. Plot 270 shows an illustrative portion of region 256, where the system is employing a cardiac cycle modulation in addition to the drive cycle modulation. Plot 250 may include a drive cycle modulation technique with a period of time interval 272. The time scale of plot 270 may be significantly shorter than the time scale of plot 250, such that time interval 272 is significantly shorter than time interval 260. For example, time interval 260 (i.e., the period of the cardiac cycle modulation) may be on the order of 1 second, while time interval 272 (i.e., the period of the drive cycle modulation) may be on the order of 1 ms. **Time interval 272 may include a sequence of red “on” portion 274, a first “off” portion 276, IR “on” portion 278, and a second “off” portion 280. The first “off” portion 276 and second “off” portion 280 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 274 and IR “on” period 278.**

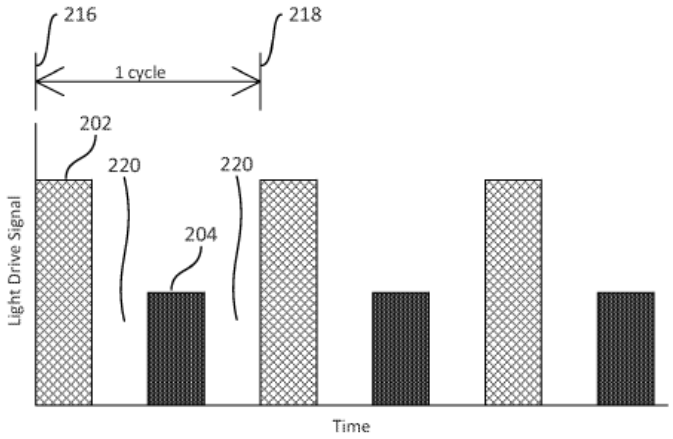
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	Region 258 of plot 250 indicates an interval of the timing diagram where the red light modulation 252 is in an “off” portion of the cardiac cycle modulation and IR light modulation 254 is in an “on” portion of the cardiac cycle modulation. Plot 282 shows an illustrative portion of region 258, where the system is employing a drive cycle modulation technique in addition to the cardiac cycle modulation. Plot 282 may include a drive cycle modulation technique with a period of time interval 284. The time scale of plot 282 may be significantly shorter than the time scale of plot 250, such that time interval 284 is significantly shorter than time interval 260. In some embodiments, the time scale of plot 282 may be the same as the time scale of plot 270. **Time interval 284 may include a sequence of red “on” portion 286, a first “off” portion 288, IR “on” portion 290, and a second “off” portion 292. The red “on” portion 286 may include less red light emitted than during red “on” portion 274, or no red light emitted, as red light modulation 252 is in an “off” phase during region 258. The first “off” portion 288 and second “off” portion 292 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 286 and IR “on” portion 290**. Red light modulation 252 may be in an “on” portion during region 256 (illustrated in detail in plot 270) and an “off” portion during region 258 (illustrated in detail in plot 282). Thus, the level of red light indicated by red “on” portion 274 is at a high level and the level of red light indicated by red “on” portion 286 is at a low level. This is illustrative of an embodiment where drive cycle modulation occurs together with cardiac cycle modulation. It will be understood that the techniques illustrated by FIG. 2C are merely exemplary and that other suitable techniques may be used for drive cycle modulation, as described above. It will also be understood that other suitable methods may be used to combine the drive cycle modulation and the cardiac cycle modulation. It will also be understood that the combining technique may depend in part on the particular drive cycle modulation and cardiac cycle modulation technique. It will also be understood that conventional servo algorithms may be used in addition to combinations of drive cycle modulation and cardiac cycle modulation. Lisogurski at 16:17-17:29 In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. **The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof.** For example, the light source may include light source

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	130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. Lisogurski at 19:20-27 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Lisogurski discloses or renders obvious wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. Systems and methods are provided for optimizing power consumption in an optical physiological monitoring system. The system may vary light drive signal parameters to reduce power consumption or vary power use. The system may vary parameters in a technique correlated to cardiac pulse cycles. In some embodiments, reducing power consumption may allow for increased battery life in portable systems or increased portability. In some embodiments, varying light output during a cardiac cycle may reduce heating effects of the emitters. Parameters that may be varied include light intensity, firing rate, duty cycle, other suitable parameters, or any combination thereof. The generated signals may be used to determined physiological parameters such as blood oxygen saturation, hemoglobin, blood pressure, pulse rate, other suitable parameters, or any combination thereof. Lisogurski at 1:10-25 Pulse oximeters may be included in patient monitoring systems that measure and display various blood flow characteristics including, but not limited to, the oxygen saturation of hemoglobin in arterial blood. Such patient monitoring systems may also measure and display additional physiological parameters, such as a patient's pulse rate and blood pressure. An oximeter may include a light sensor that is placed at a site on a patient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot. The oximeter may use a light source to

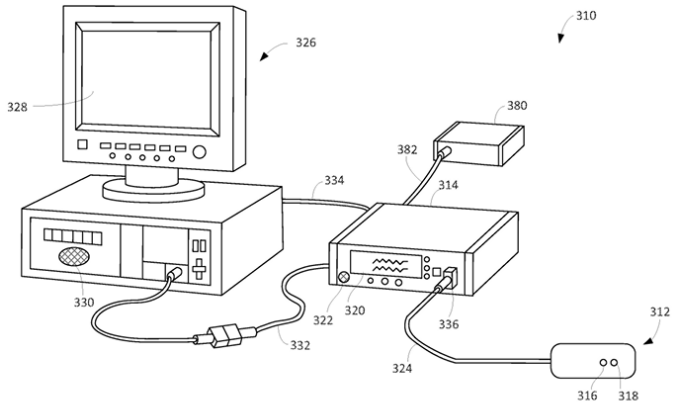
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	pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically understood to be optimal for pulse oximetry serve as suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional suitable sensor locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patient's thigh to monitor femoral artery pulsatile flow, the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. Suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. **In all suitable locations, for example, the oximeter may measure the intensity of light that is received at the light sensor as a function of time**. The oximeter may also include sensors at multiple locations. A signal representing light intensity versus time or a mathematical manipulation of this signal (e.g., a scaled version thereof; a logarithm taken thereof, a scaled version of a logarithm taken thereof; a derivative taken thereof, a difference taken thereof, etc.) may be referred to as the photoplethysmograph (PPG) signal. In addition, the term “PPG signal,” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue), a transmission signal (i.e., representing the amount of light received from the tissue), any suitable mathematical manipulation thereof; or any combination thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs. In some applications, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Red and infrared (IR) wavelengths may be used because it has been observed that highly oxygenated blood will absorb relatively less red light and more IR light than blood with a lower oxygen saturation. By comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen saturation of hemoglobin in arterial blood. The system may process data to determine physiological parameters using techniques well known in the art. For example, the system may determine blood oxygen saturation using two wavelengths of light and a ratio-of-ratios calculation. The system also may identify pulses and determine pulse amplitude, respiration, blood pressure, other suitable parameters, or any combination thereof, using any suitable calculation techniques. In some embodiments, the system may use information from external sources (e.g., tabulated data, secondary sensor devices) to determine physiological parameters. Lisogurski at 3:66-4:62

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	In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a "dark" period, followed by a second light source, followed by a "dark" period. The system may measure the ambient light detected by the detector during the "dark" period and then subtract this ambient contribution from the signals received during the first and second "on" periods. Lisogurski at 6:7-19 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:9-27 Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue at certain oxygen saturations. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. Lisogurski at 12:9-16

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	 FIG. 2B Lisogurski at Fig. 2B FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below. Lisogurski at 12:52-13:6 Demultiplexer 156 may operate on detector current waveform 214 of FIG. 2B to generate a Red signal, an IR signal, a first dark signal (e.g., corresponding to the dark component that occurs immediately after

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	the Red component), and a second dark signal (e.g., corresponding to the dark component that occurs immediately after the IR component). Lisogurski at 13:35-41  FIG. 2A Lisogurski at Fig. 2A Dark subtractor 162 may operate on the digital signal. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red "on" period 202 may be adjusted by determining the amount of dark signal during the "off' period 220 preceding red "on" period 202. The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red “on” period 202. Alternatively, the “off” period 220 after red “on” period 202 may be used to correct red “on” period 202 rather than the “off” period 220 preceding it. Additionally, an average of the “off” periods 220 before and after red “on” period 202 may be used.

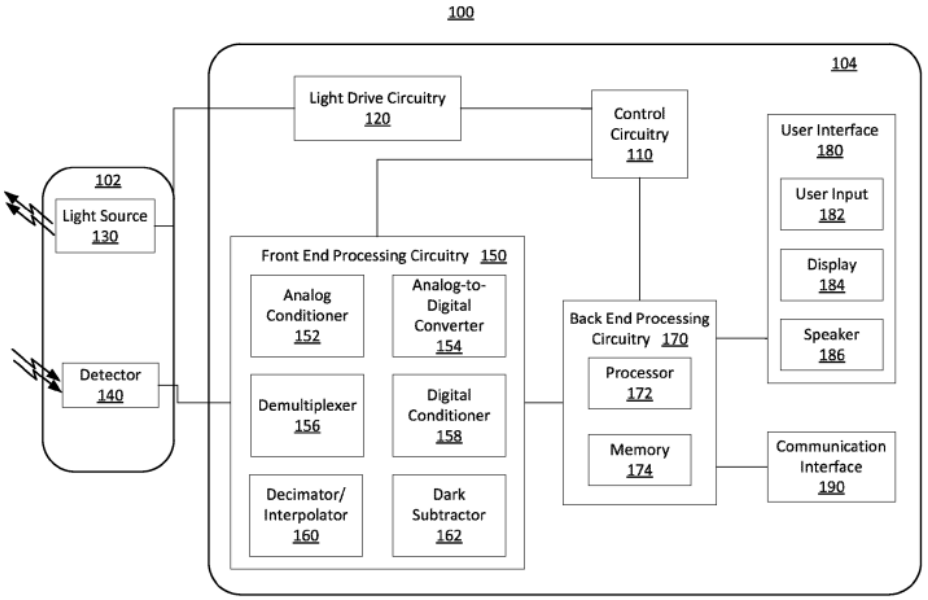
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	Lisogurski at 13:60-14:10 It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Lisogurski at 15:66-16:16 FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. System 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two different locations on a subject's body. Lisogurski at 17:30-53

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	 FIG. 3 Lisogurski at Fig.3 Multi-parameter physiological monitor 326 may be configured to calculate physiological parameters and to provide a display 328 for information from monitor 314 and from other medical monitoring devices or systems (not shown). Lisogurski at 18:49-53 In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. In some embodiments, any of the processing components and/or circuits, or portions thereof, of FIGS. 1 and 3 may be referred to collectively as processing equipment. For example, processing equipment may be configured to generate light drive signals, amplify, filter, sample and digitize detector signals, and calculate physiological information from the digitized signal. In some embodiments, all or some of the components of the processing equipment may be referred to as a processing module. FIG. 4 is flow diagram 400 showing illustrative steps for determining a physiological parameter in accordance with some embodiments of the present disclosure. In some embodiments, the system may

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	emit a photonic signal from a first light source and use information from the related attenuated signal to generate a light drive signal for a second light source. In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulation. For example, the first light drive signal may be configured to activate one LED to emit a photonic signal and not activate other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated. In step 404, the system may receive a light signal. The light may be received using a sensor, for example, detector 140 of FIG. 1 or detector 318 of FIG. 3. The light signal may be attenuated by the subject. The received light signal may in part include light from the first photonic signal. For example, the system may emit light that is reflected by the subject or transmitted through the subject. The interaction of the emitted light with the subject may cause the light to become attenuated. In some embodiments, the attenuation of the light may depend on the wavelength of the light and the tissue with which the light interacts. For example, particular wavelengths of light may be attenuated more strongly by oxyhemoglobin than other wavelengths. In some embodiments, the system may amplify the received signal using front end processor circuitry. In some embodiments, the gain may be modulated using a technique correlated to the cardiac cycle modulation. The gain of the amplifier may be adjusted based on the emitted light brightness, historical information related to the brightness of prior received attenuated signals, other suitable information, or any combination thereof, so that the amplified signal matches the range of the analog-to-digital converter and thus increases resolution. In some embodiments, the system may account for the gain using hardware, software, or any combination thereof, such that the original intensity information is retained. In step 406, the system may analyze the received light signal to determine when to activate a second light source and/or parameters of a second photonic signal In some embodiments, the second light source may include one or more emitters. In some embodiments, the system may identify peaks, valleys, inflection points, slope changes, fiducial points, other suitable elements, or any combination thereof in the received

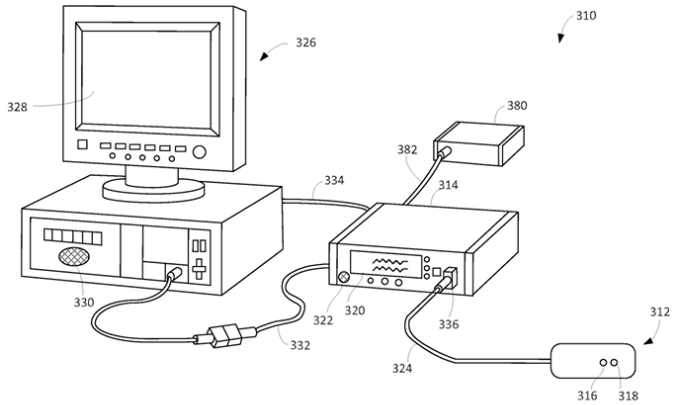
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	light source. In some embodiments, the system may use information determined from analyzing the first light source in addition to other information. Other information may include, for example, historical analysis of prior cardiac cycles and information from external sensors. For example, the system may determine an average pulse period from a number of prior pulse cycles. Statistical information such as the standard deviation may also be calculated to in part determine a confidence parameter for the historical information. In some embodiments, the system may use a respiration rate. For example, the system may determine a respiration rate from an external sensor and use information from the respiration rate to determine a modulation technique. In some embodiments, the cardiac cycle modulation applied to the second light drive signal may be varied based on the historical and statistical information. In some embodiments, the system may determine to turn on a second light source with a time offset to the element of interest in the cardiac cycle. For example, the system may turn on the second light source a certain number of milliseconds prior to the peak (or expected peak) of a pulse signal. In a further example, the system may wait a certain number of milliseconds following a peak in an ECG signal. In some embodiments, the time offsets may be adjusted based on prior signal analysis, adjusted by user input, adjusted by predetermined values, adjusted by any other suitable technique, or any combination thereof. In some embodiments, parameters of the second photonic signal, for example duty cycle, decimation ratio, and brightness, may be determined based on analysis of the received light signal. In step 408, the system may generate a second light drive signal. The second light drive signal may be configured to activate a second light source or a different emitter from the first light source to emit a second photonic signal. For example, in a cardiac cycle modulation where a first light source remains on at a constant level (e.g., in a drive cycle modulation) and a second light source is turned on and off to optimize power consumption, the second light drive signal may cause a second light source to emit light at a particular time or times in the cardiac cycle. Light from the second photonic signal may be attenuated by the subject and received by a sensor. In some embodiments, the system may adjust the second light drive signal based on historical data. For example, the system may use information from prior pulse cycles to determine an optimal emitter brightness. In step 410, the system may determine a physiological parameter using information from the attenuated photonic signals. The physiological parameter may be determined using any suitable hardware technique, software technique, or combination thereof. In some embodiments, processing equipment remote to the system may be used to determine physiological parameters. The system may display the determined physiological parameter using a local display (e.g., display 320 of FIG. 3 or display 328 of FIG. 3), display them on a remote display, publish the data to a server or website, make the parameters available to a user by any other suitable technique, or any combination thereof.

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	Lisogurski at 19:1-20:60 In some embodiments, the system may detect a physiological parameter, for example, a low blood oxygen saturation, low pulse rate, high pulse rate, high blood pressure, low blood pressure, any other suitable condition, or any combination thereof. **In some embodiments, the system may detect a signal indicative of a system error such as a physiologically impossible value, a probe-off signal, any other suitable signal, or any combination thereof.** The system may detect the physiological condition using information obtained through measurements in step 1902, from an external sensor or controller, by any other suitable technique, or any combination thereof. Lisogurski at 36:66-37:5 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at	Lisogurski discloses or renders obvious the apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal. *See* claim 1 above. *See also*, e.g.: In some embodiments, the system may vary the algorithm used to determine a physiological parameter based, in part, on the cardiac cycle modulation technique. For example, if a cardiac cycle modulation technique only detects the peaks and valleys of a pulse cycle, a first type of blood oxygen saturation

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least a portion of the output signal.	algorithm may be used (e.g., discrete oximetry based only on the peak and valley information). If the cardiac cycle modulation technique detects the entire pulse, a different blood oxygen saturation detection algorithm may be used (e.g., a regression based algorithm). In some embodiments, the system may alter the cardiac cycle modulation technique based on the level of noise, ambient light, other Suitable reasons, or any combination thereof. The system may receive, for example, an increased level of background noise in the signal due to patient motion. The system may increase the brightness of the light sources in response to the noise to improve the signal-to-noise ratio. Lisogurski at 9:36-52  FIG. 1 Lisogurski at Fig. 1 Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing

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	circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Lisogurski at 12:42-51 Back end processing circuitry 170 may include processor 172 and memory 174. Processor 172 may be adapted to execute software, which may include an operating system and one or more applications, as part of performing the functions described herein. Processor 172 may receive and process physiological signals received from front end processing circuitry 150. **For example, processor 172 may determine one or more physiological parameters based on the received physiological signals. Memory 174 may include any suitable computer-readable media capable of storing information that can be interpreted by processor 172. This information may be data or may take the form of computer-executable instructions, such as software applications, that cause the microprocessor to perform certain functions and/or computer-implemented methods. Depending on the embodiment, such computer-readable media may include computer storage media and communication media. Computer storage media may include volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. Computer storage media may include, but is not limited to, RAM, ROM, EPROM, EEPROM, flash memory or other solid state memory technology, CD-ROM, DVD, or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by components of the system. Back end processing circuitry 170 may be communicatively coupled with use interface 180 and communication interface 190**. User interface 180 may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device. The inputs received by user input 182 can include information about the subject, such as age, weight, height, diagnosis, medications, treatments, and so forth. In an embodiment, the subject may be a medical patient and display 184 may exhibit a list of values which may generally apply to the patient, such as, for example, age ranges or medication families, which the user may select using user input 182. Additionally, display 184 may

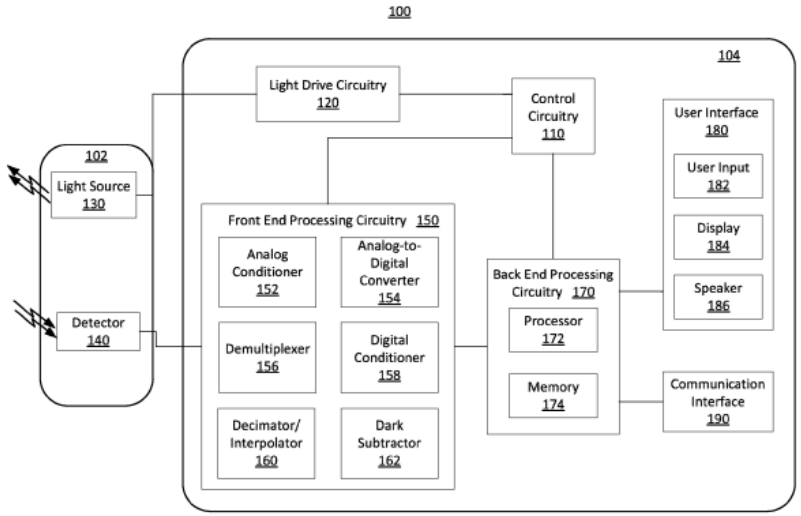
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	display, for example, an estimate of a subject's blood oxygen saturation generated by monitor 104 (referred to as an “SpO2” measurement), pulse rate information, respiration rate information, blood pressure, any other parameters, and any combination thereof. Display 184 may include any type of display such as a cathode ray tube display, a flat panel display such a liquid crystal display or plasma display, or any other suitable display device. Speaker 186 within user interface 180 may provide an audible sound that may be used in various embodiments, such as for example, sounding an audible alarm in the event that a patient's physiological parameters are not within a predefined normal range. Communication interface 190 may enable monitor 104 to exchange information with external devices. Communications interface 190 may include any suitable hardware, software, or both, which may allow monitor 104 to communicate with electronic circuitry, a device, a network, a server or other workstations, a display, or any combination thereof. Communications interface 190 may include one or more receivers, transmitters, transceivers, antennas, plug-in connectors, ports, communications buses, communications protocols, device identification protocols, any other suitable hardware or software, or any combination thereof. Communications interface 190 may be configured to allow wired communication (e.g., using USB, RS-232 or other standards), wireless communication (e.g., using WiFi, IR, WiMax, BLUETOOTH, UWB, or other standards), or both. For example, communications interface 190 may be configured using a universal serial bus (USB) protocol (e.g., USB 2.0, USB 3.0), and may be configured to couple to other devices (e.g., remote memory devices storing templates) using a four-pin USB standard Type-A connector (e.g., plug and/or socket) and cable. In some embodiments, communications interface 190 may include an internal bus such as, for example, one or more slots for insertion of expansion cards. It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry.

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	Lisogurski at 14:56-16:16  FIG. 3 Lisogurski at Fig.3 FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. System 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two different locations on a subject's body.

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	In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and acoustic detection received from one or more sensor units such as sensor unit 312. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxygenated, and/or total), any other suitable physiological parameters, or any combination thereof. In some embodiments, calculations may be performed on the sensor units or an intermediate device and the result of the calculations may be passed to monitor 314. Further, monitor 314 may include display 320 configured to display the physiological parameters or other information about the system. In the embodiment shown, monitor 314 may also include a speaker 322 to provide an audible sound that may be used in various other embodiments, such as for example, sounding an audible alarm in the event that a subject's physiological parameters are not within a predefined normal range. In some embodiments, the system 310 includes a stand-alone monitor in communication with the monitor 314 via a cable or a wireless network link. In some embodiments, monitor 314 may be implemented as monitor 104 of FIG. 1. In some embodiments, sensor unit 312 may be communicatively coupled to monitor 314 via a cable 324. Cable 324 may include electronic conductors (e.g., wires for transmitting electronic signals from detector 318), optical fibers (e.g., multi-mode or single-mode fibers for transmitting emitted light from light source 316), any other suitable components, any suitable insulation or sheathing, or any combination thereof. In some embodiments, a wireless transmission device (not shown) or the like may be used instead of or in addition to cable 324. Monitor 314 may include a sensor interface configured to receive physiological signals from sensor unit 312, provide signals and power to sensor unit 312, or otherwise communicate with sensor unit 312. The sensor interface may include any suitable hardware, software, or both, which may be allow communication between monitor 314 and sensor unit 312. Calibration device 380, which may be powered by monitor 314, a battery, or by a conventional power source such as a wall outlet, may include any suitable calibration device. Calibration device 380 may be communicatively coupled to monitor 314 via communicative coupling 382, and/or may communicate wirelessly (not shown). In some embodiments, calibration device 380 is completely integrated within monitor 314. In some embodiments, calibration device 380 may include a manual input device (not shown) used by an operator to manually input reference signal measurements obtained from some other source (e.g., an external invasive or non-invasive physiological measurement system).

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	In the illustrated embodiment, system 310 includes a multi-parameter physiological monitor 326. The monitor 326 may include a cathode ray tube display, a flat panel display (as shown) such as a liquid crystal display (LCD) or a plasma display, or may include any other type of monitor now known or later developed. Multi-parameter physiological monitor 326 may be configured to calculate physiological parameters and to provide a display 328 for information from monitor 314 and from other medical monitoring devices or systems (not shown). For example, multi-parameter physiological monitor 326 may be configured to display an estimate of a subject's blood oxygen saturation and hemoglobin concentration generated by monitor 314. Multi-parameter physiological monitor 326 may include a speaker 330. Monitor 314 may be communicatively coupled to multi-parameter physiological monitor 326 via a cable 332 or 334 that is coupled to a sensor input port or a digital communications port, respectively and/or may communicate wirelessly (not shown). In addition, monitor 314 and/or multi-parameter physiological monitor 326 may be coupled to a network to enable the sharing of information with servers or other workstations (not shown). Monitor 314 may be powered by a battery (not shown) or by a conventional power source such as a wall outlet. In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. In some embodiments, any of the processing components and/or circuits, or portions thereof, of FIGS. 1 and 3 may be referred to collectively as processing equipment. For example, processing equipment may be configured to generate light drive signals, amplify, filter, sample and digitize detector signals, and calculate physiological information from the digitized signal. In some embodiments, all or some of the components of the processing equipment may be referred to as a processing module. Lisogurski at 17:30-19:12 The system may display the determined physiological parameter using a local display (e.g., display 320 of FIG. 3 or display 328 of FIG. 3), display them on a remote display, publish the data to a server or website, make the parameters available to a user by any other suitable technique, or any combination thereof. Lisogurski at 20:55-60

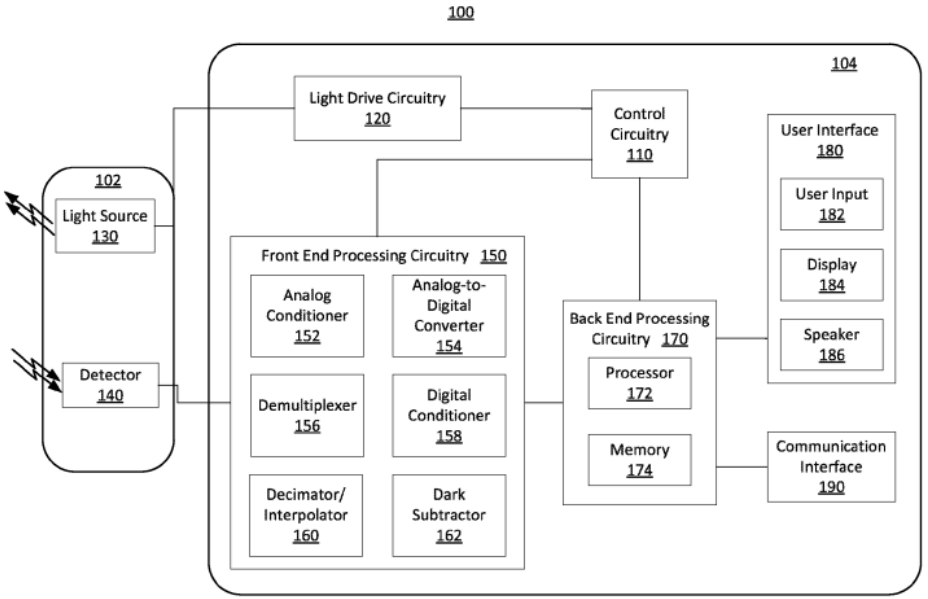
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	The system may determine the timing of the diastole periods using historical information from previous cardiac cycles, from an external sensor, from user input, from measurements made with a different cardiac cycle modulation, by any other suitable technique, or any combination thereof. Lisogurski at 27:31–36 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	
6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	Lisogurski discloses or renders obvious the apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. *See* claim 1 above. *See also*, e.g.:

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	 FIG. 1 Lisogurski at Fig. 1 The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using **one or more physiological sensors. The system may include, for example, a light source** and a photosensitive detector. Lisogurski at 3:43-46 **Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140**. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue. **For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals**. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. **It will be understood that light source 130 may include any number of light sources with any suitable characteristics**. **In embodiments**

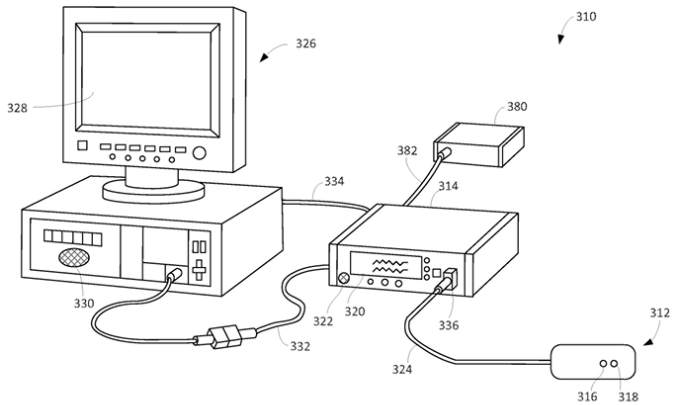
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	where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. It will be understood that, as used herein, the term “light” may refer to energy produced by radiative sources and may include one or more of ultrasound, radio, microwave, millimeter wave, infrared, visible, ultraviolet, gamma ray or X-ray electromagnetic radiation. As used herein, light may also include any wavelength within the radio, microwave, infrared, visible, ultraviolet, or X-ray spectra, and that any suitable wavelength of electromagnetic radiation may be appropriate for use with the present techniques. Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130. Lisogurski at 10:48-11:6 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an **array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength**. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:9-27 System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. **Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart**.

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	Lisogurski at 17:35-45 In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The **light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof**. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulation. For example, the first light drive signal may be configured to activate one LED to emit a photonic signal and not activate other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated. Lisogurski at 19:20-39 The system may determine the time offsets between the “on” periods and the region of interest based on user input, predetermined parameters, previous measurements, other suitable parameters, or any combination thereof. The system may determine the timing of the diastole periods using historical information from previous cardiac cycles, from an external sensor, from user input, from measurements made with a different cardiac cycle modulation, by any other suitable technique, or any combination thereof. For example, the system may desire to align a particular portion of the received signal with the center of a modulation cycle (or other suitable criteria) and advance or delay subsequent modulation cycles to improve the alignment. It will be understood that the system may align modulation with pulses of the heart, pulses of a particular muscle group, other suitable pulses, any other suitable physiological function, or any combination thereof. Lisogurski at 27:28-43 In step 1702, the system may receive a signal. The signal may be sampled at a first rate. The signal may be sampled using an analog-to-digital converter in the front end processing circuitry. For example, an

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	attenuated light signal may be converted to an analog electronic signal by a detector. The analog electronic signal may be converted to a digital signal at a particular rate by an analog to digital converter, such that at each sampling point the converter determines the amplitude of the analog signal (e.g., current or voltage) and outputs a digital word related to that amplitude. The rate at which sampling occurs may be controlled by, for example, a timing control signal (e.g., provided by control circuitry 110 of FIG. 1). In some embodiments, the sampling rate may represent the number of samples taken during an “on” period of the drive cycle modulation. In some embodiments, the sampling rate may represent the amount of time between “on” periods. Lisogurski at 33:65-34:13 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	Lisogurski discloses or renders obvious the apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. *See* claim 6 above. *See also*, e.g.: In some embodiments, reducing power consumption may allow for increased battery life in portable systems or increased portability.

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	Lisogurski at 1:16-18  FIG. 1 Lisogurski at Fig. 1 Back end processing circuitry 170 may include processor 172 and memory 174. Processor 172 may be adapted to execute software, which may include an operating system and one or more applications, as part of performing the functions described herein. Processor 172 may receive and process physiological signals received from front end processing circuitry 150. For example, processor 172 may determine one or more physiological parameters based on the received physiological signals. Memory 174 may include any suitable computer-readable media capable of storing information that can be interpreted by processor 172. This information may be data or may take the form of computer-executable instructions, such as software applications, that cause the microprocessor to perform certain functions and/or computer-implemented methods. Depending on the embodiment, such computer-readable media may include computer storage media and communication media. Computer storage media may include volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data.

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	Computer storage media may include, but is not limited to, RAM, ROM, EPROM, EEPROM, flash memory or other solid state memory technology, CD-ROM, DVD, or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by components of the system. Back end processing circuitry 170 may be communicatively coupled with use interface 180 and communication interface 190. User interface 180 may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device. The inputs received by user input 182 can include information about the subject, such as age, weight, height, diagnosis, medications, treatments, and so forth. In an embodiment, the subject may be a medical patient and display 184 may exhibit a list of values which may generally apply to the patient, such as, for example, age ranges or medication families, which the user may select using user input 182. Additionally, display 184 may display, for example, an estimate of a subject's blood oxygen saturation generated by monitor 104 (referred to as an “SpO2” measurement), pulse rate information, respiration rate information, blood pressure, any other parameters, and any combination thereof. Display 184 may include any type of display such as a cathode ray tube display, a flat panel display such a liquid crystal display or plasma display, or any other suitable display device. Speaker 186 within user interface 180 may provide an audible sound that may be used in various embodiments, such as for example, sounding an audible alarm in the event that a patient's physiological parameters are not within a predefined normal range. Communication interface 190 may enable monitor 104 to exchange information with external devices. Communications interface 190 may include any suitable hardware, software, or both, which may allow monitor 104 to communicate with electronic circuitry, a device, a network, a server or other workstations, a display, or any combination thereof. Communications interface 190 may include one or more receivers, transmitters, transceivers, antennas, plug-in connectors, ports, communications buses, communications protocols, device identification protocols, any other suitable hardware or software, or any combination thereof. Communications interface 190 may be configured to allow wired communication (e.g., using USB, RS-232 or other standards), wireless communication (e.g., using WiFi, IR, WiMax, BLUETOOTH, UWB, or other standards), or both. For example, communications interface 190 may be configured using a universal serial bus (USB) protocol (e.g., USB 2.0, USB 3.0), and may be configured to couple to other devices (e.g., remote memory devices storing templates) using a four-pin USB standard

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	Type-A connector (e.g., plug and/or socket) and cable. In some embodiments, communications interface 190 may include an internal bus such as, for example, one or more slots for insertion of expansion cards. It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Lisogurski at 14:56-16:16  FIG. 3 Lisogurski at Fig.3

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	FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. System 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two different locations on a subject's body. In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and acoustic detection received from one or more sensor units such as sensor unit 312. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxygenated, and/or total), any other suitable physiological parameters, or any combination thereof. In some embodiments, calculations may be performed on the sensor units or an intermediate device and the result of the calculations may be passed to monitor 314. Further, monitor 314 may include display 320 configured to display the physiological parameters or other information about the system. In the embodiment shown, monitor 314 may also include a speaker 322 to provide an audible sound that may be used in various other embodiments, such as for example, sounding an audible alarm in the event that a subject's physiological parameters are not within a predefined normal range. In some embodiments, the system 310 includes a stand-alone monitor in communication with the monitor 314 via a cable or a wireless network link. In some embodiments, monitor 314 may be implemented as monitor 104 of FIG. 1. In some embodiments, sensor unit 312 may be communicatively coupled to monitor 314 via a cable 324. Cable 324 may include electronic conductors (e.g., wires for transmitting electronic signals from

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	detector 318), optical fibers (e.g., multi-mode or single-mode fibers for transmitting emitted light from light source 316), any other suitable components, any suitable insulation or sheathing, or any combination thereof. In some embodiments, a wireless transmission device (not shown) or the like may be used instead of or in addition to cable 324. Monitor 314 may include a sensor interface configured to receive physiological signals from sensor unit 312, provide signals and power to sensor unit 312, or otherwise communicate with sensor unit 312. The sensor interface may include any suitable hardware, software, or both, which may be allow communication between monitor 314 and sensor unit 312. Calibration device 380, which may be powered by monitor 314, a battery, or by a conventional power source such as a wall outlet, may include any suitable calibration device. Calibration device 380 may be communicatively coupled to monitor 314 via communicative coupling 382, and/or may communicate wirelessly (not shown). In some embodiments, calibration device 380 is completely integrated within monitor 314. In some embodiments, calibration device 380 may include a manual input device (not shown) used by an operator to manually input reference signal measurements obtained from some other source (e.g., an external invasive or non-invasive physiological measurement system). In the illustrated embodiment, system 310 includes a multi-parameter physiological monitor 326. The monitor 326 may include a cathode ray tube display, a flat panel display (as shown) such as a liquid crystal display (LCD) or a plasma display, or may include any other type of monitor now known or later developed. Multi-parameter physiological monitor 326 may be configured to calculate physiological parameters and to provide a display 328 for information from monitor 314 and from other medical monitoring devices or systems (not shown). For example, multi-parameter physiological monitor 326 may be configured to display an estimate of a subject's blood oxygen saturation and hemoglobin concentration generated by monitor 314. Multi-parameter physiological monitor 326 may include a speaker 330. Monitor 314 may be communicatively coupled to multi-parameter physiological monitor 326 via a cable 332 or 334 that is coupled to a sensor input port or a digital communications port, respectively and/or may communicate wirelessly (not shown). In addition, monitor 314 and/or multi-parameter physiological monitor 326 may be coupled to a network to enable the sharing of information with servers or other workstations (not shown). Monitor 314 may be powered by a battery (not shown) or by a conventional power source such as a wall outlet. In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. In some embodiments, any of the processing components and/or circuits, or portions thereof, of FIGS. 1 and 3 may be referred to collectively as processing equipment. For example, processing equipment may be configured to generate light drive

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	signals, amplify, filter, sample and digitize detector signals, and calculate physiological information from the digitized signal. In some embodiments, all or some of the components of the processing equipment may be referred to as a processing module. Lisogurski at 17:30-19:12 The system may display the determined physiological parameter using a local display (e.g., display 320 of FIG. 3 or display 328 of FIG. 3), display them on a remote display, publish the data to a server or website, make the parameters available to a user by any other suitable technique, or any combination thereof. Lisogurski at 20:55-60 In step 906, the system may determine a physiological parameter using information from the attenuated photonic signals. The physiological parameter may be determined using any suitable hardware technique, software technique, or combination thereof. In some embodiments, processing equipment remote to the system may be used to determine physiological parameters. The system may display the determined physiological parameter using a local display (e.g., display 320 of FIG. 3 or display 328 of FIG. 3), display them on a remote display, publish the data to a server or website, make the parameters available to a user by any other suitable technique, or any combination thereof. Lisogurski at 26:49-60 The system may determine the timing of the diastole periods using historical information from previous cardiac cycles, from an external sensor, from user input, from measurements made with a different cardiac cycle modulation, by any other suitable technique, or any combination thereof. Lisogurski at 27:31–36 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lisogurski discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. *See* claim 1[pre], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Lisogurski discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;. *See* claim 1[c], 1[j], 1[k], above. *See also*, e.g.*:* Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control

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	signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Lisogurski at 11:33-49 In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulation. For example, the first light drive signal may be configured to activate one LED to emit a photonic signal and not activate other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated. Lisogurski at 19:20-39 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Lisogurski discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. *See* claim 1[d], above.

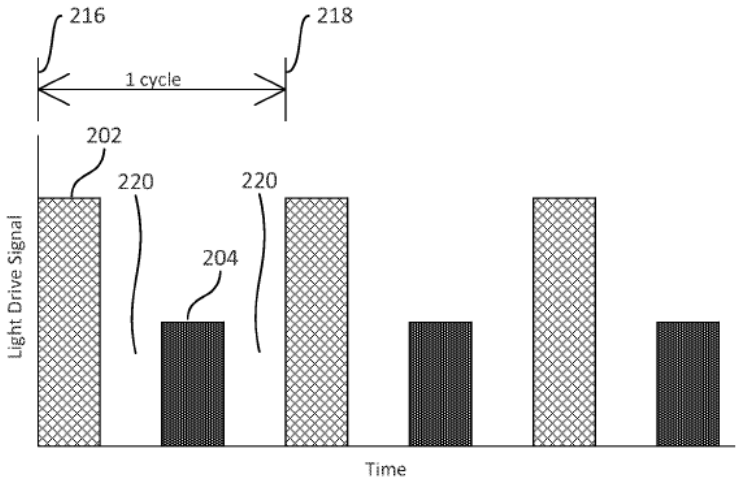
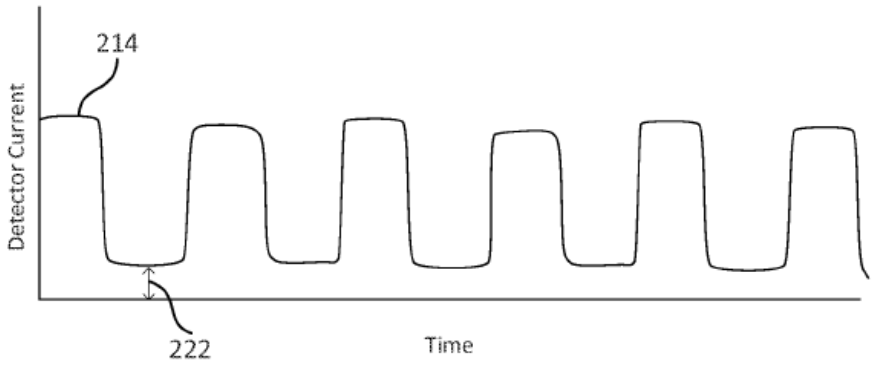
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Lisogurski discloses or renders obvious a detector. *See* claim 1[e], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Lisogurski discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio. *See* claim 1[k], above. *See also*, e.g.: Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Lisogurski at 12:42-51

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	For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Lisogurski at 16:4-16 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Lisogurski discloses or renders obvious (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. *See* claim 1[j], above. *See also*, e.g.: In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the ambient light detected by the detector during the “dark” period and then subtract this ambient contribution from the signals received during the first and second “on” periods. In some embodiments,

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	drive cycle modulation may be implemented using time division multiplexing as described above, code division multiplexing, carrier frequency multiplexing, phase division multiplexing, feedback circuitry, DC restoration circuitry, any other suitable technique, or any combination thereof. For example, the system may use frequency division multiplexing in a drive cycle modulation technique. The cardiac cycle modulation may represent a lower frequency envelope function on the higher frequency drive cycle. For example, cardiac cycle modulation may be an envelope on the order of 1 Hz superimposed on a 1 kHz sine wave drive cycle modulation. Lisogurski at 6:7-31 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Lisogurski at 11:9-27 The light drive signal of FIG. 2A may also include “off” periods 220 between the Red and IR light “on” periods. “Off” periods 220 are periods during which no drive current may be applied to light source 130. “Off” periods 220 may be provided, for example, to prevent overlap of the emitted light, since light source 130 may require time to turn completely on and completely off. The period from time 216 to time 218 may be referred to as a drive cycle, which includes four segments: a Red light “on” periods 202, followed by an “off” period 220, followed by an IR light “on” period 204, and followed by an “off” period 220. After time 218 the drive cycle may be repeated (e.g., as long as a light drive signal is provided to light source 130). It will be understood that the starting point of the drive cycle is merely illustrative and that the drive cycle can start at any location within FIG. 2A, provided the cycle spans two light “on”

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	periods and two “off” periods. Thus, each Red light “on” period 202 and each IR “on” period 204 may be understood to be surrounded by two dark periods 220. Lisogurski at 12:23-41 FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with light “on” periods driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not fall all of the way to zero. Rather, dark current 222 may be present in the detector waveform. Since dark current 222 may interfere with accurate determinations of physiological characteristics, dark current 222 may be removed as discussed in more detail below. Lisogurski at 12:52-13:6 For example, in reference to FIG. 2A, a detection signal peak corresponding to red “on” period 202 may be adjusted by determining the amount of dark signal during the “off” period 220 preceding red “on” period 202. The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red “on” period 202. Alternatively, the “off” period 220 after red “on” period 202 may be used to correct red “on” period 202 rather than the “off” period 220 preceding it. Additionally, an average of the “off” periods 220 before and after red “on” period 202 may be used. Lisogurski at 13:67-14:6 However, if the contribution of ambient light is large relative to the contribution of light from a light source, the total analog gain applied to the detection current may need to be reduced to avoid saturating analog-to-digital converter 154. When the analog gain is reduced, the portion of the signal corresponding

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	to the light source may map to a smaller number of analog-to-digital conversion bits. Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Lisogurski at 14:40-55 Region 256 of plot 250 indicates an interval of the timing diagram where both red light modulation 252 and IR light modulation 254 are in an “on” portion of the cardiac cycle modulation. Plot 270 shows an illustrative portion of region 256, where the system is employing a cardiac cycle modulation in addition to the drive cycle modulation. Plot 250 may include a drive cycle modulation technique with a period of time interval 272. The time scale of plot 270 may be significantly shorter than the time scale of plot 250, such that time interval 272 is significantly shorter than time interval 260. For example, time interval 260 (i.e., the period of the cardiac cycle modulation) may be on the order of 1 second, while time interval 272 (i.e., the period of the drive cycle modulation) may be on the order of 1 ms. Time interval 272 may include a sequence of red “on” portion 274, a first “off” portion 276, IR “on” portion 278, and a second “off” portion 280. The first “off” portion 276 and second “off” portion 280 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 274 and IR “on” period 278. Lisogurski at 16:33-54

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	 FIG. 2A Lisogurski at Fig. 2A  FIG. 2B Lisogurski at Fig. 2B

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	Lisogurski discloses or renders obvious (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. *See* claim 1[e], 1[h], 1[l], above. *See also*, e.g.: In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a “dark” period, followed by a second light source, followed by a “dark” period. The system may measure the ambient light detected by the detector during the “dark” period and then subtract this ambient contribution from the signals received during the first and second “on” periods. In some embodiments, drive cycle modulation may be implemented using time division multiplexing as described above, code division multiplexing, carrier frequency multiplexing, phase division multiplexing, feedback circuitry, DC restoration circuitry, any other suitable technique, or any combination thereof. For example, the system may use frequency division multiplexing in a drive cycle modulation technique. The cardiac cycle modulation may represent a lower frequency envelope function on the higher frequency drive cycle. For example, cardiac cycle modulation may be an envelope on the order of 1 Hz superimposed on a 1 kHz sine wave drive cycle modulation. Lisogurski at 6:7-31

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	Dark subtractor 162 may operate on the digital signal. In some embodiments, dark subtractor 162 may subtract dark values from the Red and IR components to generate adjusted Red and IR signals. For example, dark subtractor 162 may determine a subtraction amount from the dark signal portion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the dark signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red "on" period 202 may be adjusted by determining the amount of dark signal during the "off" period 220 preceding red "on" period 202. The dark signal amount determined in this manner may be subtracted from the detector peak corresponding to red "on" period 202. Alternatively, the "off" period 220 after red "on" period 202 may be used to correct red "on" period 202 rather than the "off" period 220 preceding it. Additionally, an average of the "off" periods 220 before and after red "on" period 202 may be used. Lisogurski at 13:60-14:10 However, if the contribution of ambient light is large relative to the contribution of light from a light source, the total analog gain applied to the detection current may need to be reduced to avoid saturating analog-to-digital converter 154. When the analog gain is reduced, the portion of the signal corresponding to the light source may map to a smaller number of analog-to-digital conversion bits. Thus, more ambient light noise in the input of analog-to-digital converter 154 may results in fewer bits of resolution for the portion of the signal from the light source. This may have a detrimental effect on the signal-to-noise ratio of the detection signal. Accordingly, passive or active filtering or signal modification techniques may be employed to reduce the effect of ambient light on the detection signal that is applied to analog-to-digital converter 154, and thereby reduce the contribution of the noise component to the converted digital signal. Lisogurski at 14:40-55 Region 256 of plot 250 indicates an interval of the timing diagram where both red light modulation 252 and IR light modulation 254 are in an "on" portion of the cardiac cycle modulation. Plot 270 shows an illustrative portion of region 256, where the system is employing a cardiac cycle modulation in addition to the drive cycle modulation. Plot 250 may include a drive cycle modulation technique with a period of time interval 272. The time scale of plot 270 may be significantly shorter than the time scale of plot 250, such that time interval 272 is significantly shorter than time interval 260. For example, time interval 260

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	(i.e., the period of the cardiac cycle modulation) may be on the order of 1 second, while time interval 272 (i.e., the period of the drive cycle modulation) may be on the order of 1 ms. Time interval 272 may include a sequence of red “on” portion 274, a first “off” portion 276, IR “on” portion 278, and a second “off” portion 280. The first “off” portion 276 and second “off” portion 280 may be used to determine the level of ambient light, noise, dark current, other suitable signals, or any combination thereof. The system may subtract the background or dark level from the levels received during red “on” portion 274 and IR “on” period 278. Lisogurski at 16:33-54 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.	Lisogurski discloses or renders obvious (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user. *See* claim 1[m], above. *See also*, e.g.: In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. Lisogurski at 16:12-14 In step 1904, the system may detect a physiological condition. For example, the system may detect dysrhythmia, arrhythmia, fibrillation, non-periodic heartbeat, tachycardia, other cardiac irregularity, or any combination thereof. The system may also detect no heartbeat. In some embodiments, the system may false-positive detect a physiological condition in the presence of noise, ambient light, a loss of

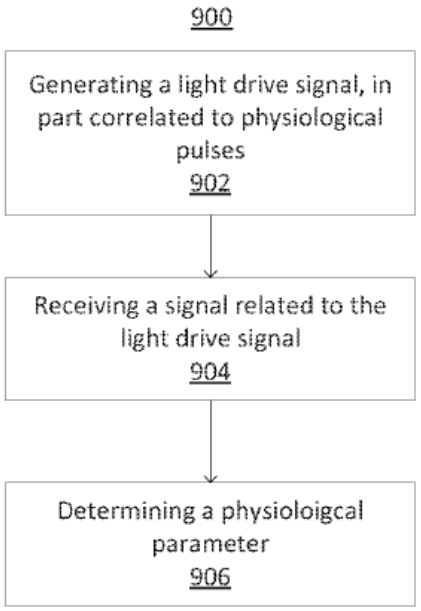
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	detector signal, any other suitable reason, or any combination thereof. In some embodiments, the system may detect a physiological parameter, for example, a low blood oxygen saturation, low pulse rate, high pulse rate, high blood pressure, low blood pressure, any other suitable condition, or any combination thereof. In some embodiments, the system may detect a signal indicative of a system error such as a physiologically impossible value, a probe-off signal, any other suitable signal, or any combination thereof. The system may detect the physiological condition using information obtained through measurements in step 1902, from an external sensor or controller, by any other suitable technique, or any combination thereof. Lisogurski at 36:54-37:5 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	

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11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	Lisogurski discloses or renders obvious the wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. *See* claim 8 above. *See also,* e.g.: Systems and methods are provided for optimizing power consumption in an optical physiological monitoring system. The system may vary light drive signal parameters to reduce power consumption or vary power use. The system may vary parameters in a technique correlated to cardiac pulse cycles. In some embodiments, reducing power consumption may allow for increased battery life in portable systems or increased portability. In some embodiments, varying light output during a cardiac cycle may reduce heating effects of the emitters. Parameters that may be varied include light intensity, firing rate, duty cycle, other suitable parameters, or any combination thereof. The generated signals may be used to determined physiological parameters such as blood oxygen saturation, hemoglobin, blood pressure, pulse rate, other suitable parameters, or any combination thereof. Lisogurski at 1:10-25 An oximeter is a medical device that may determine the Oxygen saturation of an analyzed tissue. One common type of oximeter is a pulse oximeter, which may non-invasively measure the oxygen saturation of a patient's blood (as opposed to measuring oxygen saturation directly by analyzing a blood sample taken from the patient). Pulse oximeters may be included in patient monitoring systems that measure and display various blood flow characteristics including, but not limited to, the oxygen saturation of hemoglobin in arterial blood. Such patient monitoring systems may also measure and display additional physiological parameters, such as a patient's pulse rate and blood pressure. Lisogurski at 3:61-4:5 In some applications, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Red and infrared (IR) wavelengths may be used because it has been observed that highly

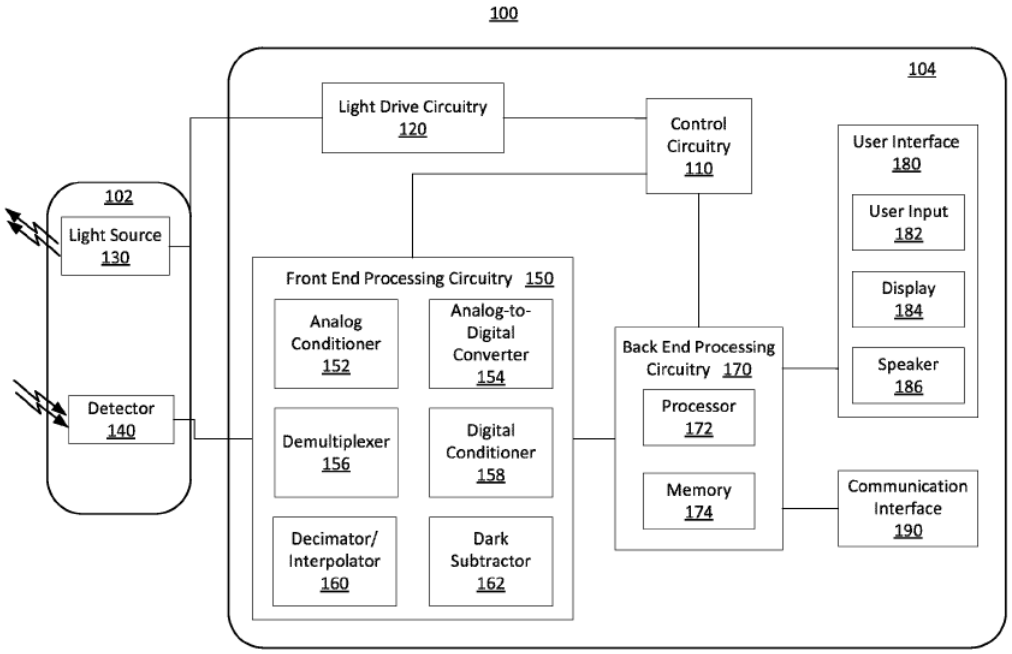
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	oxygenated blood will absorb relatively less red light and more IR light than blood with a lower oxygen saturation. By comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen saturation of hemoglobin in arterial blood. Lisogurski at 4:42-51 In some embodiments of cardiac cycle modulation, the system may modulate multiple light sources using a plurality of modulation techniques. For example, in a system with two light sources, the system may operate a first light source at full or regular brightness, while operating one or more additional light sources in a switched or otherwise modulated mode. In some embodiments, the system may operate a first light source according to a first cardiac cycle modulation technique and a second light source according to a second cardiac modulation technique. The first and second cardiac cycle modulation techniques may be the same, correlated, or unrelated. In some embodiments, the system may use the first light source to determine periods of interest in the cardiac cycle. The system may, according to the periods of interest, power additional light sources, alter the modulation of the additional light sources, perform other suitable power optimization techniques, or any combination thereof. In some embodiments, the system may include a first light source (e.g., a light source powered at full or regular brightness) of a type that is a more efficient light source than the one or more additional light sources. For example, the first light source may be a high efficiency infrared (IR) LED while the one or more additional light sources may be lower efficiency red LEDs or laser diodes. In some embodiments, the first light source may be selected based on efficiency parameters and information from the first light source may be used only to control a second light source. For example, a highly efficient first light source that is not at a wavelength of interest for physiological parameter determination may be used to control one or more second light sources at wavelengths of interest. In this case, the light from the first light source may be used only for controlling the second light source and not for determining physiological parameters. Lisogurski at 7:38-8:3 **Sensor 102 of physiological monitoring system 100 may include light source 130** and detector 140. **Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue**. **For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting**

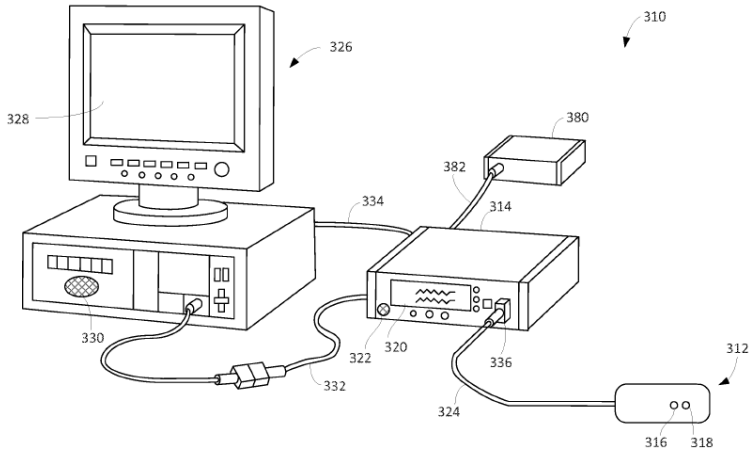
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	diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, **the Red wavelength may be between** about 600 nm and **about 700 nm,** and **the IR wavelength may be between about 800 nm and about 1000 nm.** It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. It will be understood that, as used herein, **the term “light” may refer to energy produced by radiative sources and may include one or more of** ultrasound, radio, microwave, millimeter wave, **infrared, visible**, ultraviolet, gamma ray or X-ray electromagnetic radiation. As used herein, light may also include any wavelength within the radio, microwave, infrared, visible, ultraviolet, or X-ray spectra, and that any suitable wavelength of electromagnetic radiation may be appropriate for use with the present techniques. Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130. Lisogurski at 10:48-11:8. Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term "detection signal," as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Lisogurski at 12:42-48 One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. **Any suitable configuration of light source 316 and detector 318 may be used**. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. System 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two different locations on a subject's body.

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	In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and acoustic detection received from one or more sensor units such as sensor unit 312. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxygenated, and/or total), any other suitable physiological parameters, or any combination thereof. Lisogurski at 17:39-67 In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. **The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1** or light source 316 of FIG. 3. In some embodiments, **the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led.** In some embodiments, **the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement**, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulation. For example, the first light drive signal may be configured to activate one LED to emit a photonic signal and not activate other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated. Lisogurski at 19:20-39. In some embodiments, blood with a relatively high blood oxygen saturation may absorb IR light more strongly than red light. Thus, the IR light may be more sensitive to pulsatile signals than red light. For example, blood with a high blood oxygen saturation may have a relatively higher concentration of oxyhemoglobin and a relatively lower concentration of deoxyhemoglobin, resulting in higher IR sensitivity. Conversely, in some embodiments, blood with a relatively low blood oxygen saturation may absorb red light more strongly than infrared light. For example, blood with a low blood oxygen saturation may have a relatively lower concentration of oxyhemoglobin and a relatively higher concentration of

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	deoxyhemoglobin, resulting in higher red sensitivity. Thus, it may be desired to monitor activity with the more sensitive available wavelength. Lisogurski at 24:58-25:5  Lisogurski at Fig. 9. **FIG. 9 is flow diagram 900 showing illustrative steps for determining a physiological parameter in accordance with some embodiments of the present disclosure**. In some embodiments, the system may emit a photonic signal correlated to physiological pulses from a light source, and use information from the related attenuated signal to determine physiological parameters. In some embodiments, varying parameters of the light drive signal may reduce, optimize, or otherwise suitably alter the power consumption of the system.

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	In step 902, the system may generate a light drive signal, in part correlated to physiological pulses. **The system may generate a light drive signal used by a light source to emit a photonic signal. The light source may be one or more emitters of one or more wavelengths, and they may emit one or more photonic signals**. For example**, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3**. In some embodiments, **the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR LED**. In some embodiments**, the light source may include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof**. Lisogurski at 25:22-43 In step 904, the system may receive a light signal. The light may be received using a sensor, for example, detector 140 of FIG. 1 or detector 318 of FIG. 3. The light signal may be attenuated by the subject. The received light signal may in part include light from the photonic signal. For example, the system may emit light that is reflected by the subject or transmitted through the subject. Interactions of the emitted light with the subject may cause the light to become attenuated. In some embodiments, the attenuation of the light may depend on the wavelength of the light and the tissue with which the light interacts. For example, particular wavelengths of light may be attenuated more strongly by oxyhemoglobin than other wavelengths. In some embodiments, the system may amplify the received signal using front end processor circuitry. The gain of the amplifier may be adjusted based on the emitted light brightness, historical information related to the brightness of prior received attenuated signals, other suitable information, or any combination thereof, so that the amplified signal matches the range of the analog-to-digital converter and thus increases resolution. In some embodiments, the system may account for the gain using hardware, software, or any combination thereof, such that the original intensity information is retained. Lisogurski at 26:26-48

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	 FIG. 1 Lisogurski at Fig. 1

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	 FIG. 3 Lisogurski at Fig. 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	Lisogurski discloses the wearable device of claim 8, wherein the physiological paramter of the user is associated with a blood consitutent or a blood flow of the user. *See* claim 8 above. *See* claim 1[b] above.

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	See also, e.g.: The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs. Lisogurski at 4:36-41 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	Lisogurski discloses or renders obvious the wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency. *See* claim 8 above. *See also*, e.g.: In some embodiments, the system may use information from a first light source to control a second light source. The system may generate a first light drive signal for activating a first light source to emit a first photonic signal. The first light source and second light source may each include one or more emitters. The system may receive a light signal attenuated by the subject, wherein the light signal comprises a component corresponding to the first photonic signal. The system may analyze the component of the light signal to determine when to activate a second light source. The system may generate a second light drive signal, based on the analysis of the first component, for activating the second light source to emit

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	one or more second photonic signals. The system may determine one or more physiological parameters based on the light signals. Lisogurski at 1:26-41 The present disclosure is directed towards power optimization in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. The system may include, for example, a light source and a photosensitive detector. Providing a light drive signal to the light source may account for a significant portion of the system's total power consumption. Thus, it may be desirable to reduce the power consumption of the light source, while still enabling high quality physiological parameters to be determined. **The system may reduce the power consumption by modulating parameters associated with the light drive signal in techniques correlated to the cardiac cycle or other cyclical physiological activity**. For example, the system may decrease brightness during a particular portion of the cardiac cycle. It may also be desirable to reduce the power consumption by the light drive signal to reduce heating effects caused by an emitter. Lisogurski at 3:43-60 In some applications, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Lisogurski at 4:42-45 In some embodiments, it may be desirable to implement techniques to optimize power consumption in an oximeter or other system. For example, in a battery powered system, reducing the power requirements may allow for smaller devices, longer life, or both. In some embodiments, powering the light source may include a large amount of the power load a device may experience. In some embodiments, variation of parameters in the light drive signal may enable a particular amount of power to be used more efficiently. For example, the brightness of a light source may be decreased during a less important period and increased during a more important period. In some embodiments, parameter variation may reduce the impact of heating effects caused by a light source on a subject. Techniques to vary the amount of time a

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	light source is turned on, to vary the brightness of the light source, other techniques, or any combination thereof, may be employed to modify power consumption. **In some embodiments, the brightness of one of more light sources may be modulated in a technique that is related to the cardiac cycle**. The cardiac cycle is the substantially periodic repetition of events that occur, for example, during heartbeats. The cardiac cycle may include a systole period and diastole period. The cardiac cycle may include pressure changes in the ventricles, pressure changes in the atria, volume changes in the ventricles, volume changes in the atria, opening and closing of heart valves, heart sounds, and other cyclic events. In some embodiments, the heart may enter a non-periodic state, for example, in certain types ofarrhythmia and fibrillation. As used herein, “cardiac cycle modulation” will refer to the modulation techniques generally correlated to the cardiac cycle. It will be understood that cardiac cycle modulation may include modulation aligned with pulses of the heart, pulses of a particular muscle group, other suitable pulses, any other suitable physiological cyclical function, or any combination thereof. In some embodiments, the system may use a cardiac cycle modulation with a period on the order of the cardiac cycle period. For example, the cardiac cycle modulation may repeat every cardiac cycle. In some embodiments, the system may use a cardiac cycle modulation with a period on the order of some multiple of the cardiac cycle period. For example, the cardiac cycle modulation may repeat every three cardiac cycles. In some embodiments, the cardiac cycle modulation may relate to both a cardiac cycle and a respiratory cycle. The cardiac cycle and the respiratory cycle may have a time varying phase relationship. It will be understood that cardiac cycle modulation techniques, while generally related to the cardiac cycle, may not necessarily be precisely correlated to the cardiac cycle and may be related to predetermined parameters, other physiological parameters, other physiological cycles, external triggers (e.g., respiration), user input, other suitable techniques, or any combination thereof. Lisogurski at 4:63-5:47 As used herein, “cardiac cycle modulation” will refer to the modulation techniques generally correlated to the cardiac cycle. It will be understood that cardiac cycle modulation may include modulation aligned with pulses of the heart, pulses of a particular muscle group, other suitable pulses, any other suitable physiological cyclical function, or any combination thereof. In some embodiments, the system may use a cardiac cycle modulation with a period on the order of the cardiac cycle period. For example, the

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	cardiac cycle modulation may repeat every cardiac cycle. In some embodiments, the system may use a cardiac cycle modulation with a period on the order of some multiple of the cardiac cycle period. For example, the cardiac cycle modulation may repeat every three cardiac cycles. In some embodiments, the cardiac cycle modulation may relate to both a cardiac cycle and a respiratory cycle. The cardiac cycle and the respiratory cycle may have a time varying phase relationship. It will be understood that cardiac cycle modulation techniques, while generally related to the cardiac cycle, may not necessarily be precisely correlated to the cardiac cycle and may be related to predetermined parameters, other physiological parameters, other physiological cycles, external triggers (e.g., respiration), user input, other suitable techniques, or any combination thereof. Lisogurski at 5:35-46 **In some embodiments, a technique to remove ambient and background signals may be used in addition to or in place of a power saving light modulation scheme. In a drive cycle modulation technique, the system may cycle light output at a rate significantly greater than the cardiac cycle. For example, a drive cycle modulation cycle may include the system turning on a first light source, followed by a "dark" period, followed by a second light source, followed by a "dark" period. The system may measure the ambient light detected by the detector during the "dark" period and then subtract this ambient contribution from the signals received during the first and second "on" periods. In some embodiments, drive cycle modulation may be implemented using time division multiplexing as described above, code division multiplexing, carrier frequency multiplexing, phase division multiplexing, feedback circuitry, DC restoration circuitry, any other suitable technique, or any combination thereof. For example, the system may use frequency division multiplexing in a drive cycle modulation technique. The cardiac cycle modulation may represent a lower frequency envelope function on the higher frequency drive cycle. For example, cardiac cycle modulation may be an envelope on the order of 1 Hz superimposed on a 1 kHz sine wave drive cycle modulation.** In some embodiments, the system may use various cardiac cycle modulation schemes to adjust the brightness of a light source controlled by the light drive signal used in determining physiological parameters. **The system may modulate the brightness of the light source using a periodic waveform, for example, a sinusoidal or triangle wave**. The period of the waveform may be substantially related to the cardiac pulse rate, for example, in a one-to-one relationship, a two-to-one relationship, any other suitable relationship, or any suitable combination thereof. The system may align the peak of the

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	modulated light drive signal with a particular point in the cardiac cycle to improve the quality of the determined physiological parameter, for example, it may be aligned with the diastolic period, the systolic period, the dicrotic notch, any other suitable point, or any combination thereof. In some embodiments, the system may modulate the light drive signal with a square wave function, such that it is at a low brightness level during a first part of the cardiac cycle and a high brightness level during a second part of the cardiac cycle. In some embodiments, the low brightness level may include turning one or more light sources off. Lisogurski at 6:7-52 **In some embodiments of cardiac cycle modulation, the system may modulate multiple light sources using a plurality of modulation techniques. For example, in a system with two light sources, the system may operate a first light source at full or regular brightness, while operating one or more additional light sources in a switched or otherwise modulated mode. In some embodiments, the system may operate a first light source according to a first cardiac cycle modulation technique and a second light source according to a second cardiac modulation technique. The first and second cardiac cycle modulation techniques may be the same, correlated, or unrelated**. In some embodiments, the system may use the first light source to determine periods of interest in the cardiac cycle. The system may, according to the periods of interest, power additional light sources, alter the modulation of the additional light sources, perform other suitable power optimization techniques, or any combination thereof. In some embodiments, the system may include a first light source (e.g., a light source powered at full or regular brightness) of a type that is a more efficient light source than the one or more additional light sources. For example, the first light source may be a high efficiency infrared (IR) LED while the one or more additional light sources may be lower efficiency red LEDs or laser diodes. In some embodiments, the first light source may be selected based on efficiency parameters and information from the first light source may be used only to control a second light source. For example, a highly efficient first light source that is not at a wavelength of interest for physiological parameter determination may be used to control one or more second light sources at wavelengths of interest. In this case, the light from the first light source may be used only for controlling the second light source and not for determining physiological parameters. In some embodiments, the system may use the first light source to determine a pulse rate or identify elements of the cardiac cycle, and the system may use the pulse rate or identified elements in part to

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	control modulation of the light drive signal. Identified elements may include peaks, valleys, troughs, notches, fiducial points, other suitable elements, or any combination thereof. Fiducial points may be related to the zero crossings of first and higher order derivatives of the waveform. In some embodiments, the system may modulate the first light drive signal according to a first cardiac cycle modulation technique and may modulate the one or more additional light drive signal according to a second cardiac cycle modulation technique. For example, the system may operate the first light source at full or regular brightness for a first “on” period, and then “off” for a second period. The system may use the first “on” period to adjust or calibrate a second modulation technique. The system may implement the second modulation technique for the “off” period, using, for example, one or more light sources that may or may not include the first light source. As described above, this cardiac cycle modulation may be implemented in addition to a drive cycle modulation, conventional servo algorithms, or any combination thereof. Lisogurski at 7:38-8:26 FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g., Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. It will be understood that, as used herein, the term “light” may refer to energy produced by radiative sources and may include one or more of ultrasound, radio, microwave, millimeter wave, infrared, visible, ultraviolet, gamma ray or X-ray electromagnetic radiation. As used herein, light may also include any

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	wavelength within the radio, microwave, infrared, visible, ultraviolet, or X-ray spectra, and that any suitable wavelength of electromagnetic radiation may be appropriate for use with the present techniques. Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130. Lisogurski at 10:42-11:8 Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals to coordinate its operation with front end processing circuitry 150. Light drive circuitry 120, as discussed above, may be configured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of when light source 130 is turned on and off. When light source 130 is configured to emit two or more wavelengths of light, the light drive signal may be configured to control the operation of each wavelength of light. The light drive signal may comprise a single signal or may comprise multiple signals (e.g., one signal for each wavelength of light). An illustrative light drive signal is shown in FIG. 2A. Lisogurski at 11:33-60 It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple

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	components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In an embodiment, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Lisogurski at 15:66-16:16 Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detector 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Lisogurski at 17:37-45 In some embodiments, sensor unit 312 may be communicatively coupled to monitor 314 via a cable 324. Cable 324 may include electronic conductors (e.g., wires for transmitting electronic signals from detector 318), optical fibers (e.g., multi-mode or single-mode fibers for transmitting emitted light from light source 316), any other suitable components, any suitable insulation or sheathing, or any combination thereof. In some embodiments, a wireless transmission device (not shown) or the like may be used instead of or in addition to cable 324. Monitor 314 may include a sensor interface configured to receive physiological signals from sensor unit 312, provide signals and power to sensor unit 312, or otherwise communicate with sensor unit 312. The sensor interface may include any suitable hardware, software, or both, which may be allow communication between monitor 314 and sensor unit 312. Lisogurski at 18:16-31 In step 402, the system may generate a first light drive signal. The light drive signal may be used by a light source to emit a photonic signal. The light source may be one or more LEDs, laser diodes, other suitable device, or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. In some embodiments, the light source may

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	include multiple LEDs of the same wavelength, multiple LEDs of different wavelengths, any other suitable arrangement, or any combination thereof. In some embodiments, the light source may include a fiber optic or other light pipe to communicate light from one location to another. **In some embodiments, the light drive signal may include or be a component of a cardiac cycle modulation**. For example, the first light drive signal may be configured to activate one LED to emit a photonic signal and not activate other LEDs, such that some physiological parameters may be determined, but with lower power consumption than when the other LEDs are illuminated. Lisogurski at 19:20-39 In some embodiments, the system may send a drive signal without a cardiac modulation to a first light source. For example, the system may not apply a cardiac cycle modulation to IR light drive signal 558. IR light drive signal 558 may, for example, correspond to the first light drive signal generated at step 402 of FIG. 4. In some embodiments, the system may detect an attenuated photonic signal associated with IR light drive signal 558 throughout the cardiac pulse cycle. In some embodiments, elements of the cardiac cycle may be identified using other signals, for example, ECG signal 554. The system may determine periods of the cardiac cycle and apply a cardiac cycle modulation to a second light source. For example, red light drive signal 556 may be switched on at period 532 during systole period 502, off during diastole period 504, on at period 534 during systole period 506, and off during diastole period 508. Red light drive signal 556 may, for example, correspond to the second light drive signal generated at step 408 of FIG. 4. Thus, the cardiac cycle modulation applied to red light drive signal 556 may be substantially synchronous with the systole periods of the cardiac cycle. In some embodiments, the system may determine the timing of the systole periods using information from the attenuated first photonic signal associated with IR light drive signal 558. In some embodiments, the system may use historical information from multiple cardiac cycles to determine the red light drive signal 556. Lisogurski at 21:34-56 The system may generate the light drive signal such that a parameter of the emitted one or more photonic signals varies substantially synchronously with physiological pulses of the subject. For example, the system may generate a light drive signal that varies with a period the same as or closely related to the period of the cardiac cycle, thus generating a cardiac cycle modulation. The system may vary parameters related to the light drive signal including drive current or light brightness, duty cycle, firing rate,

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	modulation parameters, other suitable parameters, or any combination thereof. In some embodiments, the system may use a cardiac cycle modulation that spans several cardiac cycles (e.g., emitting light from a light source during the first one of every five cycles). In some embodiments, the system may generate a light drive signal that modulates parameters of more than one light source using more than one modulation technique. It will be understood that the system may apply this cardiac cycle modulation to the light drive signal in addition to a drive cycle modulation, as illustrated in FIG. 2C, and conventional servo algorithms. Lisogurski at 25:46-65 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lisogurski, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lisogurski, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

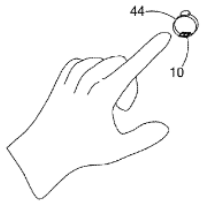
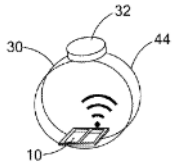
U.S. Pat. No. 12,268,475 in view of U.S. Patent Publication No. 2015/0057511 A1 to Amar Sarbbasesh Basu ("Basu")

As described in detail below, Basu (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Basu. The cited portions of Basu are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Basu. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Basu "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Basu does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Basu (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Basu anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

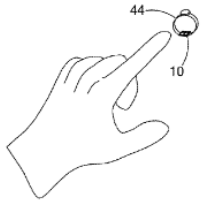
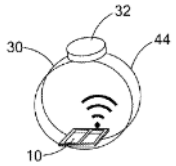
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Basu discloses or renders obvious an apparatus adapted to be worn by a user comprising. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. **The optical proximity sensor is accommodated on a wearable carrier**. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract] Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery or vascular stiffness this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health. Basu at [0009] This invention includes new technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor. The blood pressure may be indirectly measured using pulse wave velocity by placing several sensors in different locations along an artery. In this manner, vascular conditions can be detected, such as restricted blood flow. Basu at [0034] OPS 10 can provide heart rate sensing comparable to commercial reflectance photoplethosymography devices and reflectance pulse oximeters, but in a much more compact package with a printed circuit board (PCB) area less than about 16 mm2 compared to typical detectors with a PCB area of 200 mm2 for all the individual components. More importantly the power consumption is less than about 200 μW

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	compared to 10 mW for conventional photoplethysmography sensors. **This order of magnitude improvement makes it possible to make a 24 hour heart rate sensor integrated in a wearable carrier, and one small enough to be worn unobtrusively in on a finger, ear, etc**. Due to the low power consumption, a battery 32 holding a charge for operating the OPS for at least 24 hours can be unobtrusively small. **For example, FIGS. 3B and 3C show an OPS 10 integrated in wearable carrier in the form of a finger ring 44, in which the ring shape is formed by a flexible cable 30**. The cable 30 connects the OPS 10 with a rechargeable battery 32 providing for a sufficient capacity for at least several hours of monitoring, preferably at least 24 hours. FIG. 4, for example, is a picture of an OPS 10 used for photoplethysmography placed on a finger tip. Although the capillary bed is smaller than the fingertip, the presence of reflective bone backing formed by the finger bone improves the reflected signal. Basu at [0040]  FIG. 3B  FIG. 3C Basu at Fig. 3B & 3C **These technologies are integrated with a Bluetooth module 46 or another suitable wireless technology and with rechargeable batteries 32 in a small package, making the sensor assembly wireless and comfortably wearable throughout the day**. OPS 10 and a low power Bluetooth transmitter can be integrated into the underside of a ring 44 or placed on a separate board 12′ along with the battery 32. Beside Bluetooth technology and Bluetooth Low Energy technology, any other low-power transmission protocol is suitable for communication with a computer for evaluation. Basu at [0062]

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	In yet a further development, a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. Basu at [0093] 1.An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and **a wearable carrier accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin**. Basu at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	Basu discloses or renders obvious one or more biosensors adapted to be placed on the user. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise

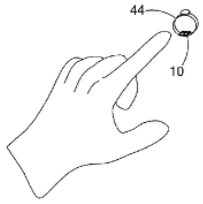
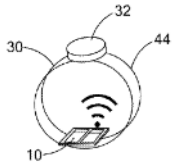
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	reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. **The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness**. Basu at [Abstract] Also, **several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery or vascular stiffness** this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health. Basu at [0009] This invention includes new technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor. The blood pressure may be indirectly measured using pulse wave velocity by placing several sensors in different locations along an artery. In this manner, vascular conditions can be detected, such as restricted blood flow. Basu at [0034] **In a first approach, this device utilizes electronic optical proximity sensors (OPS) 10 to sense a patient's heart rate**. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. Variations of OPS are widely used for non-contact distance measurement in a variety of applications. In smart phones, for example, OPS detect when a phone is placed in a pocket, triggering touch-screen locking. In factory robotics, OPS are used for motion feedback control. In many industrial and consumer applications, OPS serve as touchless switches and gesture sensing devices in personal notebooks, vending machines, sanitary dispensers, lavatories, dimming control, and video games. Basu at [0035] OPS 10 can provide heart rate sensing comparable to commercial reflectance photoplethosymography devices and reflectance pulse oximeters, but in a much more compact package with a printed circuit

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	board (PCB) area less than about 16 mm2 compared to typical detectors with a PCB area of 200 mm2 for all the individual components. More importantly the power consumption is less than about 200 μW compared to 10 mW for conventional photoplethysmography sensors. **This order of magnitude improvement makes it possible to make a 24 hour heart rate sensor integrated in a wearable carrier, and one small enough to be worn unobtrusively in on a finger, ear, etc**. Due to the low power consumption, a battery 32 holding a charge for operating the OPS for at least 24 hours can be unobtrusively small. For example, FIGS. 3B and 3C show an OPS 10 integrated in wearable carrier in the form of a finger ring 44, in which the ring shape is formed by a flexible cable 30. The cable 30 connects the OPS 10 with a rechargeable battery 32 providing for a sufficient capacity for at least several hours of monitoring, preferably at least 24 hours. FIG. 4, for example, is a picture of an OPS 10 used for photoplethysmography placed on a finger tip. Although the capillary bed is smaller than the fingertip, the presence of reflective bone backing formed by the finger bone improves the reflected signal. Basu at [0040]  FIG. 3B  FIG. 3C Basu at Fig. 3B & 3C These technologies are integrated with a Bluetooth module 46 or another suitable wireless technology and with rechargeable batteries 32 in a small package, making the sensor assembly wireless and comfortably wearable throughout the day. OPS 10 and a low power Bluetooth transmitter can be integrated into the underside of a ring 44 or placed on a separate board 12′ along with the battery 32. Beside Bluetooth technology and Bluetooth Low Energy technology, any other low-power transmission protocol is suitable for communication with a computer for evaluation. Basu at [0062]

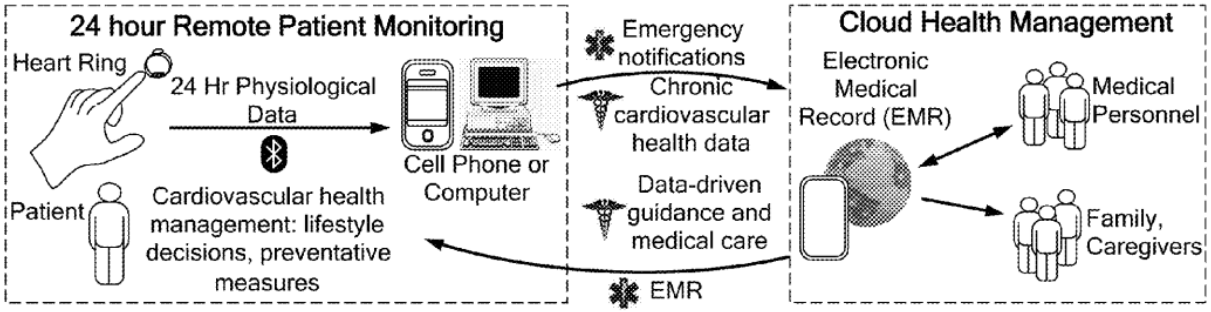
US'475 Patent	Basu
	In yet a further development, a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. Basu at [0093] 1.An **optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising**: **an optical proximity sensor having** **a first IR LED emitting light having an infrared wavelength,** **a first IR photo detector sensitive to the infrared wavelength**; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and **a wearable carrier accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin**. Basu at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a	Basu discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement.

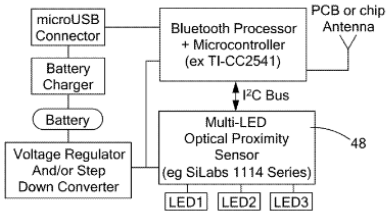
US'475 Patent	Basu
differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. **Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness**. Basu at [Abstract] The present invention relates to a device, a system, and a **method for vascular health monitoring of a person. More particularly, the invention relates to a sensor suitable for remote patient monitoring**. Basu at [0002] According to a first aspect of the invention, an optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. Basu at [0007] Also, several sensors may be placed on a person's skin **along a vascular path to obtain data relating to blood flow and artery or vascular stiffness this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health**. Basu at [0009]

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	This invention includes new **technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor**. The blood pressure may be indirectly measured using pulse wave velocity by placing several sensors in different locations along an artery. In this manner, vascular conditions can be detected, such as restricted blood flow. Basu at [0034] **In a first approach, this device utilizes electronic optical proximity sensors (OPS) 10 to sense a patient's heart rate. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object**. Variations of OPS are widely used for non-contact distance measurement in a variety of applications. In smart phones, for example, OPS detect when a phone is placed in a pocket, triggering touch-screen locking. In factory robotics, OPS are used for motion feedback control. In many industrial and consumer applications, OPS serve as touchless switches and gesture sensing devices in personal notebooks, vending machines, sanitary dispensers, lavatories, dimming control, and video games. Basu at [0035] **OPS 10 can provide heart rate sensing comparable to commercial reflectance photoplethosymography devices and reflectance pulse oximeters**, but in a much more compact package with a printed circuit board (PCB) area less than about 16 mm2 compared to typical detectors with a PCB area of 200 mm2 for all the individual components. More importantly the power consumption is less than about 200 μW compared to 10 mW for conventional photoplethysmography sensors. This order of magnitude improvement makes it possible to make a 24 hour heart rate sensor integrated in a wearable carrier, and one small enough to be worn unobtrusively in on a finger, ear, etc. Due to the low power consumption, a battery 32 holding a charge for operating the OPS for at least 24 hours can be unobtrusively small. For example, FIGS. 3B and 3C show an OPS 10 integrated in wearable carrier in the form of a finger ring 44, in which the ring shape is formed by a flexible cable 30. The cable 30 connects the OPS 10 with a rechargeable battery 32 providing for a sufficient capacity for at least several hours of monitoring, preferably at least 24 hours. FIG. 4, for example, is a picture of an OPS 10 used for photoplethysmography placed on a finger tip. Although the capillary bed is smaller than the fingertip, the presence of reflective bone backing formed by the finger bone improves the reflected signal. Basu at [0040]

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	Electronic noise and offset reduction: The second function of the bandpass filter in photoplethysmography sensors is to remove high frequency noise, including 60/120 Hz noise from ambient light sources. While a 0.5-5 Hz filter can usually remove such noise, it limits the bandwidth of the photoplethysmography sensor, which makes it difficult to resolve some time dependent features of the pressure pulse. An OPS 10 uses electronic modulation to cancel noise and ambient light. The LED 14 is modulated at 1 KHz frequency or higher. The received PD signal oscillates at the same frequency, and the on-chip signal processing utilizes a bandpass or lock-in filtering scheme to remove all the other signal components. This technique effectively eliminates both high and low frequency noise without limiting the bandwidth. It also diminishes the impact of sunlight, which occurs as direct current (DC). Finally, offset can be reduced if a glass overlay (not shown) is placed between the sensor and the skin. An ambient light sensor (ALS) in the form of a visible-light photodiode 20 can also be used as a reference for additional ambient light cancellation. Basu at [0055]  FIG. 3B  FIG. 3C Basu at Fig. 3B & 3C These technologies are integrated with a Bluetooth module 46 or another suitable wireless technology and with rechargeable batteries 32 in a small package, making the sensor assembly wireless and comfortably wearable throughout the day. OPS 10 and a low power Bluetooth transmitter can be integrated into the underside of a ring 44 or placed on a separate board 12′ along with the battery 32. Beside Bluetooth technology and Bluetooth Low Energy technology, any other low-power transmission protocol is suitable for communication with a computer for evaluation.

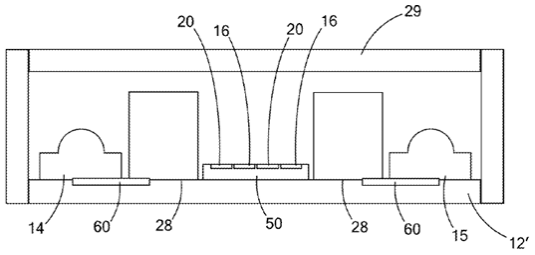
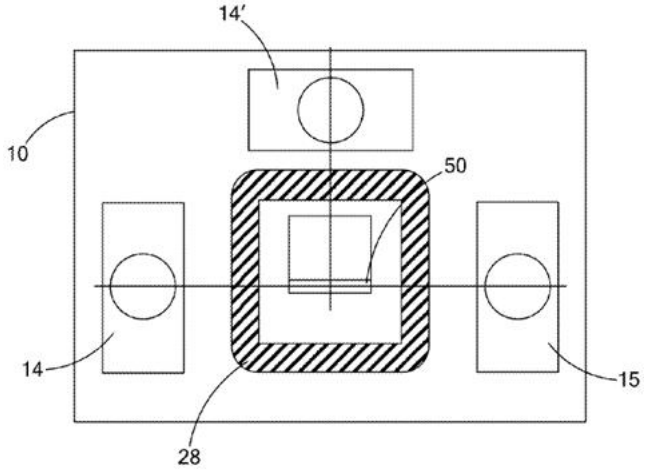
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	Basu at [0062] As further shown in FIG. 11, a "cloud-based" RPM infrastructure can actively manage cardiovascular health. **Using OPS technology, cardiovascular parameters can be monitored on a 24-hour ambulatory basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record**. These data will then be available to the patient's physician, providing an effective tool for quantitative assessment, without bias from "white-coat" alteration, thus providing a means for evidence-based medical management. In emergency situations, notifications can be sent to a medical response team and family members. An RPM-driven model will dramatically reduce the cost of chronic cardiovascular care through earlier detection of impending decompensation, white also improving health outcomes by motivating the patient to actively monitor health and take preventative measures. Basu at [0064] Having demonstrated that the sensor technology is fairly robust, a wireless ring 44 which combines the sensor with a Bluetooth, Bluetooth Low Energy (BLE), or other wireless transmitter linked to an application running on the user's cell phone. Basu at [0066] In yet a further development, a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. Basu at [0093] **Pulse oximetry measures blood oxygenation (SpO2) by comparing the pulsation indices at two wavelengths with known absorbance characteristics in oxygenated vs. deoxygenated blood**. A multi-LED digital OPS 10 can provide multiple photoplethysmography waveforms, each with a different LED, and can therefore obtain radiometric measurements required for pulse oximetry. Basu at [0094]

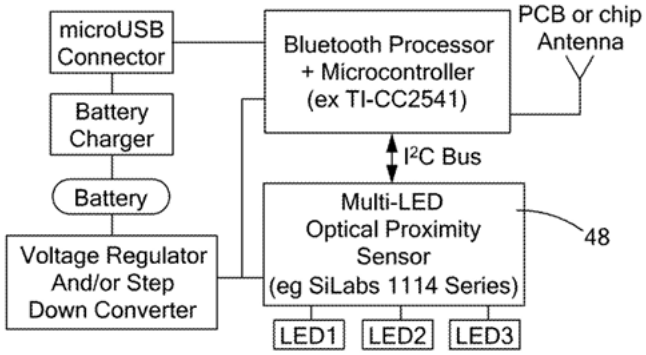
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	 FIG. 11 Basu at Fig. 11 For pulse oximetry, the Silicon Labs Si1143 was used, a triple-LED digital OPS 10, as is schematically indicated in FIG. 17. The chip 48 includes a photodiode 50 with FWHM spectral bandwidth of 600-1000 nm, 3 LED drivers, and a signal conditioning logic on the embedded IC. Unlike the VCNL4000, the Si1143 does not include the LEDs on the chip 48 itself. Surface mount IR LEDs 14, 14′, and 15 (OSRAM) were placed within 3 mm on either side of the photodiode. The half angle of the chosen LEDs 14, 14′, and 15 is 22 degrees, which limits the light leakage. Each LED current can be set between 5.6 and 360 mA. The Si1143 uses time multiplexing to measure the reflectance from two or three LEDs on a single photo detector. Like the VCNL4000, it uses short LED pulses (25 μsec), which reduces the power consumption of the system. With three 100 mA LEDs 14, 14′, and 15 operating at a 100 Hz data rate, the power consumption is still less than about 800 μW. The Si1143 also includes an I2 C bus interface 26 for sensor configuration and reading sensor data. The ambient light sensor 20 included on the chip 48 can be used for sensing whether the chip 48 has been placed in contact with the skin. Basu at [0104]

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	 FIG. 17 Basu at Fig. 17 1.An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and a wearable carrier accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin. Basu at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an	Basu discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths.

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output optical light having one or more optical wavelengths;	**An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector**; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. **A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both**. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract] According to a first aspect of the invention, an optical proximity sensor assembly includes an optical proximity sensor with an **IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector**; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. Basu at [0007] According to further embodiments of the invention, **a single sensor may include a plurality of identical or different LEDs**, a plurality of photodiodes, or both. Basu at [0008] This invention includes new technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor. The blood pressure may be indirectly measured using pulse wave velocity by placing several sensors in different locations along an artery. In this manner, vascular conditions can be detected, such as restricted blood flow.

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	Basu at [0034] **In yet a further development, a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. For example, if one LED 15 emits red light and a second LED 14 emits light in the near infrared, a pulse oximetry sensor can be realized with a very small size**. FIG. 14 illustrates how one red LED 15 and one IR LED 14 are arranged on opposite sides of a photo detector 50 that includes photodiodes 16 and 20 sensitive to different spectral ranges, here red for photodiode 20 and near IR for photodiode 16. Each of the LEDs 14 and 15 is separated from the photo detector by an optical barrier 28. The optical barriers 28 do not touch the transparent cover 29 that separates the LEDS 14 and 15, the optical barriers 28, and the photo detector 50 from the human skin because a direct contact between the optical barrier 28 and the cover 29 might result in a bad signal quality. The height of the optical barriers 28 may be derived from empirical measurements until an optimum configuration is found. The arrangement of FIG. 14 further shows copper barriers 60 embedded in circuit board 12′ extending from underneath each of the LEDs 14 and 15 to a location underneath the adjacent optical barrier 28, respectively, to avoid a light leakage through the circuit board 12′ from the LEDs 14 and 15 to the photodiodes 16 and 20. Basu at [0093] **Pulse oximetry measures blood oxygenation (SpO2) by comparing the pulsation indices at two wavelengths with known absorbance characteristics in oxygenated vs. deoxygenated blood**. A multi-LED digital OPS 10 can provide multiple photoplethysmography waveforms, each with a different LED, and can therefore obtain radiometric measurements required for pulse oximetry. Basu at [0094] **The use of a multi-LED OPS 10 for pulse oximetry is shown schematically in FIGS. 14, 15, 16, and 17. The multi-LED OPS 10 detects signals from multiple discrete LEDs 14 and 15, and optionally 14′, which can be multiplexed on a single photo detector 50 equipped with photodiodes 16 of infrared detection and photodiodes 20 for detecting red light**. A typical sensor shown in 17 includes the photo detector 50, 2 or more LED drivers, and electronics for signal conditioning and multiplexing the data channels on a common circuit board 48. The LEDs 14 and 15, and optionally 14′, are added

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	separately to the circuit board, along with an optical barrier 28 to reduce leakage if desired as shown in 15. **While this increases the chip count, it does allow flexibility in positioning the LEDs 14 and 15, and 14′ for either transmittance or reflectance mode, and in choosing the appropriate wavelengths**. Basu at [0096]  FIG. 14 Basu at Fig. 14  FIG. 15 Basu at Fig. 15

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	 FIG. 17 Basu at Fig.17 **Thus, suitable wavelengths for pulse oximetry are in the range of about 600 nm to 700 nm for the red LED 15, preferably between about 650 nm and 670 nm, and about 850 nm to 950 nm, preferably about 900 nm to 940 nm for the near infrared LED 14. Notably, a deviation from the preferred wavelengths is feasible and may make the sensor 10 cheaper due to the availability of commercially produced LEDs 14 and 15. The two LEDs 14 and 15 may be pulsed**. Optionally, the two LEDs 14 and 15 may be pulsed at different frequencies through frequency multiplexing. Alternatively. The LEDs 14 and 15 may be pulsed in an alternating mode through time multiplexing. Pulsing the LEDs 14 and 15 promotes an easy distinction of the two signals where both signals are received by the same photo detector. Basu at [0099] It is known that certain factors may render pulse oximetry unreliable because the presence of other components (e.g. methemoglobin or carboxyhemoglobin) in the blood may mimic the absorption of oxyhemoglobin at the IR LED frequency so that the reading is falsified. **Such errors can be minimized by adding a third LED emitting light of a wavelength at which the component shows a different behavior than oxyhemoglobin and reduced hemoglobin**. **FIG. 15 shows an arrangement of the three LEDs 14, 14′, and 15, positioned on three sides of a photo detector in the form of photodiode 50. An optical barrier 28 separates the photo detector from all three LEDs 14, 14′, and 15. The three LEDs 14, 14′, and 15 may all emit different wavelengths. LEDs 15, and 14, for**

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	example, may emit light in the red and IR spectrum, respectively, while LED 14′ may emit light at a wavelength at which the presence of falsifying components can be detected. The photo detector 50 includes photodiodes sensitive to all three wavelengths. Basu at [0109] 1.An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and a wearable carrier accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin. Basu at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	Basu discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin. **An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength**, an IR photo detector sensitive to the infrared wavelength, **an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector**; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to

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	digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. **The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness**. Basu at [Abstract] Also, **several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery or vascular stiffness this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health**. Basu at [0009]FIGS. 3D and 1 illustrate the general working mechanism. **The OPS 10 is placed in direct contact with the skin, near a capillary bed 40. Ideal locations include the fingertip, earlobe, or forehead. A protective overlay (not shown in this figure) can be added if desired. The IR LED 14 emits light into the tissue, where it experiences diffuse reflection from the tissue** and capillary bed 40. **This establishes a baseline reflectance signal at the IR photodiode 16**. When a pressure wave propagates through the capillary bed 40, the signal falls slightly (0.5-5%) due to increased light scattering. The change is detected by an amplification and signal processing circuitry in the IC 24 embedded in the OPS 10. In the case of an earlobe or fingertip sensor, a metal backing can be placed on the opposite side of the earlobe or fingertip to improve the reflectance signal. In some embodiments, the metal backing may be provided by the battery 32. Basu at [0045] The assembly of claim 1, wherein the optical proximity sensor further comprises a transparent cover covering the first IR LED and the first IR photo detector. Basu at Claim 2

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	Basu discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. **An optical proximity sensor assembly includes an optical proximity sensor** with an IR LED emitting light having an infrared wavelength, **an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector**, an analog to digital converter, LED drivers, **noise reduction and ambient light cancellation circuitry**, and a digital interface for communication with a microcontroller. **The optical proximity sensor is accommodated on a wearable carrier**. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract] According to a first aspect of the invention, an optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an **IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector**, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. Basu at [0007]

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	As, for example, shown in FIG. 1, **An OPS 10 includes an infrared (IR) light emitter, such as an IR LED 14, and an integrated circuit (IC) 24 providing LED drivers modulating the infrared light emitter at a fixed or varying frequency. The drivers may also operate in a burst or low duty cycle operation where the measurement is performed quickly, and then the IR emitter is shut off to conserve power**. The OPS 10 includes mixed signal circuits for amplification, signal conditioning, and digitization, i.e. analog-digital conversion, of the detected radiation. **During frequency modulation, the LED 14 is pulsed at a predetermined and unique, fixed or variable, frequency. In return the detection circuitry is operated with a digital lock-in technique to detect and select the photodiode signal at the same frequency and phase as the operation of the LED driver**. uses a digital lock in technique to select the photodiode signal which is at the same frequency and phase as the signal driving the LED. Basu at [0036] **The influx of ambient light can be measured during OFF phases of the LED 14. The ambient light component can then be subtracted from the photo detector signal during ON phases to provide a sensitivity offset for proper calibration**. This technique being similar in concept to **lock-in detection** or to **electronic noise cancellation, it improves the signal to noise ratio and reduces the impact of noise and ambient light.** Basu at [0037] Optical barrier for reduced light leakage: One drawback of a small LED-PD spacing is light leakage between the two components, which increases the so-called baseline photoplethysmography signal. As shown in FIG. 3D and FIG. 6A Integrated OPS 10 include an optical barrier 28, placed between the LED **The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected. The reflected signal is sensed by each of the photodiodes 16**. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7. Basu at [0042]

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	The OPS 10 is generally illustrated in FIG. 1 and includes an embedded 895 nm IR LED 14 and a photodiode 16 with visible light blocking filter 22. The spacing between the LED 14 and photodiode 16 is about 2 mm, resulting in a large reflectance and sensitivity. The LED14 is embedded in a recessed region which serves as an optical barrier28 to reduce light leakage. The embedded signal processing IC 24 handles LED modulation, current control (10-200 mA in 10 mA steps), **photo detector amplification** and signal conditioning, ambient light cancellation, 16-bit analog to digital conversion (ADC), and I2C bus communication. The ADC can resolve pulsation indices of 15 ppm. The LED 14 can be modulated at frequencies up to 3.1 MHz (user selectable) for electronic noise cancellation. Basu at [0047] Optical barrier for reduced light leakage: One drawback of a small LED-PD spacing is light leakage between the two components, which increases the so-called baseline photoplethysmography signal. As shown in FIG. 3D and FIG. 6A Integrated OPS 10 include an optical barrier 28, placed between the LED 14 and the photodiode 16, which greatly reduces light leakage. The dimensions of the optical barrier 28 are important, particularly in "zero-distance detection" where the skin is in direct contact with the sensor. If the optical barrier 28 is too wide, it will block the reflectance signal completely, and if it is too thin, the baseline leakage signal could be large enough to obscure the pulsation signal. **An appropriately sized optical barrier 28 helps to ensure a high signal-to-noise ratio**. Basu at [0053] Electronic noise and offset reduction: The second function of the bandpass filter in photoplethysmography sensors is to remove high frequency noise, including 60/120 Hz noise from ambient light sources. While a 0.5-5 Hz filter can usually remove such noise, it limits the bandwidth of the photoplethysmography sensor, which makes it difficult to resolve some time dependent features of the pressure pulse. An OPS 10 uses electronic modulation to cancel noise and ambient light. The LED 14 is modulated at 1 KHz frequency or higher. The received PD signal oscillates at the same frequency, and the on-chip signal processing utilizes a bandpass or lock-in filtering scheme to remove all the other signal components. This technique effectively eliminates both high and low frequency noise without limiting the bandwidth. It also diminishes the impact of sunlight, which occurs as direct current (DC). Finally, offset can be reduced if a glass overlay (not shown) is placed between the sensor and the skin. An ambient light sensor (ALS) in the form of a visible-light photodiode 20 can also be used as a reference for additional ambient light cancellation.

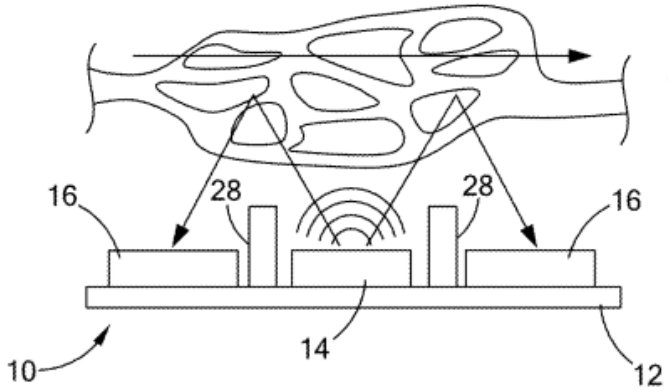
US'475 Patent	Basu
	Basu at [0055] For pulse oximetry, the Silicon Labs Si1143 was used, a triple-LED digital OPS 10, as is schematically indicated in FIG. 17. The chip 48 includes a photodiode 50 with FWHM spectral bandwidth of 600-1000 nm, 3 LED drivers, and a signal conditioning logic on the embedded IC. Unlike the VCNL4000, the Si1143 does not include the LEDs on the chip 48 itself. Surface mount IR LEDs 14, 14′, and 15 (OSRAM) were placed within 3 mm on either side of the photodiode. The half angle of the chosen LEDs 14, 14′, and 15 is 22 degrees, which limits the light leakage. Each LED current can be set between 5.6 and 360 mA. The Si1143 uses time multiplexing to measure the reflectance from two or three LEDs on a single photo detector. Like the VCNL4000, it uses short LED pulses (25 μsec), which reduces the power consumption of the system. With three 100 mA LEDs 14, 14′, and 15 operating at a 100 Hz data rate, the power consumption is still less than about 800 μW. The Si1143 also includes an I2 C bus interface 26 for sensor configuration and reading sensor data. The ambient light sensor 20 included on the chip 48 can be used for sensing whether the chip 48 has been placed in contact with the skin. Basu at [0104] 1. An optical proximity sensor assembly for cardiovascular monitoring, **the optical proximity sensor assembly comprising**: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, **a first IR photo detector sensitive to the infrared wavelength**; and **an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector**, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation **circuitry**, and a digital interface for communication with a microcontroller; and **a wearable carrier** accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin. Basu at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

US'475 Patent	Basu
	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Basu discloses or renders obvious, the detection system is configured to be synchronized to the light source. **An optical proximity sensor assembly includes an optical proximity sensor** with an IR LED emitting light having an infrared wavelength, **an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector**, an analog to digital converter, LED drivers, **noise reduction and ambient light cancellation circuitry**, and a digital interface for communication with a microcontroller. **The optical proximity sensor is accommodated on a wearable carrier**. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract] **The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected**. The reflected signal is sensed by each of the photodiodes 16. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7. Basu at [0042] The OPS 10 is generally illustrated in FIG. 1 and includes an embedded 895 nm IR LED 14 and a photodiode 16 with visible light blocking filter 22. The spacing between the LED 14 and photodiode 16 is about 2 mm, resulting in a large reflectance and sensitivity. The LED14 is embedded in a recessed region which serves as an optical barrier28 to reduce light leakage. The embedded signal processing IC 24 handles LED modulation, current control (10-200 mA in 10 mA steps), **photo detector amplification**

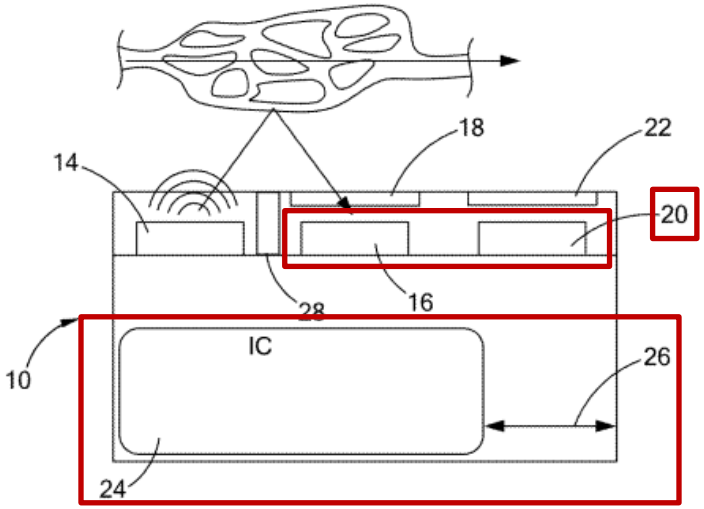
US'475 Patent	Basu
	and signal conditioning, ambient light cancellation, 16-bit analog to digital conversion (ADC), and I2C bus communication. The ADC can resolve pulsation indices of 15 ppm. The LED 14 can be modulated at frequencies up to 3.1 MHz (user selectable) for electronic noise cancellation. Basu at [0047] 1. An optical proximity sensor assembly for cardiovascular monitoring, **the optical proximity sensor assembly comprising**: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, **a first IR photo detector sensitive to the infrared wavelength; and** **an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector**, an analog to digital converter, LED drivers, **noise reduction and ambient light cancellation circuitry**, and a digital interface for communication with a microcontroller; and **a wearable carrier** accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin. Basu at Claim 1 As, for example, shown in FIG. 1, **An OPS 10 includes an infrared (IR) light emitter, such as an IR LED 14, and an integrated circuit (IC) 24 providing LED drivers modulating the infrared light emitter at a fixed or varying frequency. The drivers may also operate in a burst or low duty cycle operation where the measurement is performed quickly, and then the IR emitter is shut off to conserve power**. The OPS 10 includes mixed signal circuits for amplification, signal conditioning, and digitization, i.e. analog-digital conversion, of the detected radiation. **During frequency modulation, the LED 14 is pulsed at a predetermined and unique, fixed or variable, frequency. In return the detection circuitry is operated with a digital lock-in technique to detect and select the photodiode signal at the same frequency and phase as the operation of the LED driver**. uses a digital lock in technique to select the photodiode signal which is at the same frequency and phase as the signal driving the LED. Basu at [0036]

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	The influx of ambient light can be measured during OFF phases of the LED 14. The ambient light component can then be subtracted from the photo detector signal during ON phases to provide a sensitivity offset for proper calibration. This technique being similar in concept to **lock-in detection** or to **electronic noise cancellation, it improves the signal to noise ratio and reduces the impact of noise and ambient light.** Basu at [0037] Optical barrier for reduced light leakage: One drawback of a small LED-PD spacing is light leakage between the two components, which increases the so-called baseline photoplethysmography signal. As shown in FIG. 3D and FIG. 6A Integrated OPS 10 include an optical barrier 28, placed between the LED 14 and the photodiode 16, which greatly reduces light leakage. The dimensions of the optical barrier 28 are important, particularly in "zero-distance detection" where the skin is in direct contact with the sensor. If the optical barrier 28 is too wide, it will block the reflectance signal completely, and if it is too thin, the baseline leakage signal could be large enough to obscure the pulsation signal. An appropriately sized **optical barrier 28 helps to ensure a high signal-to-noise ratio.** Basu at [0053] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	Basu discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. **An optical proximity sensor assembly includes an optical proximity sensor** with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for

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	amplifying a signal detected by the photo detector, **an analog to digital converter**, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract] **According to a first aspect of the invention, an optical proximity sensor assembly includes** an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the **at least one photo detector**; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, **an analog to digital converter**, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. Basu at [0007] FIG. 6A: A schematic of a proposed sensor system for blood pressure monitoring with two photo detectors and two optical barriers; Basu at [0019]

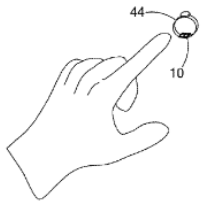
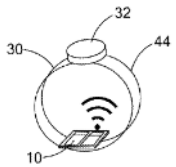
US'475 Patent	Basu
	 FIG. 6A Basu at Fig. 6A An OPS 10 for detecting pulse wave velocity uses a novel sensor setup which detects how fast a pulse wave travels from one side of the sensor to the other side of the sensor (FIGS. 6A and 7). This approach can be robust to environmental noise and to drift of the sensor. Pulse wave velocity can be correlated with blood pressure. The device works in the near infrared (˜950 nm) range. **By putting two generally identical photodiodes 16 in two different locations on a circuit board 12 symmetrically on opposite sides of an IR LED 14**, the time it takes for a pulse wave to move through the vessel can be measured as shown in the diagram of FIG. 6B. The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected. The reflected signal is sensed by each of the photodiodes 16. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7. Basu at [0042] The OPS 10 is generally illustrated in FIG. 1 and includes an embedded 895 nm IR LED 14 and a photodiode 16 with visible light blocking filter 22. The spacing between the LED 14 and photodiode 16 is about 2 mm, resulting in a large reflectance and sensitivity. The LED14 is embedded in a recessed

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	region which serves as an optical barrier28 to reduce light leakage. **The embedded signal processing IC 24 handles** LED modulation, current control (10-200 mA in 10 mA steps), photo detector amplification and signal conditioning, ambient light cancellation, **16-bit analog to digital conversion** (ADC), and I2C bus communication. **The ADC can resolve pulsation indices of 15 ppm**. The LED 14 can be modulated at frequencies up to 3.1 MHz (user selectable) for electronic noise cancellation. Basu at [0047] High sensitivity and dynamic range due to high-resolution analog to digital conversion: A fundamental requirement in photoplethysmography sensors is the ability to detect a small pulsation superimposed on a large baseline (DC) signal. In a standard photoplethysmography sensor arrangement, the AC signal is extracted using a 0.5-5 Hz bandpass filter and additional amplifiers. Recently available digital **OPS 10 incorporate a high resolution analog to digital converter (ADC), which can resolve small pulsations without additional filters**. For example, a 16 bit ADC can resolve a PI as little as ½16, or 15 ppm. The advantage of this approach is that both DC and AC components of the photoplethysmography signal can be simultaneously measured. This is useful for direct measurement of the PI, and for adjusting the LED intensity to prevent saturation of the light detector. A lower resolution of at least 12 bit may even be sufficient to perform this task. Basu at [0054] The arrangement of FIG. 14 further shows copper barriers 60 embedded in circuit board 12′ extending from underneath each of the LEDs 14 and 15 to a location underneath the adjacent optical barrier 28, respectively, to avoid a light leakage through the circuit board 12′ from the LEDs 14 and 15 to the **photodiodes 16 and 20**. Basu at [0093]

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	 FIG. 1 Basu at Fig. 1 The **photo detector 50 includes photodiodes** sensitive to all three wavelengths. Basu at [0109] 1. An optical proximity sensor assembly for cardiovascular monitoring, **the optical proximity sensor assembly comprising**: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, **an analog to digital converter**, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and **a wearable carrier** accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin. Basu at Claim 1

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	Basu discloses or renders obvious the output signal is indicative of the one or more physiological parameters. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract] Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery or vascular stiffness this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health. Basu at [0009] This invention includes new technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor. The blood pressure may be indirectly measured using pulse wave velocity by placing several sensors in different locations along an artery. In this manner, vascular conditions can be detected, such as restricted blood flow.

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	Basu at [0034] In a first approach, this device utilizes electronic optical proximity sensors (OPS) 10 to sense a patient's heart rate. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. Variations of OPS are widely used for non-contact distance measurement in a variety of applications. In smart phones, for example, OPS detect when a phone is placed in a pocket, triggering touch-screen locking. In factory robotics, OPS are used for motion feedback control. In many industrial and consumer applications, OPS serve as touchless switches and gesture sensing devices in personal notebooks, vending machines, sanitary dispensers, lavatories, dimming control, and video games. Basu at [0035] OPS 10 can provide heart rate sensing comparable to commercial reflectance photoplethosymography devices and reflectance pulse oximeters, but in a much more compact package with a printed circuit board (PCB) area less than about 16 mm2 compared to typical detectors with a PCB area of 200 mm2 for all the individual components. More importantly the power consumption is less than about 200 μW compared to 10 mW for conventional photoplethysmography sensors. This order of magnitude improvement makes it possible to make a 24 hour heart rate sensor integrated in a wearable carrier, and one small enough to be worn unobtrusively in on a finger, ear, etc. Due to the low power consumption, a battery 32 holding a charge for operating the OPS for at least 24 hours can be unobtrusively small. For example, FIGS. 3B and 3C show an OPS 10 integrated in wearable carrier in the form of a finger ring 44, in which the ring shape is formed by a flexible cable 30. The cable 30 connects the OPS 10 with a rechargeable battery 32 providing for a sufficient capacity for at least several hours of monitoring, preferably at least 24 hours. FIG. 4, for example, is a picture of an OPS 10 used for photoplethysmography placed on a finger tip. Although the capillary bed is smaller than the fingertip, the presence of reflective bone backing formed by the finger bone improves the reflected signal. Basu at [0040]

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	 FIG. 3B  FIG. 3C Basu at Fig. 3B & 3C These technologies are integrated with a Bluetooth module 46 or another suitable wireless technology and with rechargeable batteries 32 in a small package, making the sensor assembly wireless and comfortably wearable throughout the day. OPS 10 and a low power Bluetooth transmitter can be integrated into the underside of a ring 44 or placed on a separate board 12′ along with the battery 32. Beside Bluetooth technology and Bluetooth Low Energy technology, any other low-power transmission protocol is suitable for communication with a computer for evaluation. Basu at [0062] In yet a further development, a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. **The proposed system can be used to monitor physiological activity and health on a continual basis.** For example, the low-cost, hear rate sensor could be used to monitor sleep, exercise, and stress levels, enabling patient self-monitoring and driven decision making by health care providers. The key benefits to the proposed approach is 1) low cost, so it can be deployed to a large number of patients, ii) the sensor is small and nonintrusive, reducing patient discomfort and thereby increasing patient compliance, iii) it consumes low power, so it can provide 24 hour operation, iv) data is automatically transmitted wirelessly via Bluetooth, further reducing patient burden. The technology will result in new methods to assess efficacy and improve patient compliance to with physician-prescribed regimens.

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	Basu at [0080] Basu at [0093] **FIG. 19 shows the normalized sensitivities of two photodiodes 20 and 16, one for the visible spectrum and one for the near infrared spectrum**. The sensitivities overlap so that the diode for the visible spectrum will also sense near infrared light and vice versa. Proper calibrations can compensate this disturbance with algorithms reducing the component of the respective other light source. Calibration measurements can be performed periodically or sporadically by individually taking measurements without any LED light, with one LED light operating, and with the other LED light operating. **For pulse oximetry, the Silicon Labs Si1143 was used, a triple-LED digital OPS 10, as is schematically indicated in FIG. 17. The chip 48 includes a photodiode 50 with FWHM spectral bandwidth of 600-1000 nm, 3 LED drivers, and a signal conditioning logic on the embedded IC**. Unlike the VCNL4000, the Si1143 does not include the LEDs on the chip 48 itself. Surface mount IR LEDs 14, 14′, and 15 (OSRAM) were placed within 3 mm on either side of the photodiode. The half angle of the chosen LEDs 14, 14′, and 15 is 22 degrees, which limits the light leakage. Each LED current can be set between 5.6 and 360 mA. The Si1143 uses time multiplexing to measure the reflectance from two or three LEDs on a single photo detector. Like the VCNL4000, it uses short LED pulses (25 μsec), which reduces the power consumption of the system. With three 100 mA LEDs 14, 14′, and 15 operating at a 100 Hz data rate, the power consumption is still less than about 800 μW. The Si1143 also includes an I2 C bus interface 26 for sensor configuration and reading sensor data. **The ambient light sensor 20 included on the chip 48 can be used for sensing whether the chip 48 has been placed in contact with the skin**. Results from the Multi-LED are shown in FIG. 16. **This experiment used three LEDs 14, 14′, and 15 placed 3 mm from a photo detector 50 formed by a Si1143 sensor** as indicated in FIG. 15. **A single measurement was taken at the fingertip at a fixed, moderate pressure**. The three simultaneous photoplethysmography waveforms are shown in the same graph. The signal-to-noise ratio is somewhat lower than similar measurements taken with the VCNL4000, but this is likely due to the smaller LED current used (30 mA vs. 100 mA). The pulsation index is slightly larger, which may be due to the placement or emission characteristics of the LEDs. **The SPO2 measurement can be found by taking the ratio of amplitudes in two LED channels. This calculation is performed by a microcontroller** (not shown).

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	Basu at [0103-0105] In summary, OPS 10 have traditionally been used in robotics and smart phones, but here we show that **OPS 10 perform all photoplethysmography functions in a single, 4 mm-by-4 mm package which links directly to a microcontroller via a standard serial interface**. Moreover, it provides substantial performance advantages over existing state-of-the-art photoplethysmography sensors, including: i) 10 times lower power consumption (200 μW), ii) 5 times lower cost ($4), iii) 20 times smaller area, and iv) High signal-to-noise ratio (more than about 90), as a result of built-in optical barriers 28, filters, and ambient light cancellation. The versatility of the device can be demonstrated by measuring photoplethysmography data in several anatomical locations. A multi-LED OPS 10 can provide dual wavelength measurements required for pulse oximetry. **These unique qualities make OPS 10 an elegant solution for battery-powered, wearable physiological monitors.** Basu at [0110] 1. An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and a wearable carrier accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin. Basu at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would

US'475 Patent	Basu
	have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Basu discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract] **According to further embodiments of the invention, a single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both** Basu at [0008] The influx of ambient light can be measured during OFF phases of the LED 14. The ambient light component can then be subtracted from the photo detector signal during ON phases to provide a sensitivity offset for proper calibration. **This technique being similar in concept to lock-in detection or to electronic noise cancellation, it improves the signal to noise ratio and reduces the impact of noise and ambient light**. Basu at [0037]

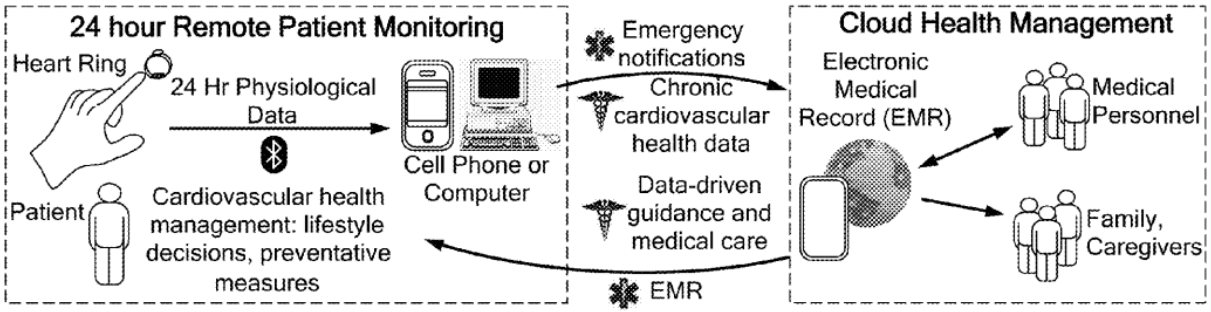
US'475 Patent	Basu
	Electronic noise and offset reduction: The second function of the bandpass filter in photoplethysmography sensors is to remove high frequency noise, including 60/120 Hz noise from ambient light sources. While a 0.5-5 Hz filter can usually remove such noise, it limits the bandwidth of the photoplethysmography sensor, which makes it difficult to resolve some time dependent features of the pressure pulse. An OPS 10 uses electronic modulation to cancel noise and ambient light. The LED 14 is modulated at 1 KHz frequency or higher. The received PD signal oscillates at the same frequency, and the on-chip signal processing utilizes a bandpass or lock-in filtering scheme to remove all the other signal components. This technique effectively eliminates both high and low frequency noise without limiting the bandwidth. It also diminishes the impact of sunlight, which occurs as direct current (DC). Finally, offset can be reduced if a glass overlay (not shown) is placed between the sensor and the skin. An ambient light sensor (ALS) in the form of a visible-light photodiode 20 can also be used as a reference for additional ambient light cancellation. Basu at [0055] **Intensity control: To maximize the signal-to-noise ratio in photoplethysmography, the LED intensity should be made as large as possible** without saturating the detector. **In the OPS 10, the LED intensity and modulation frequencies are programmable through the serial interface. In the case of the Vishay VCNL4000, the intensity is programmable from 10-200 mA in 10 mA increments**. Others (like the APDS-9190), include digital interrupts which trigger when the photo detector signal is saturated. Basu at [0058] In yet a further development, a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. Basu at [0093] For pulse oximetry, the Silicon Labs Si1143 was used, a triple-LED digital OPS 10, as is schematically indicated in FIG. 17. The chip 48 includes a photodiode 50 with FWHM spectral bandwidth of 600-1000 nm, 3 LED drivers, and a signal conditioning logic on the embedded IC. Unlike the VCNL4000, the

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	Si1143 does not include the LEDs on the chip 48 itself. Surface mount IR LEDs 14, 14′, and 15 (OSRAM) were placed within 3 mm on either side of the photodiode. The half angle of the chosen LEDs 14, 14′, and 15 is 22 degrees, which limits the light leakage. Each LED current can be set between 5.6 and 360 mA. The Si1143 uses time multiplexing to measure the reflectance from two or three LEDs on a single photo detector. Like the VCNL4000, it uses short LED pulses (25 μsec), which reduces the power consumption of the system. With three 100 mA LEDs 14, 14′, and 15 operating at a 100 Hz data rate, the power consumption is still less than about 800 μW. The Si1143 also includes an I2 C bus interface 26 for sensor configuration and reading sensor data. The ambient light sensor 20 included on the chip 48 can be used for sensing whether the chip 48 has been placed in contact with the skin. Basu at [0104] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Basu discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,. T**he influx of ambient light can be measured during OFF phases of the LED 14**. The ambient light component can then be subtracted from the photo detector signal during ON phases to provide a sensitivity offset for proper calibration. This technique being similar in concept to lock-in detection or to electronic noise cancellation, it improves the signal to noise ratio and reduces the impact of noise and ambient light. Basu at [0037]

US'475 Patent	Basu
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Basu discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. The influx of ambient light can be measured during OFF phases of the LED 14. **The ambient light component can then be subtracted from the photo detector signal during ON phases** to provide a sensitivity offset for proper calibration. This technique being similar in concept to lock-in detection or to electronic noise cancellation, it improves the signal to noise ratio and reduces the impact of noise and ambient light. Basu at [0037] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Basu discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. **The influx of ambient light can be measured during OFF phases of the LED 14. The ambient light component can then be subtracted from the photo detector signal during ON phases to provide a sensitivity offset for proper calibration. This technique being similar in concept to lock-in detection or to electronic noise cancellation, it improves the signal to noise ratio and reduces the impact of noise and ambient light**.

US'475 Patent	Basu
	Basu at [0037] Electronic noise and offset reduction: The second function of the bandpass filter in photoplethysmography sensors is to remove high frequency noise, including 60/120 Hz noise from ambient light sources. While a 0.5-5 Hz filter can usually remove such noise, it limits the bandwidth of the photoplethysmography sensor, which makes it difficult to resolve some time dependent features of the pressure pulse. An OPS 10 uses electronic modulation to cancel noise and ambient light. The LED 14 is modulated at 1 KHz frequency or higher. The received PD signal oscillates at the same frequency, and the on-chip signal processing utilizes a bandpass or lock-in filtering scheme to remove all the other signal components. This technique effectively eliminates both high and low frequency noise without limiting the bandwidth. It also diminishes the impact of sunlight, which occurs as direct current (DC). Finally, offset can be reduced if a glass overlay (not shown) is placed between the sensor and the skin. An ambient light sensor (ALS) in the form of a visible-light photodiode 20 can also be used as a reference for additional ambient light cancellation. Basu at [0055] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Basu discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise

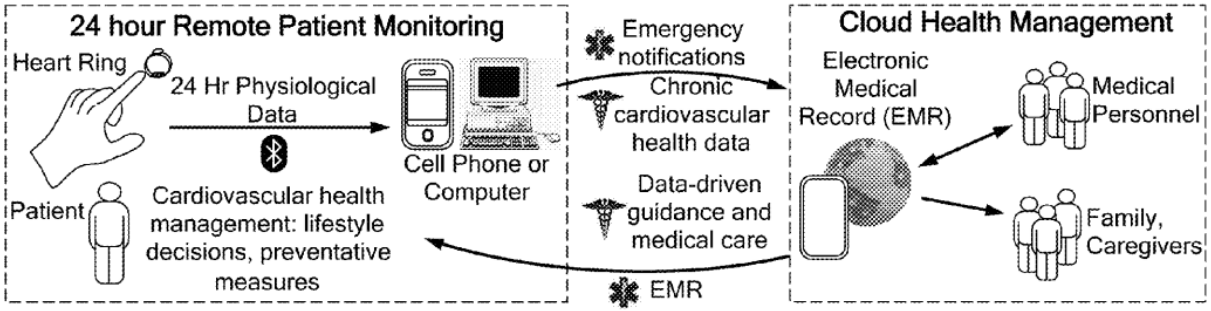
US'475 Patent	Basu
	reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. **The optical proximity sensor is accommodated on a wearable carrier**. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. **Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness**. Basu at [Abstract] According to a first aspect of the invention, an optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. Basu at [0007] Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery or vascular stiffness this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health. Basu at [0009] This invention includes new technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor. The blood pressure may be indirectly measured using pulse wave velocity by placing several sensors in different locations along an artery. In this manner, vascular conditions can be detected, such as restricted blood flow. Basu at [0034] In a first approach, this device utilizes electronic optical proximity sensors (OPS) 10 to sense a patient's heart rate. Optical proximity sensors, also called light beam sensors, detect distance by **measuring the**

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	magnitude of light reflected from an object. Variations of OPS are widely used for non-contact distance measurement in a variety of applications. In smart phones, for example, **OPS detect when a phone is placed in a pocket**, triggering touch-screen locking. In factory robotics, OPS are used for motion feedback control. In many industrial and consumer applications, OPS serve as touchless switches and gesture sensing devices in personal notebooks, vending machines, sanitary dispensers, lavatories, dimming control, and video games. Basu at [0035]  FIG. 11 Basu at Fig. 11 As further shown in FIG. 11, a "cloud-based" RPM infrastructure can actively manage cardiovascular health. Using OPS technology, cardiovascular parameters can be monitored on a 24-hour ambulatory basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record. These data will then be available to the patient's physician, providing an effective tool for quantitative assessment, without bias from "white-coat" alteration, thus providing a means for evidence-based medical management. In emergency situations, notifications can be sent to a medical response team and family members. An RPM-driven model will dramatically reduce the cost of chronic cardiovascular care through earlier detection of impending decompensation, white also improving health outcomes by motivating the patient to actively monitor health and take preventative measures. Basu at [0064]

US'475 Patent	Basu
	Having demonstrated that the sensor technology is fairly robust, a wireless ring 44 which combines the sensor with a Bluetooth, Bluetooth Low Energy (BLE), or other wireless transmitter linked to an application running on the user's cell phone. Basu at [0066] For pulse oximetry, the Silicon Labs Si1143 was used, a triple-LED digital OPS 10, as is schematically indicated in FIG. 17. The chip 48 includes a photodiode 50 with FWHM spectral bandwidth of 600-1000 nm, 3 LED drivers, and a signal conditioning logic on the embedded IC. Unlike the VCNL4000, the Si1143 does not include the LEDs on the chip 48 itself. Surface mount IR LEDs 14, 14′, and 15 (OSRAM) were placed within 3 mm on either side of the photodiode. The half angle of the chosen LEDs 14, 14′, and 15 is 22 degrees, which limits the light leakage. Each LED current can be set between 5.6 and 360 mA. The Si1143 uses time multiplexing to measure the reflectance from two or three LEDs on a single photo detector. Like the VCNL4000, it uses short LED pulses (25 μsec), which reduces the power consumption of the system. With three 100 mA LEDs 14, 14′, and 15 operating at a 100 Hz data rate, the power consumption is still less than about 800 μW. The Si1143 also includes an I2 C bus interface 26 for sensor configuration and reading sensor data. **The ambient light sensor 20 included on the chip 48 can be used for sensing whether the chip 48 has been placed in contact with the skin**. Basu at [0104] 1. An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having a first IR LED emitting light having an infrared wavelength, a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and a wearable carrier accommodating the optical proximity sensor and **configured for placing the optical proximity sensor in contact with skin**. Basu at Claim 1

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.	See claim 1 above. Basu discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the **at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller**. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract] The present invention relates to a device, a system, and a method for vascular health monitoring of a person. More particularly, **the invention relates to a sensor suitable for remote patient monitoring**. Basu at [0002]

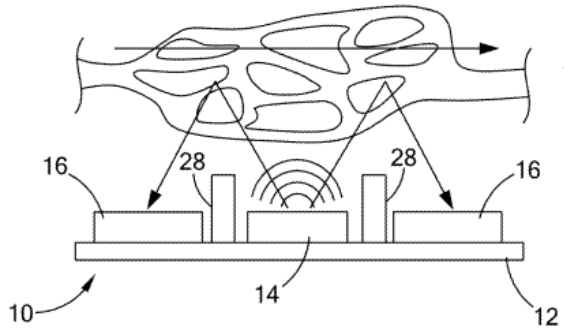
US'475 Patent	Basu
	According to a first aspect of the invention, an optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the **at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller**. The optical proximity sensor is accommodated on a wearable carrier. Basu at [0007] Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery or vascular stiffness this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health. Basu at [0009] This invention includes new technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor. The blood pressure may be indirectly measured using pulse wave velocity by placing several sensors in different locations along an artery. In this manner, vascular conditions can be detected, such as restricted blood flow. Basu at [0034]

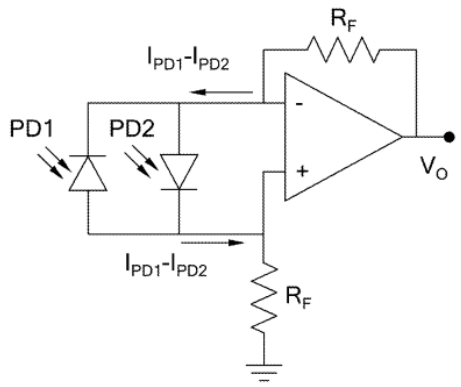
US'475 Patent	Basu
	 FIG. 11 Basu at Fig. 11 This technology leads to a remarkably small (less than 50 mm2, preferably less than about 25 mm2) and cheap (less than about $20) wireless heart rate sensor. The technology can be integrated into home health monitoring systems where the information is transmitted wirelessly to the patient's physician, hospital, and other caregivers, as schematically indicated in FIG. 11. It can also be incorporated into the patient's electronic medical record. The miniature, low cost wearable heart rate sensor has applications in various fields, such as remote patient monitoring (RPM). Basu at [0063] As further shown in FIG. 11, a "cloud-based" RPM infrastructure can actively manage cardiovascular health. **Using OPS technology, cardiovascular parameters can be monitored on a 24-hour ambulatory basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record. These data will then be available to the patient's physician, providing an effective tool for quantitative assessment, without bias from "white-coat" alteration, thus providing a means for evidence-based medical management. In emergency situations, notifications can be sent to a medical response team and family members**. An RPM-driven model will dramatically reduce the cost of chronic cardiovascular care through earlier detection of impending decompensation, white also improving health outcomes by motivating the patient to actively monitor health and take preventative measures. Basu at [0064]

US'475 Patent	Basu
	Having demonstrated that the sensor technology is fairly robust, a wireless ring 44 which combines the sensor with a Bluetooth, Bluetooth Low Energy (BLE), or other wireless transmitter linked to an application running on the user's cell phone. **The sensor and transmitter electronics can be arranged on a printed circuit board (PCB) using standard software. A mobile application may connect to the ring 44 via Bluetooth, downloads the photoplethysmography data, displays it on the screen, and uses signal processing to calculate the heart rate. Android is an open-source programming model with built-in libraries for simplifying the programming of Bluetooth and displays. Other operating systems and wireless protocols capable of communicating with a mobile device are also suitable. The ring 44 for slipping the sensor onto a finger may be made of injection molded plastics or cured elastomers, both of which are inexpensive, compatible with embedded electronics, and flexible to allow for multiple ring sizes**. Basu at [0066-00067] In another preferred embodiment, the upper board 12 contains the battery 32, battery charger, USB port for charging, a **microprocessor 54 programmed with an operating system and the wireless module 46 including a microprocessor and an antenna 52 for communications**. As illustrated in FIG. 12, this arrangement frees up space on the lower board 12′ for the photodiode 16 or photodiodes 16, the LED 14, and the optical barriers 28. The lower board may thus additionally carry a temperature sensor 56 and the previously mentioned galvanic skin response sensor 58. The upper board 12 and the lower board 12′ are connected via the flex cable 30 forming the ring shape of this wearable OPS 10. Basu at [0071] The proposed system can be used to monitor physiological activity and health on a continual basis. For example, the low-cost, hear rate sensor could be used to monitor sleep, exercise, and stress levels, enabling patient self-monitoring and driven decision making by health care providers. The key benefits to the proposed approach is 1) low cost, so it can be deployed to a large number of patients, ii) the sensor is small and nonintrusive, reducing patient discomfort and thereby increasing patient compliance, iii) it consumes low power, so it can provide 24 hour operation, iv) data is automatically transmitted wirelessly via Bluetooth, further reducing patient burden. The technology will result in new methods to assess efficacy and improve patient compliance to with physician-prescribed regimens.

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	The technology is suited to be deployed in a cloud-based health monitoring and mentoring framework which integrates remote patient monitoring (RPM) with an online community involving medical caregivers and a social network of the patient's peers. This framework may even be used to treat psychosocial disorders. RPM provides quantitative, unbiased data which can be used for managing a wide range of chronic physiological and psychological disorders, including post-traumatic stress disorder, depression, hypertension, heart disease, sleep apnea, work stress, and many other psychosocial and physiological disorders. The small form factor and low power consumption of the proposed device is designed to provide all day use and be invisible, reducing patient burden. Medical technology has increased the costs of healthcare over the last several decades. As a whole, remote patient telemonitoring is widely believed to be a critical step toward managing health care costs, while enhancing patient engagement and treatment compliance, an area of critical national priority given the rising costs of healthcare. Telemonitoring can reduce the total cost of care by reducing emergency and hospital visits, and unnecessary treatment, and is especially well suited for supporting patients with chronic conditions. Basu at [0080-0083] Before performing the measurement, the current for the IR LED 14 must be set appropriately. It is advantageous to use a large current to maximize the reflected light. The signal-to-noise ratio is found to scale proportionally with the reflected light. However, too large a current will saturate the photodiode 16. The ideal current setting for the IR emitter lies between 80-130 mA, depending on the anatomical location, on the presence of a metallic reflector, and on the individual being tested. The IR emitter current can be set to autorange: in other words, the microcontroller can automatically tune down the emitter current if it saturates the photodiode, and increase the current if the reflected signal is low. Basu at [0089] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

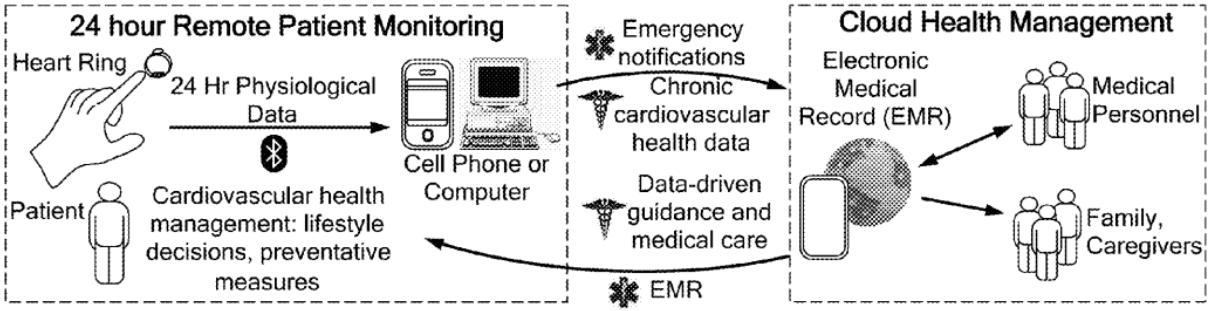
US'475 Patent	Basu
	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	
6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	See claim 1 above. Basu discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a **plurality of identical or different LEDs**, **a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness**. Basu at [Abstract] Also, **several sensors** may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery or vascular stiffness this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health. Basu at [0009] This invention includes new technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor. The blood pressure may be indirectly measured using pulse wave velocity by **placing several sensors in different locations along an artery**. In this manner, vascular conditions can be detected, such as restricted blood flow.

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	Basu at [0034] An OPS 10 for detecting pulse wave velocity uses a novel sensor setup which detects how fast a pulse wave travels from one side of the sensor to the other side of the sensor (FIGS. 6A and 7). This approach can be robust to environmental noise and to drift of the sensor. Pulse wave velocity can be correlated with blood pressure. The device works in the near infrared (˜950 nm) range. By putting two generally identical photodiodes 16 in two different locations on a circuit board 12 symmetrically on opposite sides of an IR LED 14, the time it takes for a pulse wave to move through the vessel can be measured as shown in the diagram of FIG. 6B. The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially reflected. The reflected signal is sensed by each of the photodiodes 16. As a pulse of blood flows through the capillary bed, both photodiodes experience nearly identical pulse waves offset by a short transit time due to the finite velocity of the pulse wave. A difference amplifier will produce a series of pulses whose width is inversely proportional to pulse wave velocity. An illustrative electronic circuit is shown in FIG. 7. Basu at [0042]  FIG. 6A Basu at Fig. 6.

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	 FIG. 7 Basu at Fig. 7. The OPS 10 is generally illustrated in FIG. 1 and includes an embedded 895 nm IR LED 14 and a photodiode 16 with visible light blocking filter 22. The spacing between the LED 14 and photodiode 16 is about 2 mm, resulting in a large reflectance and sensitivity. The LED14 is embedded in a recessed region which serves as an optical barrier28 to reduce light leakage. The embedded signal processing IC 24 handles LED modulation, current control (10-200 mA in 10 mA steps), photo detector amplification and signal conditioning, ambient light cancellation, 16-bit analog to digital conversion (ADC), and I2C bus communication. The ADC can resolve pulsation indices of 15 ppm. The LED 14 can be modulated at frequencies up to 3.1 MHz (user selectable) for electronic noise cancellation. Basu at [0047] In yet a further development, **a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range** (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. Basu at [0093]

US'475 Patent	Basu
	The photo detector 50 includes photodiodes sensitive to all three wavelengths. Basu at [0109] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	See claim 6 above. Basu discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. The present invention relates to a device, a system, and a method for vascular health monitoring of a person. More particularly, the invention relates to a sensor suitable for remote patient monitoring. Basu at [0002] According to a first aspect of the invention, an optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a **digital interface for communication with a microcontroller**. The optical proximity sensor is accommodated on a wearable carrier.

US'475 Patent	Basu
	Basu at [0007] Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery or vascular stiffness this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health. Basu at [0009] This invention includes new technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor. The blood pressure may be indirectly measured using pulse wave velocity by placing several sensors in different locations along an artery. In this manner, vascular conditions can be detected, such as restricted blood flow. Basu at [0034] In a first approach, this device utilizes electronic optical proximity sensors (OPS) 10 to sense a patient's heart rate. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. Variations of OPS are widely used for non-contact distance measurement in a variety of applications. In smart phones, for example, OPS detect when a phone is placed in a pocket, triggering touch-screen locking. In factory robotics, OPS are used for motion feedback control. In many industrial and consumer applications, OPS serve as touchless switches and gesture sensing devices in personal notebooks, vending machines, sanitary dispensers, lavatories, dimming control, and video games. Basu at [0035]

US'475 Patent	Basu
	 FIG. 11 Basu at Fig. 11 Multiple photoplethysmography measurements were obtained by placing the OPS 10 in firm contact with the skin at multiple locations as previously described in connection with FIG. 5. In the earlobe measurements, a metal cap was placed on the opposite side to improve the reflectance measurement. The photoplethysmography data were recorded using a Silicon Labs microcontroller directly connected to a laptop via USB. Basu at [0048]. These technologies are integrated with a Bluetooth module 46 or another suitable wireless technology and with rechargeable batteries 32 in a small package, making the sensor assembly wireless and comfortably wearable throughout the day. OPS 10 and a low power Bluetooth transmitter can be integrated into the underside of a ring 44 or placed on a separate board 12′ along with the battery 32. Beside Bluetooth technology and Bluetooth Low Energy technology, any other low-power transmission protocol is suitable for communication with a computer for evaluation. Basu at [0062]. This technology leads to a remarkably small (less than 50 mm2, preferably less than about 25 mm2) and cheap (less than about $20) wireless heart rate sensor. The technology can be integrated into home health monitoring systems where the information is transmitted wirelessly to the patient's physician, hospital, and other caregivers, as schematically indicated in FIG. 11. It can also be incorporated into the patient's

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	electronic medical record. The miniature, low cost wearable heart rate sensor has applications in various fields, such as remote patient monitoring (RPM). Basu at [0063] As further shown in FIG. 11, a "cloud-based" RPM infrastructure can actively manage cardiovascular health. Using OPS technology, cardiovascular parameters can be monitored on a 24-hour ambulatory basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record. These data will then be available to the patient's physician, providing an effective tool for quantitative assessment, without bias from "white-coat" alteration, thus providing a means for evidence-based medical management. In emergency situations, notifications can be sent to a medical response team and family members. An RPM-driven model will dramatically reduce the cost of chronic cardiovascular care through earlier detection of impending decompensation, white also improving health outcomes by motivating the patient to actively monitor health and take preventative measures. Basu at [0064] Having demonstrated that the sensor technology is fairly robust, a wireless ring 44 which combines the sensor with a Bluetooth, Bluetooth Low Energy (BLE), or other wireless transmitter linked to an application running on the user's cell phone. The sensor and transmitter electronics can be arranged on a printed circuit board (PCB) using standard software. A mobile application may connect to the ring 44 via Bluetooth, downloads the photoplethysmography data, displays it on the screen, and uses signal processing to calculate the heart rate. Android is an open-source programming model with built-in libraries for simplifying the programming of Bluetooth and displays. Other operating systems and wireless protocols capable of communicating with a mobile device are also suitable. The ring 44 for slipping the sensor onto a finger may be made of injection molded plastics or cured elastomers, both of which are inexpensive, compatible with embedded electronics, and flexible to allow for multiple ring sizes. Basu at [0066-00067] In another preferred embodiment, the upper board 12 contains the battery 32, battery charger, USB port for charging, a microprocessor 54 programmed with an operating system and the wireless module 46

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	including a microprocessor and an antenna 52 for communications. As illustrated in FIG. 12, this arrangement frees up space on the lower board 12′ for the photodiode 16 or photodiodes 16, the LED 14, and the optical barriers 28. The lower board may thus additionally carry a temperature sensor 56 and the previously mentioned galvanic skin response sensor 58. The upper board 12 and the lower board 12′ are connected via the flex cable 30 forming the ring shape of this wearable OPS 10. Basu at [0071] Due to the low price, other potential markets may include consumer fitness (as replacement for straps, watches) and the mobile phone industry (as Bluetooth accessory). The worldwide market for home health monitoring of was worth about $10 billion in 2010. Basu at [0078]. The proposed system can be used to monitor physiological activity and health on a continual basis. For example, the low-cost, hear rate sensor could be used to monitor sleep, exercise, and stress levels, enabling patient self-monitoring and driven decision making by health care providers. The key benefits to the proposed approach is 1) low cost, so it can be deployed to a large number of patients, ii) the sensor is small and nonintrusive, reducing patient discomfort and thereby increasing patient compliance, iii) it consumes low power, so it can provide 24 hour operation, iv) data is automatically transmitted wirelessly via Bluetooth, further reducing patient burden. The technology will result in new methods to assess efficacy and improve patient compliance to with physician-prescribed regimens. The technology is suited to be deployed in a cloud-based health monitoring and mentoring framework which integrates remote patient monitoring (RPM) with an online community involving medical caregivers and a social network of the patient's peers. This framework may even be used to treat psychosocial disorders. RPM provides quantitative, unbiased data which can be used for managing a wide range of chronic physiological and psychological disorders, including post-traumatic stress disorder, depression, hypertension, heart disease, sleep apnea, work stress, and many other psychosocial and physiological disorders. The small form factor and low power consumption of the proposed device is designed to provide all day use and be invisible, reducing patient burden.

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	Medical technology has increased the costs of healthcare over the last several decades. As a whole, remote patient telemonitoring is widely believed to be a critical step toward managing health care costs, while enhancing patient engagement and treatment compliance, an area of critical national priority given the rising costs of healthcare. Telemonitoring can reduce the total cost of care by reducing emergency and hospital visits, and unnecessary treatment, and is especially well suited for supporting patients with chronic conditions. Basu at [0080-0083] In summary, OPS 10 have traditionally been used in robotics and smart phones, but here we show that OPS 10 perform all photoplethysmography functions in a single, 4 mm-by-4 mm package which links directly to a microcontroller via a standard serial interface. Basu at [0110]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Basu discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. *See* claim 1[pre], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are

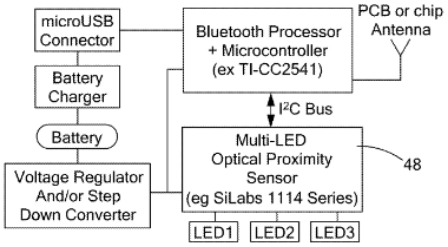
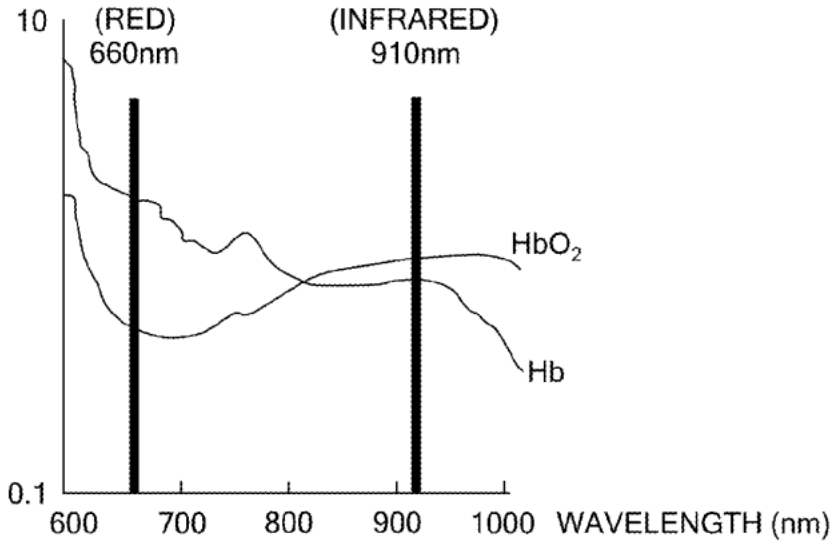
US'475 Patent	Basu
	incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Basu discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;. *See* claim 1[c], 1[j], 1[k] above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Basu discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. *See* claim 1[d], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Basu discloses or renders obvious a detector. *See* claim 1[e], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Basu discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. *See* claim 1[k], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Basu discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. *See* claim 1[j], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion	Basu discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater

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of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. *See* claim 1[e], 1[h], 1[l], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.	Basu discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user. *See* claim 1[m], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. **An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength**, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for

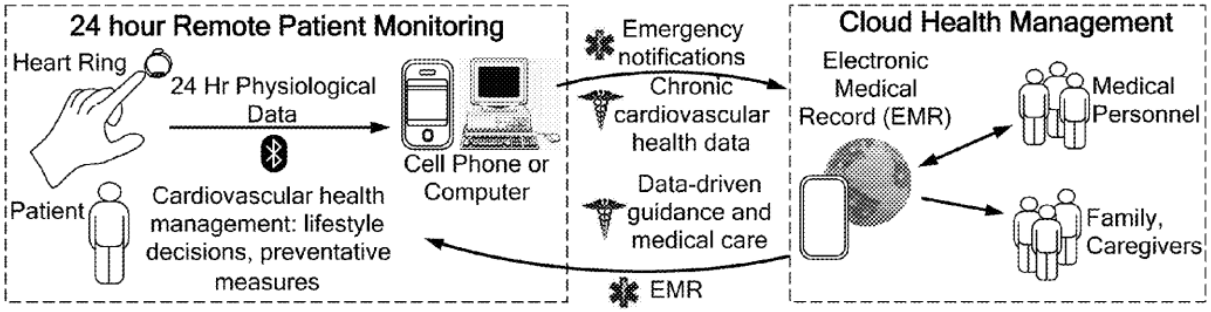
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	communication with a microcontroller. **The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both.** Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at Abstract. Integrated IR LED and visible light blocking filter: In many integrated OPS 10, **the emitter wavelength is in the near infrared range (850-950 nm), which is ideal for photoplethysmography**. Other OPS 10 allow the designer to add any discrete LED 14′ and 15, as will be later described in connection with FIGS. 14 and 15. The visible light blocking filter 14 included on some OPS 10 reduces the impact of ambient light. Basu at [0050] In yet a further development, **a compact OPS 10 may contain a plurality of LEDs that may each emit light in a different spectral range** (FIGS. 14 and 15). A photo detector equipped with different photodiodes 16 and 20 tuned to the emitted wavelengths can distinguish the individual reflected photons by their wavelength. Basu at [0093] Basu discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. Pulse oximetry measures blood oxygenation (SpO2) by comparing the pulsation indices at two wavelengths with known absorbance characteristics in oxygenated vs. deoxygenated blood. A multi-LED digital OPS 10 can provide multiple photoplethysmography waveforms, each with a different LED, and can therefore obtain radiometric measurements required for pulse oximetry. Basu at [0094] Thus, **suitable wavelengths for pulse oximetry are in the range of about 600 nm to 700 nm for the red LED 15, preferably between about 650 nm and 670 nm, and about 850 nm to 950 nm,**

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	preferably about 900 nm to 940 nm for the near infrared LED 14. Notably, a deviation from the preferred wavelengths is feasible and may make the sensor 10 cheaper due to the availability of commercially produced LEDs 14 and 15. The two LEDs 14 and 15 may be pulsed. Optionally, the two LEDs 14 and 15 may be pulsed at different frequencies through frequency multiplexing. Alternatively. The LEDs 14 and 15 may be pulsed in an alternating mode through time multiplexing. Pulsing the LEDs 14 and 15 promotes an easy distinction of the two signals where both signals are received by the same photo detector. Basu at [0099] FIG. 18 illustrates the absorption spectra of oxyhemoglobin, i.e. hemoglobin that has been enriched with oxygen and is found in arterial blood, and of reduced hemoglobin, i.e. hemoglobin that does not carry oxygen. Because Oxyhemoglobin is typically found in arteries, pulse oximetry measures the component of the reflected infrared signal that alternates with the pulse of a patient. The red signal, on the other hand, is much more indicative of the reduced hemoglobin, which is more prevalent in veins and should thus not show a strong pulse. The red LED 15 thus gives a baseline measurement. Comparing the signals from the two LEDs 14 and 15 allows one to measure blood oxygenation, also referred to as SPO2, or oxygen partial pressure. Basu at [0100] For pulse oximetry, the Silicon Labs Si1143 was used, a triple-LED digital OPS 10, as is schematically indicated in FIG. 17. The chip 48 includes a photodiode 50 with FWHM spectral bandwidth of 600-1000 nm, 3 LED drivers, and a signal conditioning logic on the embedded IC. Unlike the VCNL4000, the Si1143 does not include the LEDs on the chip 48 itself. Surface mount IR LEDs 14, 14′, and 15 (OSRAM) were placed within 3 mm on either side of the photodiode. The half angle of the chosen LEDs 14, 14′, and 15 is 22 degrees, which limits the light leakage. Each LED current can be set between 5.6 and 360 mA. The Si1143 uses time multiplexing to measure the reflectance from two or three LEDs on a single photo detector. Like the VCNL4000, it uses short LED pulses (25 μsec), which reduces the power consumption of the system. With three 100 mA LEDs 14, 14′, and 15 operating at a 100 Hz data rate, the power consumption is still less than about 800 μW. The Si1143 also includes an I2 C bus interface 26 for sensor configuration and reading sensor data. The ambient light sensor 20 included on the chip 48 can be used for sensing whether the chip 48 has been placed in contact with the skin.

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	Basu at [0104]  FIG. 17 Basu at Fig. 17  FIG. 18

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	Basu at Fig. 18 An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having **a first IR LED emitting light having an infrared wavelength,** a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller; and a wearable carrier accommodating the optical proximity sensor and configured for placing the optical proximity sensor in contact with skin. Basu at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. *See* claim 1[b], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

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Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	See claim 8 above. Basu discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency. An optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. A single sensor may include a plurality of identical or different LEDs, a plurality of photodiodes, or both. Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery stiffness. Basu at [Abstract] According to a first aspect of the invention, an optical proximity sensor assembly includes an optical proximity sensor with an IR LED emitting light having an infrared wavelength, an IR photo detector sensitive to the infrared wavelength, an optical barrier blocking direct light rays from the LED to the IR photo detector and permitting reflected light rays to reach the at least one photo detector; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to digital converter, LED drivers, noise reduction and ambient light cancellation circuitry, and a digital interface for communication with a microcontroller. The optical proximity sensor is accommodated on a wearable carrier. Basu at [0007] Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery or vascular stiffness this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health.

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	Basu at [0009] This invention includes new technologies for simultaneously sensing heart rate, blood pressure and pulse oximetry. These technologies can be combined in one sensor. The blood pressure may be indirectly measured using pulse wave velocity by placing several sensors in different locations along an artery. In this manner, vascular conditions can be detected, such as restricted blood flow. Basu at [0034]  FIG. 11 Basu at Fig. 11 The OPS 10 is generally illustrated in FIG. 1 and includes an embedded 895 nm IR LED 14 and a photodiode 16 with visible light blocking filter 22. The spacing between the LED 14 and photodiode 16 is about 2 mm, resulting in a large reflectance and sensitivity. The LED 14 is embedded in a recessed region which serves as an optical barrier 28 to reduce light leakage. **The embedded signal processing IC 24 handles LED modulation, current control (10-200 mA in 10 mA steps), photo detector amplification and signal conditioning, ambient light cancellation, 16-bit analog to digital conversion (ADC), and I2C bus communication. The ADC can resolve pulsation indices of 15 ppm**. **The LED 14 can be modulated at frequencies up to 3.1 MHz (user selectable) for electronic noise cancellatio**n. To reduce power consumption, each measurement is completed in 75 μsec, and the LED 14 is kept off at the remainder of the measurement cycle. This allows one to use a large LED current (100 mA) while consuming less than about 200 μW power at a 100 Hz data rate. The supply voltage

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	range is 2.5-3.6 V, which is well suited for operation from a 3V coin cell rechargeable battery 32. The IR LED 14 is placed on a separate supply to reduce the effects of digital switching noise. The I2C serial interface 26, supported by most microcontrollers, is used to transmit data and to configure the OPS 10. The cost of the component is comparatively low. Notably, the above specification is only one example of an operational OPS. For example, a 12-bit analog-to-digital conversion may be sufficient. Basu at [0047] Electronic noise and offset reduction: The second function of the bandpass filter in photoplethysmography sensors is to remove high frequency noise, including 60/120 Hz noise from ambient light sources. While a 0.5-5 Hz filter can usually remove such noise, it limits the bandwidth of the photoplethysmography sensor, which makes it difficult to resolve some time dependent features of the pressure pulse. An OPS 10 uses electronic modulation to cancel noise and ambient light. The LED 14 is modulated at 1 KHz frequency or higher. The received PD signal oscillates at the same frequency, and the on-chip signal processing utilizes a bandpass or lock-in filtering scheme to remove all the other signal components. This technique effectively eliminates both high and low frequency noise without limiting the bandwidth. It also diminishes the impact of sunlight, which occurs as direct current (DC). Finally, offset can be reduced if a glass overlay (not shown) is placed between the sensor and the skin. An ambient light sensor (ALS) in the form of a visible-light photodiode 20 can also be used as a reference for additional ambient light cancellation. Basu at [0055] This technology leads to a remarkably small (less than 50 mm2, preferably less than about 25 mm2) and cheap (less than about $20) wireless heart rate sensor. The technology can be integrated into home health monitoring systems where the information is transmitted wirelessly to the patient's physician, hospital, and other caregivers, as schematically indicated in FIG. 11. It can also be incorporated into the patient's electronic medical record. The miniature, low cost wearable heart rate sensor has applications in various fields, such as remote patient monitoring (RPM). Basu at [0063] As further shown in FIG. 11, a "cloud-based" RPM infrastructure can actively manage cardiovascular health. Using OPS technology, cardiovascular parameters can be monitored on a 24-hour ambulatory

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	basis using wearable biosensors, with wireless transmission of relevant data to the patient's electronic medical record. These data will then be available to the patient's physician, providing an effective tool for quantitative assessment, without bias from "white-coat" alteration, thus providing a means for evidence-based medical management. In emergency situations, notifications can be sent to a medical response team and family members. An RPM-driven model will dramatically reduce the cost of chronic cardiovascular care through earlier detection of impending decompensation, white also improving health outcomes by motivating the patient to actively monitor health and take preventative measures. Basu at [0064] Having demonstrated that the sensor technology is fairly robust, a wireless ring 44 which combines the sensor with a Bluetooth, Bluetooth Low Energy (BLE), or other wireless transmitter linked to an application running on the user's cell phone. The sensor and transmitter electronics can be arranged on a printed circuit board (PCB) using standard software. A mobile application may connect to the ring 44 via Bluetooth, downloads the photoplethysmography data, displays it on the screen, and uses signal processing to calculate the heart rate. Android is an open-source programming model with built-in libraries for simplifying the programming of Bluetooth and displays. Other operating systems and wireless protocols capable of communicating with a mobile device are also suitable. The ring 44 for slipping the sensor onto a finger may be made of injection molded plastics or cured elastomers, both of which are inexpensive, compatible with embedded electronics, and flexible to allow for multiple ring sizes. Basu at [0066-00067] In another preferred embodiment, the upper board 12 contains the battery 32, battery charger, USB port for charging, a microprocessor 54 programmed with an operating system and the wireless module 46 including a microprocessor and an antenna 52 for communications. As illustrated in FIG. 12, this arrangement frees up space on the lower board 12′ for the photodiode 16 or photodiodes 16, the LED 14, and the optical barriers 28. The lower board may thus additionally carry a temperature sensor 56 and the previously mentioned galvanic skin response sensor 58. The upper board 12 and the lower board 12′ are connected via the flex cable 30 forming the ring shape of this wearable OPS 10. Basu at [0071]

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	The proposed system can be used to monitor physiological activity and health on a continual basis. For example, the low-cost, hear rate sensor could be used to monitor sleep, exercise, and stress levels, enabling patient self-monitoring and driven decision making by health care providers. The key benefits to the proposed approach is 1) low cost, so it can be deployed to a large number of patients, ii) the sensor is small and nonintrusive, reducing patient discomfort and thereby increasing patient compliance, iii) it consumes low power, so it can provide 24 hour operation, iv) data is automatically transmitted wirelessly via Bluetooth, further reducing patient burden. The technology will result in new methods to assess efficacy and improve patient compliance to with physician-prescribed regimens. The technology is suited to be deployed in a cloud-based health monitoring and mentoring framework which integrates remote patient monitoring (RPM) with an online community involving medical caregivers and a social network of the patient's peers. This framework may even be used to treat psychosocial disorders. RPM provides quantitative, unbiased data which can be used for managing a wide range of chronic physiological and psychological disorders, including post-traumatic stress disorder, depression, hypertension, heart disease, sleep apnea, work stress, and many other psychosocial and physiological disorders. The small form factor and low power consumption of the proposed device is designed to provide all day use and be invisible, reducing patient burden. Medical technology has increased the costs of healthcare over the last several decades. As a whole, remote patient telemonitoring is widely believed to be a critical step toward managing health care costs, while enhancing patient engagement and treatment compliance, an area of critical national priority given the rising costs of healthcare. Telemonitoring can reduce the total cost of care by reducing emergency and hospital visits, and unnecessary treatment, and is especially well suited for supporting patients with chronic conditions. Basu at [0080-0083] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Basu, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Basu, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

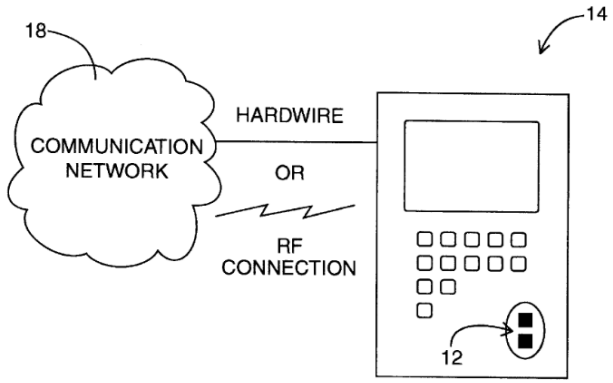
U.S. Pat. No. 12,268,475 in view of U.S. Patent No. 6,616,613 to Jesse B. Goodman ("Goodman")

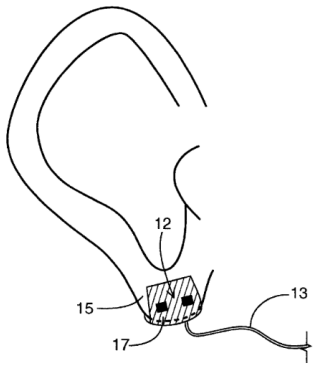
As described in detail below, Goodman (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Goodman. The cited portions of Goodman are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Goodman. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Goodman "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Goodman does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Goodman (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Goodman anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

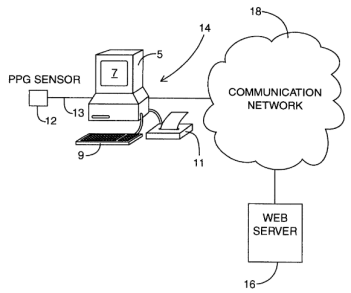
’475 Patent	Goodman
Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Goodman discloses or renders obvious an apparatus adapted to be worn by a user comprising. A health monitoring and biofeedback system comprising a photoplethysmography (PPG) sensor, a processing device, and a Web site server for determining, displaying and analyzing various cardiovascular parameters. The PPG sensor is installed within a manually operated user input device such as a mouse or keyboard, measures a user's blood volume contour and transmits it to a processing device such as a personal computer or a personal digital assistant (PDA). The system determines a plurality of cardiovascular indices including mean blood pressure, heart rate, body temperature, respiratory rate, and arterial compliance on the basis of signal characteristics of the systolic wave pulse and the systolic reflected wave pulse present within the digital volume pulse derived from the PPG pulse contour. Signal characteristics of the systolic reflected wave pulse can be determined through various pulse analysis techniques including derivative analysis of the digital volume pulse signal, bandpass filtering or respiratory matrix frequency extraction techniques. By subtracting the systolic reflected wave pulse contour from the digital volume pulse contour, characteristics of the systolic wave pulse can also be identified. The system also provides for the accurate determination of systolic and diastolic blood pressure by using a non-invasive blood pressure monitor to calibrate the relationships between arterial or digital blood pressure and characteristics of the user's digital volume pulse contour. In this way, a wide variety of cardiovascular and respiratory data can be obtained. The system also facilitates the transmittal of such data to the system web site for further analysis, storage, and retrieval purposes. Goodman at [Abstract] PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light.

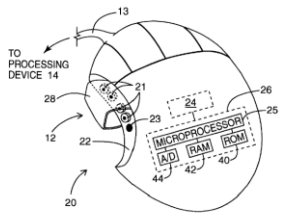
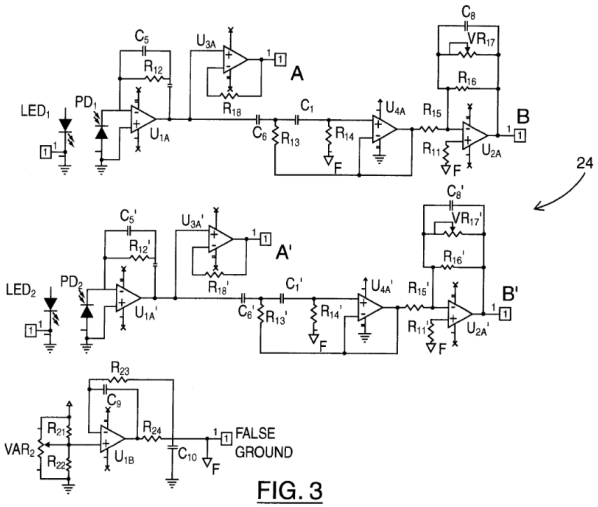
’475 Patent	Goodman
	Goodman at 09:57-10:07 FIG. 5 shows another possible configuration of system 10 wherein processing device 14 is a PDA (e.g. Palm Pilot™) having PPG sensor 12 interfaced therein. PPG sensor 12 could be directly integrated into the shell of the PDA processing device 14. Alternatively, PPG sensor 12 could be implemented within a PDA accessory card or device, or adapted to interface with the PDA processing device 14 as an external wearable device. In the latter case, it would be possible for a user to wear a wearable user input device 12 such that blood volume pulse signal information could be collected by the PDA processing device 14 over the course of a day. It would be possible to arrange for periodic download of recorded volume pulse contour signal information collected by user input device 12 to processing device 14 and/or to Web site server 16 through processing device 14 over the communication network 18. Goodman at 13:26-42  FIG. 5 Goodman at Fig. 5 Further embodiments of the invention whereby PPG sensor 12 and processing device 14 are integrated together into a single unit with a compact design are also contemplated as processing speed and device memory increase as physical dimensions decrease. For example, it is likely that PPG sensor 12 and processing device 14, and all of its associated functionality, could feasibly be incorporated into a wrist watch device in the foreseeable future. It is contemplated that PPG sensor 12 could be integrated together

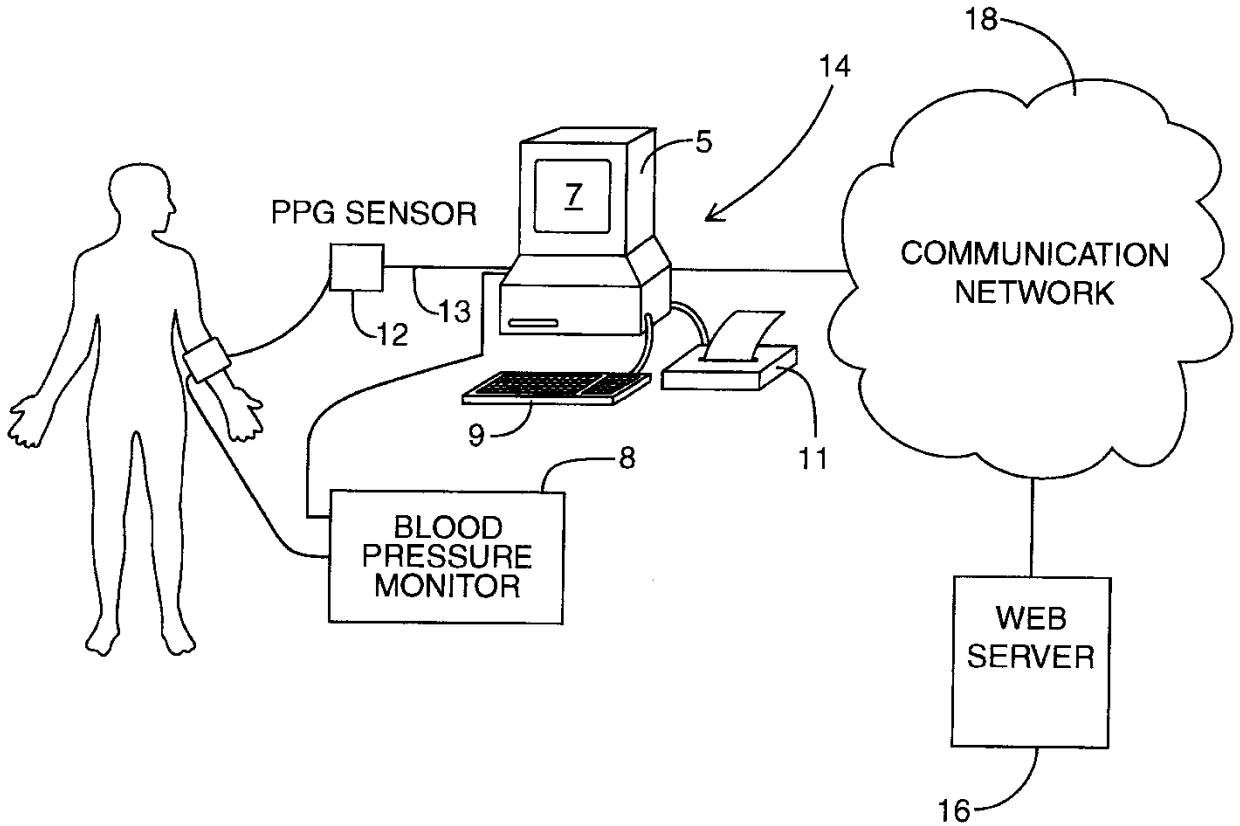
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	with a computing means, wireless transmission means (e.g. well known convention radio frequency techniques as well as emerging radio frequency communication protocols such as the BlueTooth™ standard) and a battery in a small (e.g. 2 cm2) component that would adhere to a body skin area for extended periods of time (e.g. weeks) and would transmit data to a remote computing device on a continuous basis. Goodman at 13:43-58 FIG. 6 shows how PPG sensor 12 could be associated with the user's earlobe 15 instead of the user's finger. As discussed, it is well known that the reflective wave originating in the aorta has a significant presence in the volume pulse contour obtained from a fingertip, ear or other points on the surface of the body. As is conventionally known, the volume pulse signal acquired from the ear lobe, like the finger, is similar to that acquired from the carotid artery. Specifically, it is contemplated that PPG sensor 12 operating in transmission mode could be implanted in a “clip” device 17 which would provide for skin contact between PPG sensor 12 and a user's earlobe 15. This embodiment would provide analogous pulse volume signal information from which various cardiovascular and respiratory indices could be obtained, while allowing for hands free functionality. Goodman at 13:59-14:06  FIG. 6 Goodman at Fig. 6 1. A physiological signal monitoring system comprising:

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	(a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic, wherein said physiological characteristic comprises the user's blood volume contour; (b) first processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for conducting analysis of said physiological parameters, said first processing means comprising: (i) filtering means for filtering nonpulsatile and slowly pulsatile signals from the blood volume contour to obtain a filtered blood volume contour; (ii) extraction means for extracting characteristics of the user's aortic reflected wave contour from a volume contour chosen from one of the blood volume contour and the filtered blood volume contour, the characteristics of the user's aortic reflected wave contour being determined in part from a fourth derivative of said volume contour; (iii) computing means for determining the set of physiological parameters based on characteristics of said aortic reflected wave; and, (c) display means coupled to said first processing means for displaying said physiological parameters. Goodman at Claim 1. 36. A physiological signal monitoring system for selectively providing a user with access to a resource, said system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic; (b) processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for extracting characteristics of an aortic reflected wave for the user from said data; (c) storage means for storing unique characteristics of an aortic reflected wave contour for the user; (d) verification means coupled to said processing means and said storage means for comparing said extracted characteristics of the aortic reflected wave with said unique characteristics of the aortic reflected wave and for providing the user with access to the resource only if said extracted characteristics of the user's aortic reflected wave is at least substantially identical to said unique characteristics of the aortic reflected wave; and, (e) display means coupled to said processing means for displaying said physiological parameters. Goodman at Claim 36

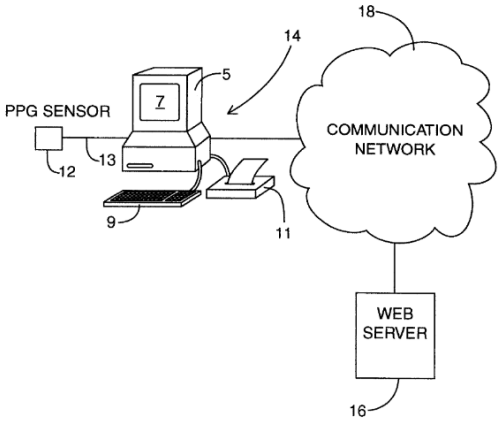
’475 Patent	Goodman
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	Goodman discloses or renders obvious one or more biosensors adapted to be placed on the user,. A health monitoring and biofeedback system comprising a photoplethysmography (PPG) sensor, a processing device, and a Web site server for determining, displaying and analyzing various cardiovascular parameters. The PPG sensor is installed within a manually operated user input device such as a mouse or keyboard, measures a user's blood volume contour and transmits it to a processing device such as a personal computer or a personal digital assistant (PDA). The system determines a plurality of cardiovascular indices including mean blood pressure, heart rate, body temperature, respiratory rate, and arterial compliance on the basis of signal characteristics of the systolic wave pulse and the systolic reflected wave pulse present within the digital volume pulse derived from the PPG pulse contour. Signal characteristics of the systolic reflected wave pulse can be determined through various pulse analysis techniques including derivative analysis of the digital volume pulse signal, bandpass filtering or respiratory matrix frequency extraction techniques. By subtracting the systolic reflected wave pulse contour from the digital volume pulse contour, characteristics of the systolic wave pulse can also be identified. The system also provides for the accurate determination of systolic and diastolic blood pressure by using a non-invasive blood pressure monitor to calibrate the relationships between arterial or digital blood pressure and characteristics of the user's digital volume pulse contour. In this way, a wide variety of cardiovascular and respiratory data can be obtained. The system also facilitates the transmittal of such data to the system web site for further analysis, storage, and retrieval purposes. Goodman at [Abstract] Reference is first made to FIG. 1, which shows the overall configuration of the preferred embodiment of a physiological monitoring system 10, according to the present invention. System 10 comprises a conventional plethysmography (PPG) sensor 12 coupled to a processing device 14 which is in data communication with a Web site server 16 through a communication network 18 (i.e. the Internet).

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	Goodman at 8:53-59  FIG. 1 Goodman at Fig. 1 PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse or some other computer peripheral (e.g. keyboard, touchpad, joystick) commonly associated with a computer processing device 14. It should be understood that it would be also possible to implement the invention by incorporating PPG sensor 12 within the casing of a personal digital assistant (PDA) or within some other type of stand alone data processing and transmitting device (e.g. a watch) or simply as a stand alone sensor device. Goodman at 8:60-9:05 Referring now to FIGS. 2 and 3, PPG sensor 12 is shown installed within a user input device 20 which is coupled to processing device 14 through data transmission cable 13. In addition to PPG sensor 12, user input device 20 comprises a thermistor 23 positioned in close proximity to PPG sensor 12, a signal conditioner module 24 to condition the raw PPG signal, and a microcontroller 26 to control the operation of user input device 20. Goodman at 9:49-56.

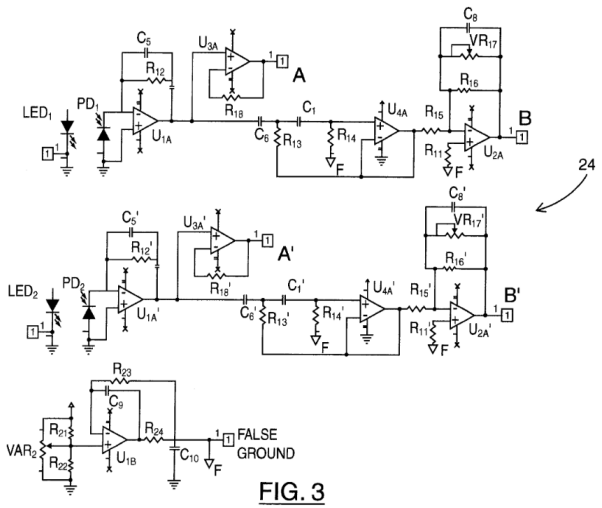
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	 FIG. 2 Goodman at Fig. 2  FIG. 3 Goodman at Fig. 3 As shown in FIG. 15B, a continuous noninvasive blood pressure monitor 8, such as the Colin model 7000 blood pressure monitor (available from Colin Medical Instruments Corp. of Texas) could be used alongside PPG sensor 12 of system 10 for calibration purposes. The unit is a wrist worn device that initially calibrates itself against a reading from an integral cuff blood pressure device. Thereafter,

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	readings from the arterial tonometer can be used by system 10 to give accurate beat to beat readings of absolute blood pressure. Specifically, the PPG signal detected by PPG sensor 12 can be used in association with the blood pressure and pressure pulse contour information from the Colin 7000 to provide a user with various blood pressure measures. Goodman at 27:53-65.  FIG. 15B

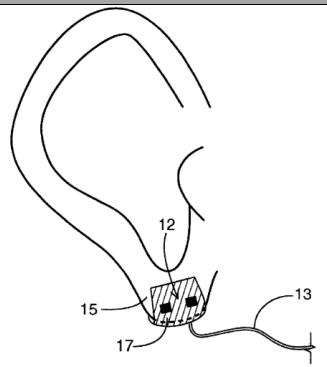
’475 Patent	Goodman
	Goodman at Fig. 15B One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	Goodman discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. A health monitoring and biofeedback system comprising a photoplethysmography (PPG) sensor, a processing device, and a Web site server for determining, displaying and analyzing various cardiovascular parameters. The PPG sensor is installed within a manually operated user input device such as a mouse or keyboard, measures a user's blood volume contour and transmits it to a processing device such as a personal computer or a personal digital assistant (PDA). The system determines a plurality of cardiovascular indices including mean blood pressure, heart rate, body temperature, respiratory rate, and arterial compliance on the basis of signal characteristics of the systolic wave pulse and the systolic reflected wave pulse present within the digital volume pulse derived from the PPG pulse contour. Signal characteristics of the systolic reflected wave pulse can be determined through various pulse analysis techniques including derivative analysis of the digital volume pulse signal, bandpass filtering or respiratory matrix frequency extraction techniques. By subtracting the systolic reflected wave pulse contour from the digital volume pulse contour, characteristics of the systolic wave pulse can also be identified. The system also provides for the accurate determination of systolic and diastolic blood pressure by using a non-invasive blood pressure monitor to calibrate the relationships between arterial or digital blood pressure and characteristics of the user's digital volume pulse contour. In this way, a wide variety of cardiovascular and respiratory data can be obtained. The system also facilitates the transmittal of such data to the system web site for further analysis, storage, and retrieval purposes. Goodman at [Abstract]

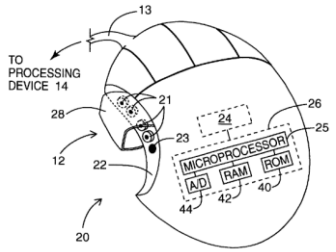
’475 Patent	Goodman
	Reference is first made to FIG. 1, which shows the overall configuration of the preferred embodiment of a physiological monitoring system 10, according to the present invention. System 10 comprises a conventional plethysmography (PPG) sensor 12 coupled to a processing device 14 which is in data communication with a Web site server 16 through a communication network 18 (i.e. the Internet). Goodman at 8:53-59  FIG. 1 Goodman at Fig. 1 PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse or some other computer peripheral (e.g. keyboard, touchpad, joystick) commonly associated with a computer processing device 14. It should be understood that it would be also possible to implement the invention by incorporating PPG sensor 12 within the casing of a personal digital assistant (PDA) or within some other type of stand alone data processing and transmitting device (e.g. a watch) or simply as a stand alone sensor device.

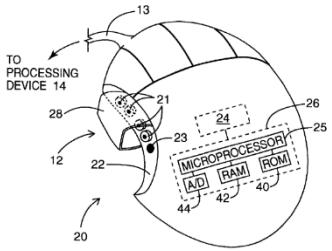
’475 Patent	Goodman
	Goodman at 8:60-9:05 PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07 PPG sensor 12 is installed within the housing in depression 22 such that PPG.sensor 12 is positioned underneath the part of depression 22 that corresponds to a user's distal thumb and so that a user's thumb when positioned within depression 22 would be completely covered by; an elastic restraint 28. It has been determined that this is an optimal configuration, since the transmitted light can penetrate adequately into the skin at a user's fingertip and due to the fact that elastic restraint 28 shields PPG sensor 12 from ambient light. For convenient operation within user input device 20, the LED and photodiode pairs are installed within depression 22 approximately one centimeter apart from each other. Goodman at 10:36-48 FIG. 3 shows the circuity of signal conditioner module 24. Signal conditioner module 24 uses two identical conditioning circuits to condition the current output of photodiodes PD1 and PD2 independently. The operation of the circuit which conditions the current signal of photodiode PD1 will be discussed, but it should be understood that the circuit which conditions photodiode PD2 operates identically. The components of the circuit which conditions the current signal output of photodiode. PD2 are identified with the same reference numbers as for the circuit for photodiode PD1, but with the part numbers primed.

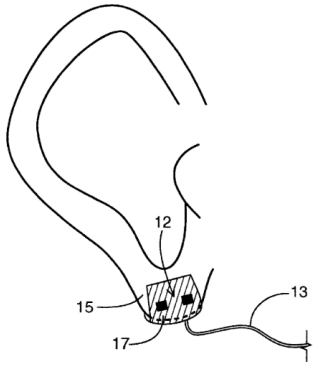
’475 Patent	Goodman
	Goodman at 10:65 -11:08  FIG. 3 Goodman at Fig. 3 Each circuit includes operational quad amplifiers U1A and U2A fabricated on a single IC (e.g. Texas Instruments brand TLC274 Precision Quad Operational Amplifier) as well as capacitors C1, C5, C6, and C8, resistors R11, R12, R13, R14, R15, R16, and R18 and variable resistor VR17. The operational amplifier U1A, PD1, C5 and R12 form a transimpedance photodetector circuit. The raw PPG photo current signal generated by PD1 is converted to a voltage signal through resistor R12. The combination of capacitor C5 and resistor R12 provides low pass filtering for the raw PPG voltage signal generated at the output of operational amplifier U1A (at node A in FIG. 3). This configuration eliminates high frequency noise and high frequency spurious signals which may be present at the input to U1A. Goodman at 11:09-21 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning

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	on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:36-48 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	Goodman discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07

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	 FIG. 6 Goodman at Fig. 6 Microcontroller 26 is also programmed to control the operation of LED1 and LED2 of PPG sensor 12 for optimal sensor operation. Microcontroller 26 is programmed to generate digital switching pulses to drive LED1 and LED2 of PPG sensor 12 alternately at a repetition rate of 1 KHz (i.e. each LED accomplishes sampling at a rate of 1 KHz). It has been determined that the sampling frequency should be 10 times the highest frequency of interest. The conditioned PPG signal has frequency components as high as 30 Hertz. However, 60 Hertz noise from electrical sources in the environment necessitates sampling of the signal at a high enough rate to ensure the effectiveness of the associated noise filtering software of CPU 5. Goodman at 12:22-34

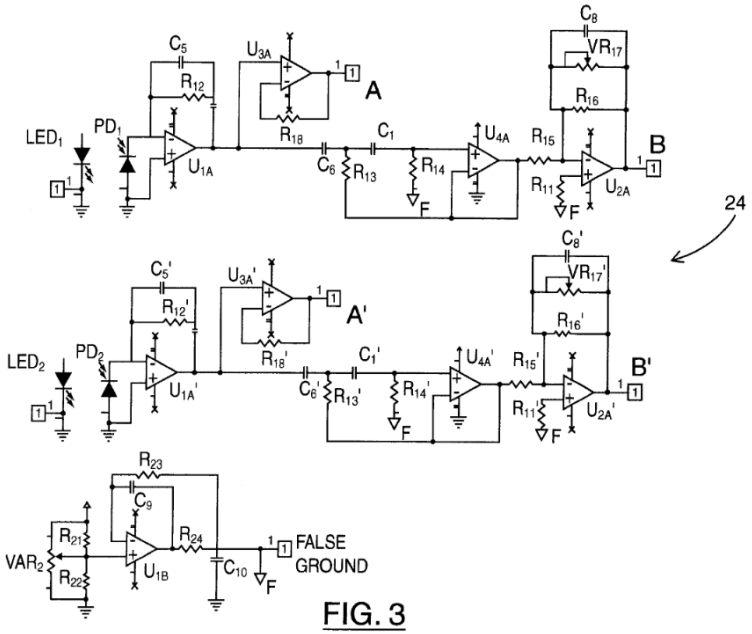
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	 FIG. 2 Goodman at Fig. 2 As previously discussed, PPG sensor 12 can utilize one or two LED's. While the PPG sensor 12 of the preferred embodiment of the invention includes two LED's it is possible to conduct the above noted analysis and obtain the above noted cardiovascular indices using just a single LED. However, it is only possible to obtain the measurement of blood oxygen saturation using a red LED1 and an infrared LED2 as will be discussed. Goodman at 32:22-29 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a	Goodman discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known

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lens output light to tissue comprising skin;	configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07  FIG. 2 Goodman at Fig. 2 Also, as shown in FIG. 2, PPG sensor 12 utilizes cylindrical baffles 21 to house LED1 and LED2 and photodiodes PD1 and PD2 to prevent direct coupling of light from the LED's to the photodiodes. When a user's finger is placed over the top openings of baffles 21, light will be only provided to the finger and spillover light will be appreciably reduced. Well known techniques to accomplish motion artifact reduction such as that discussed in PCT Pat. Application No. 99/32030 to BTG International Limited could be utilized to further reduce the amount of motion artifact related distortion of the PPG signal. Goodman at 10:08-18

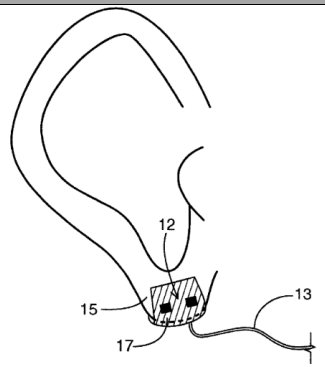
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	FIG. 6 shows how PPG sensor 12 could be associated with the user's earlobe 15 instead of the user's finger. As discussed, it is well known that the reflective wave originating in the aorta has a significant presence in the volume pulse contour obtained from a fingertip, ear or other points on the surface of the body. As is conventionally known, the volume pulse signal acquired from the ear lobe, like the finger, is similar to that acquired from the carotid artery. Specifically, it is contemplated that PPG sensor 12 operating in transmission mode could be implanted in a “clip” device 17 which would provide for skin contact between PPG sensor 12 and a user's earlobe 15. This embodiment would provide analogous pulse volume signal information from which various cardiovascular and respiratory indices could be obtained, while allowing for hands free functionality. Goodman at 13:59-14:06  FIG. 6 Goodman at Fig. 6 1. A physiological signal monitoring system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic, wherein said physiological characteristic comprises the user's blood volume contour; (b) first processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for conducting analysis of said physiological parameters, said first processing means comprising:

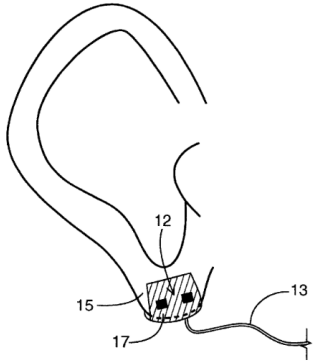
’475 Patent	Goodman
	(i) filtering means for filtering nonpulsatile and slowly pulsatile signals from the blood volume contour to obtain a filtered blood volume contour; (ii) extraction means for extracting characteristics of the user's aortic reflected wave contour from a volume contour chosen from one of the blood volume contour and the filtered blood volume contour, the characteristics of the user's aortic reflected wave contour being determined in part from a fourth derivative of said volume contour; (iii) computing means for determining the set of physiological parameters based on characteristics of said aortic reflected wave; and, (c) display means coupled to said first processing means for displaying said physiological parameters. Goodman at Claim 1 36. A physiological signal monitoring system for selectively providing a user with access to a resource, said system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic; (b) processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for extracting characteristics of an aortic reflected wave for the user from said data; (c) storage means for storing unique characteristics of an aortic reflected wave contour for the user; (d) verification means coupled to said processing means and said storage means for comparing said extracted characteristics of the aortic reflected wave with said unique characteristics of the aortic reflected wave and for providing the user with access to the resource only if said extracted characteristics of the user's aortic reflected wave is at least substantially identical to said unique characteristics of the aortic reflected wave; and, (e) display means coupled to said processing means for displaying said physiological parameters. Goodman at Claim 36 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it

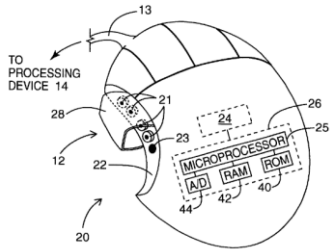
’475 Patent	Goodman
	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	Goodman discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07 PPG sensor 12 is installed within the housing in depression 22 such that PPG.sensor 12 is positioned underneath the part of depression 22 that corresponds to a user's distal thumb and so that a user's thumb when positioned within depression 22 would be completely covered by; an elastic restraint 28. It has been determined that this is an optimal configuration, since the transmitted light can penetrate adequately into the skin at a user's fingertip and due to the fact that elastic restraint 28 shields PPG sensor 12 from ambient light. For convenient operation within user input device 20, the LED and photodiode pairs are installed within depression 22 approximately one centimeter apart from each other. Goodman at 10:36-48 FIG. 3 shows the circuity of signal conditioner module 24. Signal conditioner module 24 uses two identical conditioning circuits to condition the current output of photodiodes PD1 and PD2 independently. The operation of the circuit which conditions the current signal of photodiode PD1 will be discussed, but it should be understood that the circuit which conditions photodiode PD2 operates identically. The components of the circuit which conditions the current signal output of photodiode. PD2 are identified with the same reference numbers as for the circuit for photodiode PD1, but with the part numbers primed.

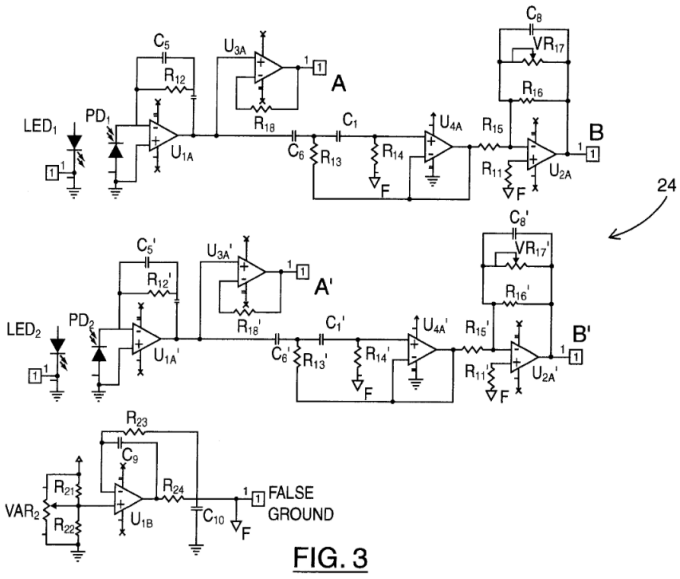
’475 Patent	Goodman
	Goodman at 10:65 -11:08  FIG. 3 Goodman at Fig. 3 Each circuit includes operational quad amplifiers U1A and U2A fabricated on a single IC (e.g. Texas Instruments brand TLC274 Precision Quad Operational Amplifier) as well as capacitors C1, C5, C6, and C8, resistors R11, R12, R13, R14, R15, R16, and R18 and variable resistor VR17. The operational amplifier U1A, PD1, C5 and R12 form a transimpedance photodetector circuit. The raw PPG photo current signal generated by PD1 is converted to a voltage signal through resistor R12. The combination of capacitor C5 and resistor R12 provides low pass filtering for the raw PPG voltage signal generated at the output of operational amplifier U1A (at node A in FIG. 3). This configuration eliminates high frequency noise and high frequency spurious signals which may be present at the input to U1A. Goodman at 11:09-21

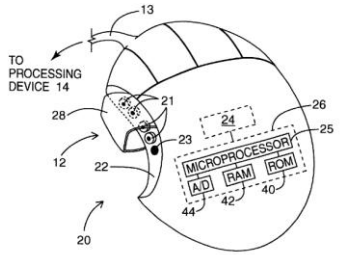
’475 Patent	Goodman
	Following this filtering process, the PPG voltage signal is applied to a combined amplifier and low pass filter stage comprised of resistors R15, R11, and R16, variable resistor VAR17, capacitor C8 and operational amplifier U2A. The gain of the amplifier is set by adjusting variable resistor VAR17. The values of resistors R16, R17 and capacitor C8 determine the corner frequency which is typically 30 Hertz. The conditioned PPG voltage signal generated by this stage (at point B) is provided to the processing device 14. In this way signal conditioner module 24 improves the signal to noise ratio of the PPG signal prior to digitization. Goodman at 11:42-52 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:36-48 FIG. 6 shows how PPG sensor 12 could be associated with the user's earlobe 15 instead of the user's finger. As discussed, it is well known that the reflective wave originating in the aorta has a significant presence in the volume pulse contour obtained from a fingertip, ear or other points on the surface of the body. As is conventionally known, the volume pulse signal acquired from the ear lobe, like the finger, is similar to that acquired from the carotid artery. Specifically, it is contemplated that PPG sensor 12 operating in transmission mode could be implanted in a “clip” device 17 which would provide for skin contact between PPG sensor 12 and a user's earlobe 15. This embodiment would provide analogous pulse volume signal information from which various cardiovascular and respiratory indices could be obtained, while allowing for hands free functionality. Goodman at 13:59-14:06

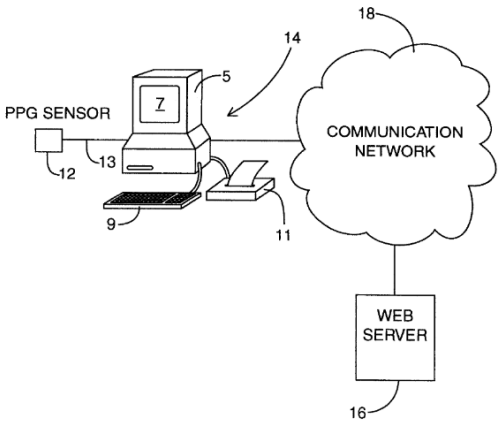
’475 Patent	Goodman
	 FIG. 6 Goodman at Fig. 6 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Goodman discloses or renders obvious, the detection system is configured to be synchronized to the light source. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light.

’475 Patent	Goodman
	Goodman at 09:57-10:07  FIG. 6 Goodman at Fig. 6 Microcontroller 26 is also programmed to control the operation of LED1 and LED2 of PPG sensor 12 for optimal sensor operation. Microcontroller 26 is programmed to generate digital switching pulses to drive LED1 and LED2 of PPG sensor 12 alternately at a repetition rate of 1 KHz (i.e. each LED accomplishes sampling at a rate of 1 KHz). It has been determined that the sampling frequency should be 10 times the highest frequency of interest. The conditioned PPG signal has frequency components as high as 30 Hertz. However, 60 Hertz noise from electrical sources in the environment necessitates sampling of the signal at a high enough rate to ensure the effectiveness of the associated noise filtering software of CPU 5. Goodman at 12:22-34

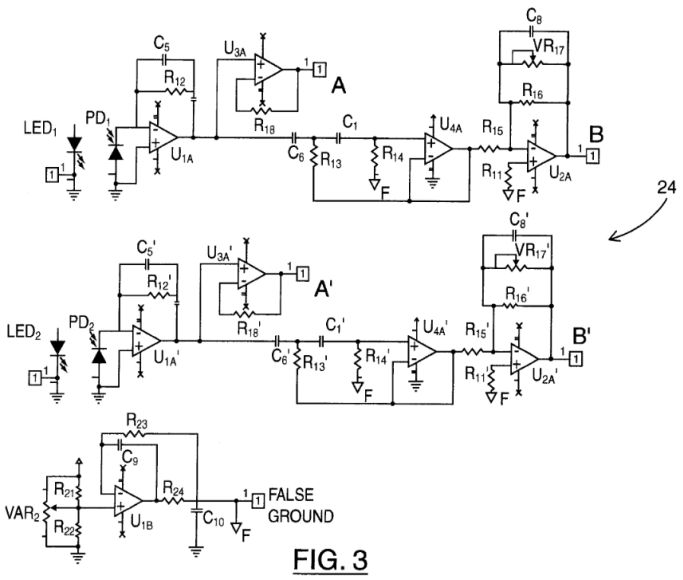
’475 Patent	Goodman
	 FIG. 2 Goodman at Fig. 2 As previously discussed, PPG sensor 12 can utilize one or two LED's. While the PPG sensor 12 of the preferred embodiment of the invention includes two LED's it is possible to conduct the above noted analysis and obtain the above noted cardiovascular indices using just a single LED. However, it is only possible to obtain the measurement of blood oxygen saturation using a red LED1 and an infrared LED2 as will be discussed. Goodman at 32:22-29 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one	Goodman discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors.

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analog to digital converter is coupled to at least one of the plurality of detectors;	PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07  FIG. 3 Goodman at Fig. 3 Also, as shown in FIG. 2, PPG sensor 12 utilizes cylindrical baffles 21 to house LED1 and LED2 and photodiodes PD1 and PD2 to prevent direct coupling of light from the LED's to the photodiodes. When

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	a user's finger is placed over the top openings of baffles 21, light will be only provided to the finger and spillover light will be appreciably reduced. Well known techniques to accomplish motion artifact reduction such as that discussed in PCT Pat. Application No. 99/32030 to BTG International Limited could be utilized to further reduce the amount of motion artifact related distortion of the PPG signal. Goodman at 10:08-18  FIG. 2 Goodman at Fig. 2 Microcontroller 26 (FIG. 2) may be any commercially available programmable device such as a Mitsubishi USB microcontroller (available from Mitsubishi Semiconductors, Inc. of Japan), although it should be understood that any type of logic circuit with similar operating functions (particularly one which has a USB interface and which includes an on-board analog-to-digital converter) can be utilized. Storage of program instructions and other static data is provided by a read only memory (ROM) 40, while storage of dynamic data is provided by a random access memory (RAM) 42. Both memory units 40 and 42 are controlled and accessed by microprocessor 25. On board analog-to-digital converter A/D 44 (10 bit, 5 channel input) is used to convert the conditioned PPG signals at B and B′ into time sampled digital signals which are then provided to processing device 14. Also, all of the circuitry of signal conditioner module 24 is provided with a 5 volt source from the USB line of microcontroller 26. Goodman at 12:04-21

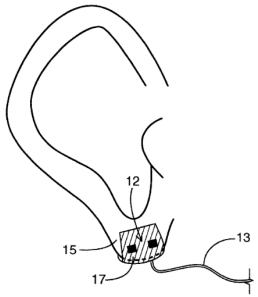
’475 Patent	Goodman
	 FIG. 1 Goodman at Fig. 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	Goodman discloses or renders obvious the output signal is indicative of the one or more physiological parameters. PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse or some other computer peripheral (e.g. keyboard,

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	touchpad, joystick) commonly associated with a computer processing device 14. It should be understood that it would be also possible to implement the invention by incorporating PPG sensor 12 within the casing of a personal digital assistant (PDA) or within some other type of stand alone data processing and transmitting device (e.g. a watch) or simply as a stand alone sensor device. Goodman at 8:60-9:05 PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07

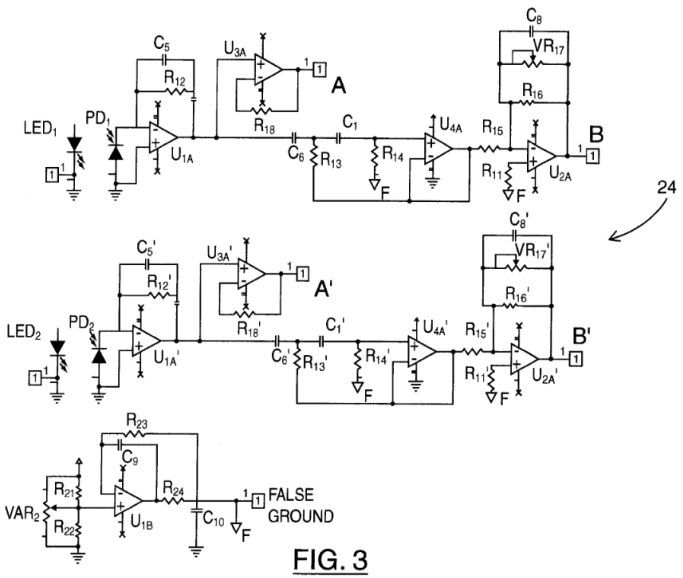
’475 Patent	Goodman
	 FIG. 3 Goodman at Fig. 3 1. A physiological signal monitoring system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic, wherein said physiological characteristic comprises the user's blood volume contour; (b) first processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for conducting analysis of said physiological parameters, said first processing means comprising: (i) filtering means for filtering nonpulsatile and slowly pulsatile signals from the blood volume contour to obtain a filtered blood volume contour; (ii) extraction means for extracting characteristics of the user's aortic reflected wave contour from a volume contour chosen from one of the blood volume contour and the filtered blood volume contour, the characteristics of the user's aortic reflected wave contour being determined in part from a fourth derivative of said volume contour; (iii) computing means for determining the set of physiological parameters based on characteristics of said aortic reflected wave; and, (c) display means coupled to said first processing means for displaying said physiological parameters.

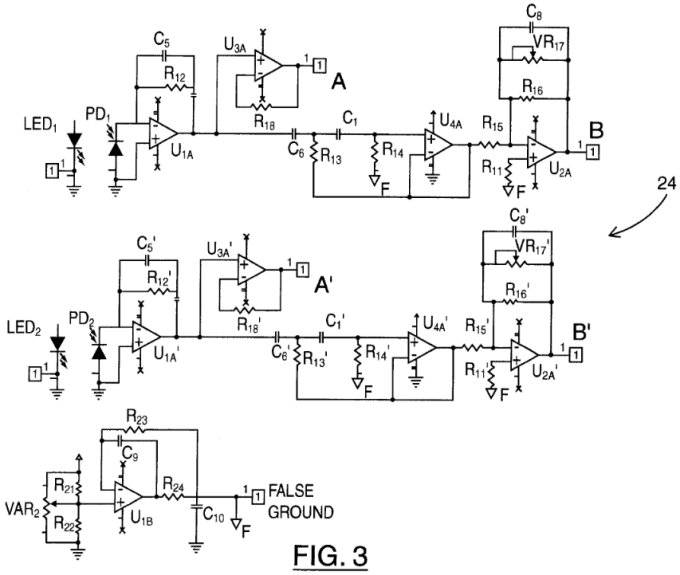
’475 Patent	Goodman
	Goodman at Claim 1 36. A physiological signal monitoring system for selectively providing a user with access to a resource, said system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic; (b) processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for extracting characteristics of an aortic reflected wave for the user from said data; (c) storage means for storing unique characteristics of an aortic reflected wave contour for the user; (d) verification means coupled to said processing means and said storage means for comparing said extracted characteristics of the aortic reflected wave with said unique characteristics of the aortic reflected wave and for providing the user with access to the resource only if said extracted characteristics of the user's aortic reflected wave is at least substantially identical to said unique characteristics of the aortic reflected wave; and, (e) display means coupled to said processing means for displaying said physiological parameters. Goodman at Claim 36 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Goodman discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. PPG sensor 12 is installed within the housing in depression 22 such that PPG.sensor 12 is positioned underneath the part of depression 22 that corresponds to a user's distal thumb and so that a user's thumb when positioned within depression 22 would be completely covered by; an elastic restraint 28. It has

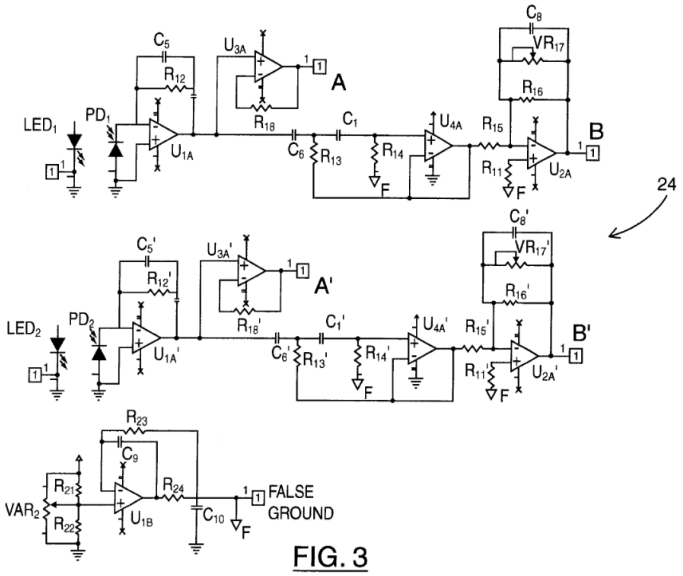
’475 Patent	Goodman
	been determined that this is an optimal configuration, since the transmitted light can penetrate adequately into the skin at a user's fingertip and due to the fact that elastic restraint 28 shields PPG sensor 12 from ambient light. For convenient operation within user input device 20, the LED and photodiode pairs are installed within depression 22 approximately one centimeter apart from each other. Goodman at 10:36-48 Following this filtering process, the PPG voltage signal is applied to a combined amplifier and low pass filter stage comprised of resistors R15, R11, and R16, variable resistor VAR17, capacitor C8 and operational amplifier U2A. The gain of the amplifier is set by adjusting variable resistor VAR17. The values of resistors R16, R17 and capacitor C8 determine the corner frequency which is typically 30 Hertz. The conditioned PPG voltage signal generated by this stage (at point B) is provided to the processing device 14. In this way signal conditioner module 24 improves the signal to noise ratio of the PPG signal prior to digitization. Goodman at 11:42-52 Microcontroller 26 is also programmed to control the operation of LED1 and LED2 of PPG sensor 12 for optimal sensor operation. Microcontroller 26 is programmed to generate digital switching pulses to drive LED1 and LED2 of PPG sensor 12 alternately at a repetition rate of 1 KHz (i.e. each LED accomplishes sampling at a rate of 1 KHz). It has been determined that the sampling frequency should be 10 times the highest frequency of interest. The conditioned PPG signal has frequency components as high as 30 Hertz. However, 60 Hertz noise from electrical sources in the environment necessitates sampling of the signal at a high enough rate to ensure the effectiveness of the associated noise filtering software of CPU 5. Goodman at 12:22-34 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary.

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	Goodman at 12:36-48 FIG. 6 shows how PPG sensor 12 could be associated with the user's earlobe 15 instead of the user's finger. As discussed, it is well known that the reflective wave originating in the aorta has a significant presence in the volume pulse contour obtained from a fingertip, ear or other points on the surface of the body. As is conventionally known, the volume pulse signal acquired from the ear lobe, like the finger, is similar to that acquired from the carotid artery. Specifically, it is contemplated that PPG sensor 12 operating in transmission mode could be implanted in a “clip” device 17 which would provide for skin contact between PPG sensor 12 and a user's earlobe 15. This embodiment would provide analogous pulse volume signal information from which various cardiovascular and respiratory indices could be obtained, while allowing for hands free functionality. Goodman at 13:59-14:06  FIG. 6 Goodman at Fig. 6 FIG. 8 is a plot of a typical conditioned PPG pulse contour signal received by processing device 14 from the user input device 20. As illustrated, the PPG pulse contour consists of three peaks, namely a peak representing the systolic maximum (A), the reflected wave maximum (B), and the dicrotic notch (C) which represents the aortic valve closure. The PPG pulse contour also consists of the upstroke point (onset of systole at D) and end diastole (E). Goodman at 15:26-33

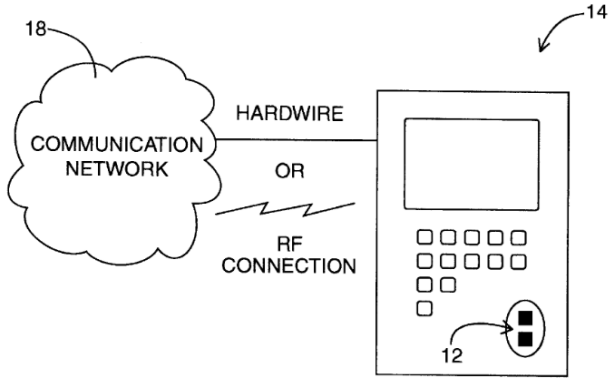
’475 Patent	Goodman
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Goodman discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,. By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:35-47

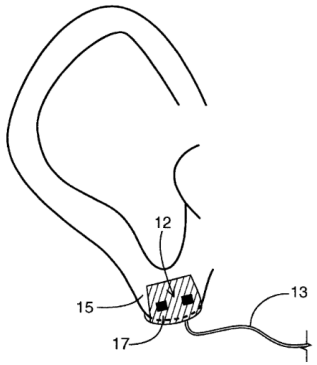
’475 Patent	Goodman
	 FIG. 3 Goodman at Fig. 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Goodman discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning

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	on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:35-47  FIG. 3 Goodman at Fig. 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the	Goodman discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal.

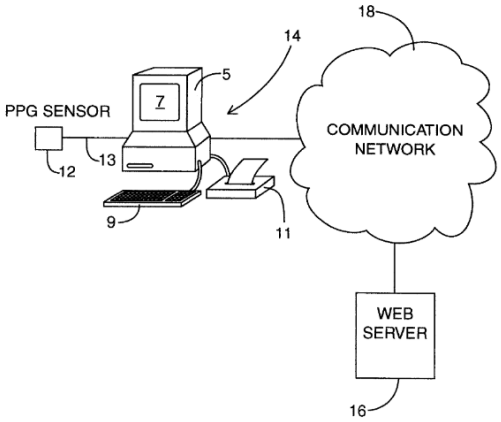
’475 Patent	Goodman
first signal and the second signal; and	By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:35-47  FIG. 3 Goodman at Fig. 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Goodman discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. PPG sensor 12 is installed within the housing in depression 22 such that PPG.sensor 12 is positioned underneath the part of depression 22 that corresponds to a user's distal thumb and so that a user's thumb when positioned within depression 22 would be completely covered by; an elastic restraint 28. It has been determined that this is an optimal configuration, since the transmitted light can penetrate adequately into the skin at a user's fingertip and due to the fact that elastic restraint 28 shields PPG sensor 12 from ambient light. For convenient operation within user input device 20, the LED and photodiode pairs are installed within depression 22 approximately one centimeter apart from each other. Goodman at 10:36-48 FIG. 5 shows another possible configuration of system 10 wherein processing device 14 is a PDA (e.g. Palm Pilot™) having PPG sensor 12 interfaced therein. PPG sensor 12 could be directly integrated into the shell of the PDA processing device 14. Alternatively, PPG sensor 12 could be implemented within a PDA accessory card or device, or adapted to interface with the PDA processing device 14 as an external wearable device. In the latter case, it would be possible for a user to wear a wearable user input device 12 such that blood volume pulse signal information could be collected by the PDA processing device 14 over the course of a day. It would be possible to arrange for periodic download of recorded volume pulse contour signal information collected by user input device 12 to processing device 14 and/or to Web site server 16 through processing device 14 over the communication network 18. Goodman at 13:26-42

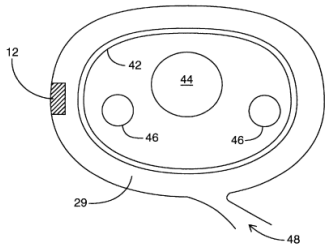
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	 FIG. 5 Goodman at Fig. 5 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:35-47 FIG. 6 shows how PPG sensor 12 could be associated with the user's earlobe 15 instead of the user's finger. As discussed, it is well known that the reflective wave originating in the aorta has a significant presence in the volume pulse contour obtained from a fingertip, ear or other points on the surface of the body. As is conventionally known, the volume pulse signal acquired from the ear lobe, like the finger, is similar to that acquired from the carotid artery. Specifically, it is contemplated that PPG sensor 12 operating in transmission mode could be implanted in a “clip” device 17 which would provide for skin contact between PPG sensor 12 and a user's earlobe 15. This embodiment would provide analogous pulse volume signal information from which various cardiovascular and respiratory indices could be obtained, while allowing for hands free functionality.

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	Goodman at 13:59-14:06  FIG. 6 Goodman at Fig. 6 1. A physiological signal monitoring system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic, wherein said physiological characteristic comprises the user's blood volume contour; (b) first processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for conducting analysis of said physiological parameters, said first processing means comprising: (i) filtering means for filtering nonpulsatile and slowly pulsatile signals from the blood volume contour to obtain a filtered blood volume contour; (ii) extraction means for extracting characteristics of the user's aortic reflected wave contour from a volume contour chosen from one of the blood volume contour and the filtered blood volume contour, the characteristics of the user's aortic reflected wave contour being determined in part from a fourth derivative of said volume contour; (iii) computing means for determining the set of physiological parameters based on characteristics of said aortic reflected wave; and, (c) display means coupled to said first processing means for displaying said physiological parameters. Goodman at Claim 1

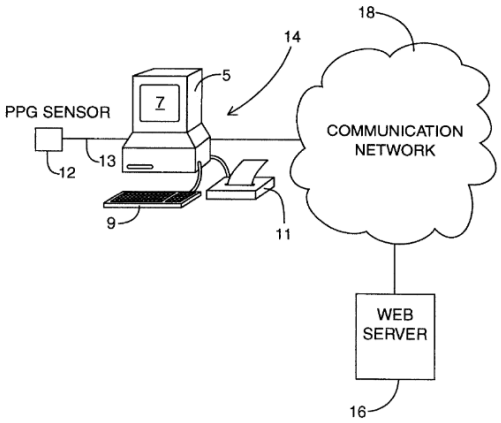
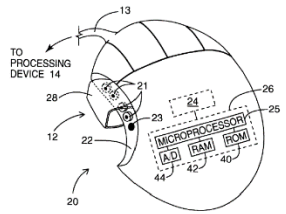
'475 Patent	Goodman
	36. A physiological signal monitoring system for selectively providing a user with access to a resource, said system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic; (b) processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for extracting characteristics of an aortic reflected wave for the user from said data; (c) storage means for storing unique characteristics of an aortic reflected wave contour for the user; (d) verification means coupled to said processing means and said storage means for comparing said extracted characteristics of the aortic reflected wave with said unique characteristics of the aortic reflected wave and for providing the user with access to the resource only if said extracted characteristics of the user's aortic reflected wave is at least substantially identical to said unique characteristics of the aortic reflected wave; and, (e) display means coupled to said processing means for displaying said physiological parameters. Goodman at Claim 36 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial	See claim 1 above. Goodman discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal. Reference is first made to FIG. 1, which shows the overall configuration of the preferred embodiment of a physiological monitoring system 10, according to the present invention. System 10 comprises a

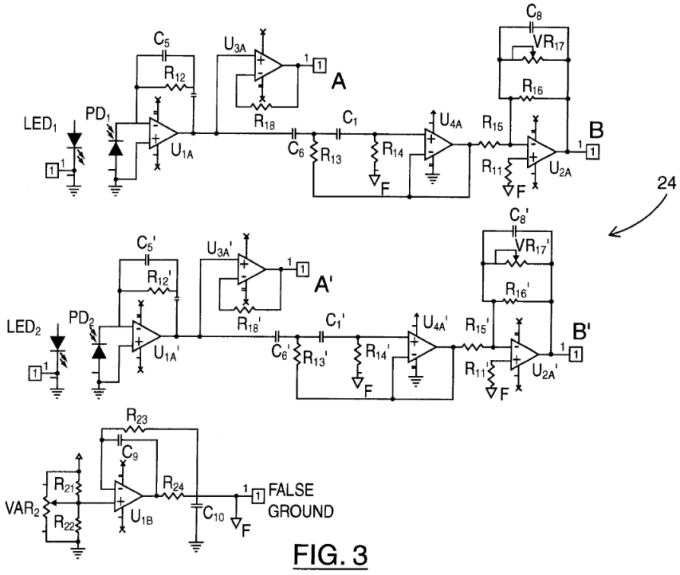
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intelligence in making decisions associated with at least a portion of the output signal.	conventional plethysmography (PPG) sensor 12 coupled to a processing device 14 which is in data communication with a Web site server 16 through a communication network 18 (i.e. the Internet). Goodman at 8:53-59  FIG. 1 Goodman at Fig. 1 PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse or some other computer peripheral (e.g. keyboard, touchpad, joystick) commonly associated with a computer processing device 14. It should be understood that it would be also possible to implement the invention by incorporating PPG sensor 12 within the casing of a personal digital assistant (PDA) or within some other type of stand alone data processing and transmitting device (e.g. a watch) or simply as a stand alone sensor device. Goodman at 08:60-09:05

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	Processing device 14 is preferably a conventional personal computer having a central processing unit (CPU) 5, display 7, keyboard 9 and printer 11. Processing device 14 also preferably has a standard Universal Serial Bus (USB), sufficient memory and processing power to run the application programs associated with system 10, and a data transmission controller for sending and receiving data over data transmission cable 13, all built integrally with processing device 14. An executable program is installed within the permanent memory of processing device 14 to instruct the user through interactive menus to utilize the PPG sensor 12 such that proper PPG signals can be obtained from the user and to provide the user with his/her own generated physiological information through graphical means. It should be understood that such an executable program could also be available for downloading online from Web site server 16. The executable program has the functionality to allow a user to observe his/her own physiological signals in real time such that biofeedback is facilitated. Also, it is contemplated that processing device 14 could be used to store a user's physiological signals for later retrieval, comparative and display purposes. Commercially available signal measurement and analysis display software such as LabVIEW™ (available from National Instruments of Austin, Tex.) is utilized to perform the necessary data analysis as well as display the results of the calculations in easy to understand format. It should be understood that processing device 14 could just as easily be a PDA, as discussed above. Goodman at 09:06-33 FIG. 4 shows an improved alternative to elastic restraint 28 which can be used to force a finger into contact with PPG sensor 12. A conventional gas filled finger cuff bladder 29 within which PPG sensor 12 is implanted, is shown surrounding the finger in a circumferential manner. The epidermis 42, bone 44, and arteries 46 of a finger are shown enveloped within cuff bladder 29 that is pressurized by a gas supply 48. The pressure of the gas within the bladder can be monitored and used by microcontroller 24 in association with pulse contour analysis data to more accurately predict absolute values for blood pressure. Goodman at 13:03-13

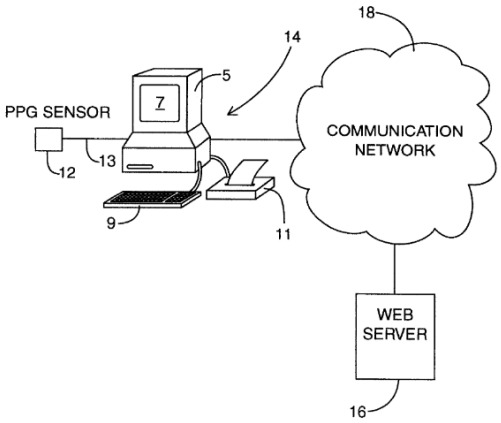
’475 Patent	Goodman
	 FIG. 4 Goodman at Fig. 4 Further embodiments of the invention whereby PPG sensor 12 and processing device 14 are integrated together into a single unit with a compact design are also contemplated as processing speed and device memory increase as physical dimensions decrease. For example, it is likely that PPG sensor 12 and processing device 14, and all of its associated functionality, could feasibly be incorporated into a wrist watch device in the foreseeable future. It is contemplated that PPG sensor 12 could be integrated together with a computing means, wireless transmission means (e.g. well known convention radio frequency techniques as well as emerging radio frequency communication protocols such as the BlueTooth™ standard) and a battery in a small (e.g. 2 cm2) component that would adhere to a body skin area for extended periods of time (e.g. weeks) and would transmit data to a remote computing device on a continuous basis. Goodman at 13:43-58 Another method of reducing reflection effects is to use an adaptive predictor which requires the use of complex algorithms. This method requires significant calculation on a real time basis and takes a large number of samples before making an accurate result. A third method which has been suggested is to band pass filter the volume pulse contour signal at 12 hertz and to transform the wave harmonic component at this frequency from real to complex to allow for accurate and rapid estimation of phase delay which is independent of sampling frequency.

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	Goodman at 33:40-49 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	
6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	See claim 1 above. Goodman discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07

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	 FIG. 1 Goodman at Fig. 1  FIG. 2

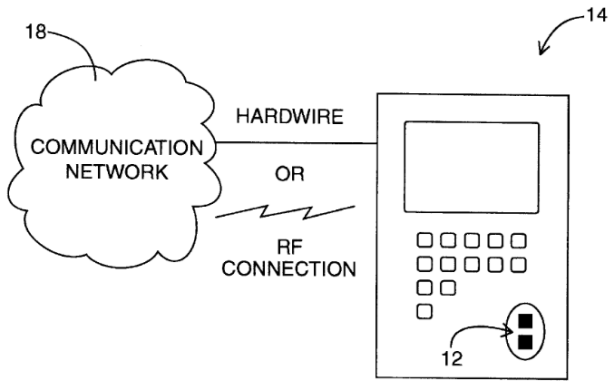
’475 Patent	Goodman
	Goodman at Fig. 2 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:35-47  FIG. 3 Goodman at Fig. 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

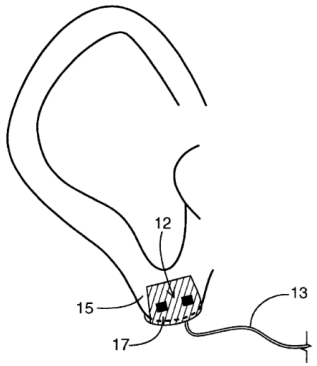
’475 Patent	Goodman
	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	See claim 6 above. Goodman discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. Reference is first made to FIG. 1, which shows the overall configuration of the preferred embodiment of a physiological monitoring system 10, according to the present invention. System 10 comprises a conventional plethysmography (PPG) sensor 12 coupled to a processing device 14 which is in data communication with a Web site server 16 through a communication network 18 (i.e. the Internet). Goodman at 8:53-59

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	 FIG. 1 Goodman at Fig. 1 PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse or some other computer peripheral (e.g. keyboard, touchpad, joystick) commonly associated with a computer processing device 14. It should be understood that it would be also possible to implement the invention by incorporating PPG sensor 12 within the casing of a personal digital assistant (PDA) or within some other type of stand alone data processing and transmitting device (e.g. a watch) or simply as a stand alone sensor device. Goodman at 08:60-09:05 Processing device 14 is preferably a conventional personal computer having a central processing unit (CPU) 5, display 7, keyboard 9 and printer 11. Processing device 14 also preferably has a standard Universal Serial Bus (USB), sufficient memory and processing power to run the application programs associated with system 10, and a data transmission controller for sending and receiving data over data

’475 Patent	Goodman
	transmission cable 13, all built integrally with processing device 14. An executable program is installed within the permanent memory of processing device 14 to instruct the user through interactive menus to utilize the PPG sensor 12 such that proper PPG signals can be obtained from the user and to provide the user with his/her own generated physiological information through graphical means. It should be understood that such an executable program could also be available for downloading online from Web site server 16. The executable program has the functionality to allow a user to observe his/her own physiological signals in real time such that biofeedback is facilitated. Also, it is contemplated that processing device 14 could be used to store a user's physiological signals for later retrieval, comparative and display purposes. Commercially available signal measurement and analysis display software such as LabVIEW™ (available from National Instruments of Austin, Tex.) is utilized to perform the necessary data analysis as well as display the results of the calculations in easy to understand format. It should be understood that processing device 14 could just as easily be a PDA, as discussed above. Goodman at 09:06-33 Further embodiments of the invention whereby PPG sensor 12 and processing device 14 are integrated together into a single unit with a compact design are also contemplated as processing speed and device memory increase as physical dimensions decrease. For example, it is likely that PPG sensor 12 and processing device 14, and all of its associated functionality, could feasibly be incorporated into a wrist watch device in the foreseeable future. It is contemplated that PPG sensor 12 could be integrated together with a computing means, wireless transmission means (e.g. well known convention radio frequency techniques as well as emerging radio frequency communication protocols such as the BlueTooth™ standard) and a battery in a small (e.g. 2 cm2) component that would adhere to a body skin area for extended periods of time (e.g. weeks) and would transmit data to a remote computing device on a continuous basis. Goodman at 13:43-58 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

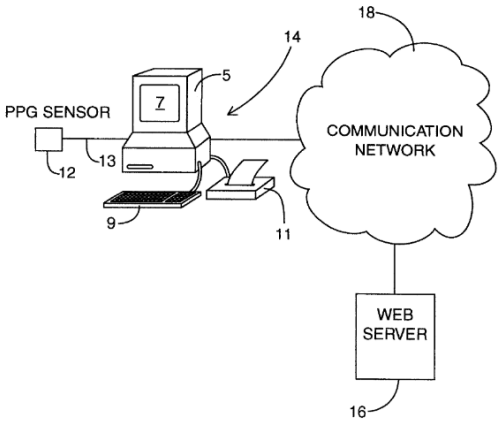
’475 Patent	Goodman
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Goodman discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. *See* claim 1[pre], above. A health monitoring and biofeedback system comprising a photoplethysmography (PPG) sensor, a processing device, and a Web site server for determining, displaying and analyzing various cardiovascular parameters. The PPG sensor is installed within a manually operated user input device such as a mouse or keyboard, measures a user's blood volume contour and transmits it to a processing device such as a personal computer or a personal digital assistant (PDA). The system determines a plurality of cardiovascular indices including mean blood pressure, heart rate, body temperature, respiratory rate, and arterial compliance on the basis of signal characteristics of the systolic wave pulse and the systolic reflected wave pulse present within the digital volume pulse derived from the PPG pulse contour. Signal characteristics of the systolic reflected wave pulse can be determined through various pulse analysis techniques including derivative analysis of the digital volume pulse signal, bandpass filtering or respiratory matrix frequency extraction techniques. By subtracting the systolic reflected wave pulse contour from the digital volume pulse contour, characteristics of the systolic wave pulse can also be identified. The system also provides for the accurate determination of systolic and diastolic blood pressure by using a non-invasive blood pressure monitor to calibrate the relationships between arterial or digital blood pressure and characteristics of the user's digital volume pulse contour. In this way, a wide variety of cardiovascular and respiratory data can be obtained. The system also facilitates the transmittal of such data to the system web site for further analysis, storage, and retrieval purposes. Goodman at [Abstract] PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses

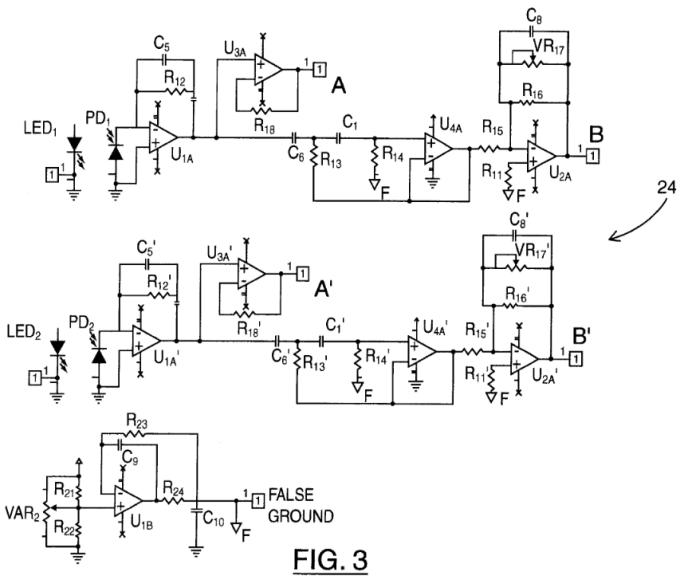
’475 Patent	Goodman
	the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07 FIG. 5 shows another possible configuration of system 10 wherein processing device 14 is a PDA (e.g. Palm Pilot™) having PPG sensor 12 interfaced therein. PPG sensor 12 could be directly integrated into the shell of the PDA processing device 14. Alternatively, PPG sensor 12 could be implemented within a PDA accessory card or device, or adapted to interface with the PDA processing device 14 as an external wearable device. In the latter case, it would be possible for a user to wear a wearable user input device 12 such that blood volume pulse signal information could be collected by the PDA processing device 14 over the course of a day. It would be possible to arrange for periodic download of recorded volume pulse contour signal information collected by user input device 12 to processing device 14 and/or to Web site server 16 through processing device 14 over the communication network 18. Goodman at 13:26-42  FIG. 5 Goodman at Fig. 5 Further embodiments of the invention whereby PPG sensor 12 and processing device 14 are integrated together into a single unit with a compact design are also contemplated as processing speed and device

’475 Patent	Goodman
	memory increase as physical dimensions decrease. For example, it is likely that PPG sensor 12 and processing device 14, and all of its associated functionality, could feasibly be incorporated into a wrist watch device in the foreseeable future. It is contemplated that PPG sensor 12 could be integrated together with a computing means, wireless transmission means (e.g. well known convention radio frequency techniques as well as emerging radio frequency communication protocols such as the BlueTooth™ standard) and a battery in a small (e.g. 2 cm2) component that would adhere to a body skin area for extended periods of time (e.g. weeks) and would transmit data to a remote computing device on a continuous basis. Goodman at 13:43-58 FIG. 6 shows how PPG sensor 12 could be associated with the user's earlobe 15 instead of the user's finger. As discussed, it is well known that the reflective wave originating in the aorta has a significant presence in the volume pulse contour obtained from a fingertip, ear or other points on the surface of the body. As is conventionally known, the volume pulse signal acquired from the ear lobe, like the finger, is similar to that acquired from the carotid artery. Specifically, it is contemplated that PPG sensor 12 operating in transmission mode could be implanted in a “clip” device 17 which would provide for skin contact between PPG sensor 12 and a user's earlobe 15. This embodiment would provide analogous pulse volume signal information from which various cardiovascular and respiratory indices could be obtained, while allowing for hands free functionality. Goodman at 13:59-14:06  FIG. 6

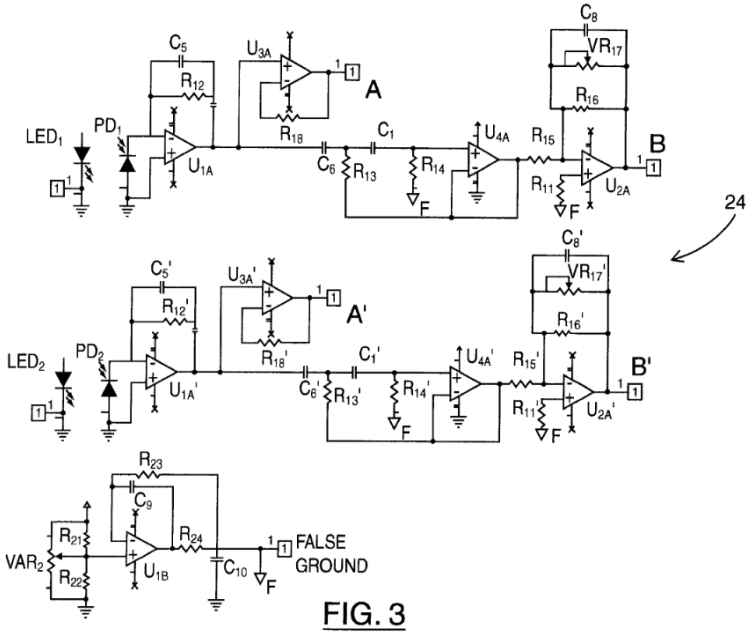
’475 Patent	Goodman
	Goodman at Fig. 6 1. A physiological signal monitoring system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic, wherein said physiological characteristic comprises the user's blood volume contour; (b) first processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for conducting analysis of said physiological parameters, said first processing means comprising: (i) filtering means for filtering nonpulsatile and slowly pulsatile signals from the blood volume contour to obtain a filtered blood volume contour; (ii) extraction means for extracting characteristics of the user's aortic reflected wave contour from a volume contour chosen from one of the blood volume contour and the filtered blood volume contour, the characteristics of the user's aortic reflected wave contour being determined in part from a fourth derivative of said volume contour; (iii) computing means for determining the set of physiological parameters based on characteristics of said aortic reflected wave; and, (c) display means coupled to said first processing means for displaying said physiological parameters. Goodman at Claim 1 36. A physiological signal monitoring system for selectively providing a user with access to a resource, said system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic; (b) processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for extracting characteristics of an aortic reflected wave for the user from said data; (c) storage means for storing unique characteristics of an aortic reflected wave contour for the user; (d) verification means coupled to said processing means and said storage means for comparing said extracted characteristics of the aortic reflected wave with said unique characteristics of the aortic reflected wave and for providing the user with access to the resource only if said extracted characteristics of the user's aortic reflected wave is at least substantially identical to said unique characteristics of the aortic reflected wave; and,

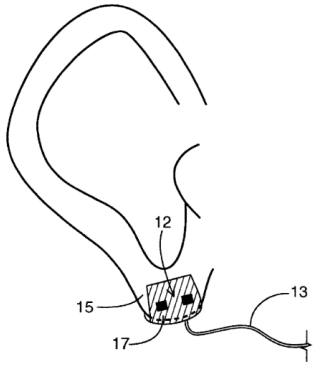
’475 Patent	Goodman
	(e) display means coupled to said processing means for displaying said physiological parameters. Goodman at Claim 36. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Goodman discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;. *See* claim 1[c], 1[j], 1[k] above. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07

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	 FIG. 1 Goodman at Fig. 1 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:35-47

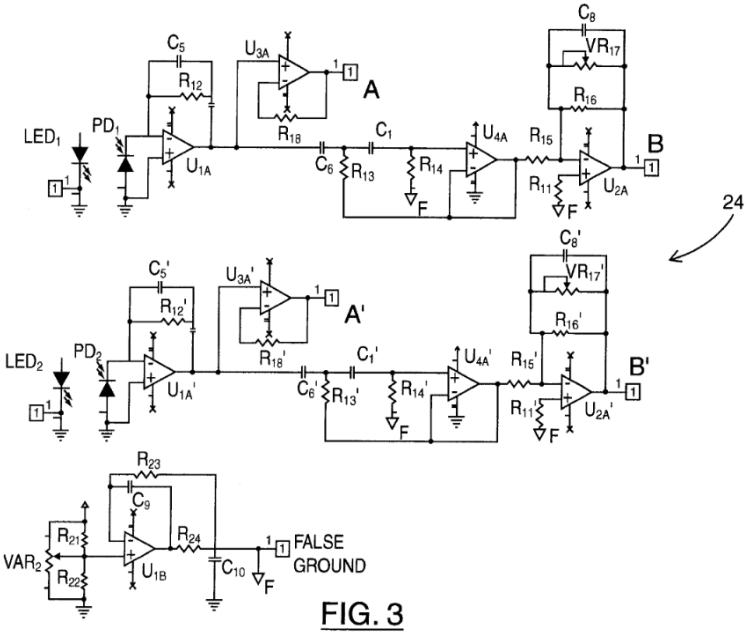
’475 Patent	Goodman
	 FIG. 3 Goodman at Fig. 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Goodman discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. *See* claim 1[d], above. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels

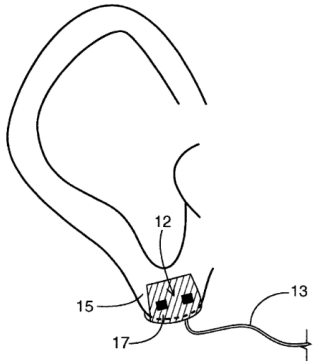
’475 Patent	Goodman
	through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07 Also, as shown in FIG. 2, PPG sensor 12 utilizes cylindrical baffles 21 to house LED1 and LED2 and photodiodes PD1 and PD2 to prevent direct coupling of light from the LED's to the photodiodes. When a user's finger is placed over the top openings of baffles 21, light will be only provided to the finger and spillover light will be appreciably reduced. Well known techniques to accomplish motion artifact reduction such as that discussed in PCT Pat. Application No. 99/32030 to BTG International Limited could be utilized to further reduce the amount of motion artifact related distortion of the PPG signal. Goodman at 10:08-18 PPG sensor 12 is installed within the housing in depression 22 such that PPG.sensor 12 is positioned underneath the part of depression 22 that corresponds to a user's distal thumb and so that a user's thumb when positioned within depression 22 would be completely covered by; an elastic restraint 28. It has been determined that this is an optimal configuration, since the transmitted light can penetrate adequately into the skin at a user's fingertip and due to the fact that elastic restraint 28 shields PPG sensor 12 from ambient light. For convenient operation within user input device 20, the LED and photodiode pairs are installed within depression 22 approximately one centimeter apart from each other. Goodman at 10:36-48 FIG. 3 shows the circuity of signal conditioner module 24. Signal conditioner module 24 uses two identical conditioning circuits to condition the current output of photodiodes PD1 and PD2 independently. The operation of the circuit which conditions the current signal of photodiode PD1 will be discussed, but it should be understood that the circuit which conditions photodiode PD2 operates identically. The components of the circuit which conditions the current signal output of photodiode. PD2

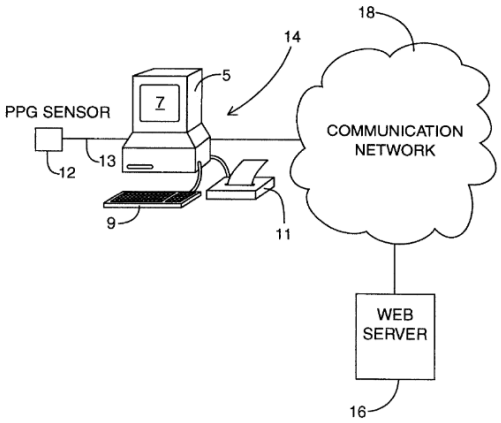
’475 Patent	Goodman
	are identified with the same reference numbers as for the circuit for photodiode PD1, but with the part numbers primed. Goodman at 10:65 -11:08  FIG. 3 Goodman at Fig. 3 Each circuit includes operational quad amplifiers U1A and U2A fabricated on a single IC (e.g. Texas Instruments brand TLC274 Precision Quad Operational Amplifier) as well as capacitors C1, C5, C6, and C8, resistors R11, R12, R13, R14, R15, R16, and R18 and variable resistor VR17. The operational amplifier U1A, PD1, C5 and R12 form a transimpedance photodetector circuit. The raw PPG photo current signal generated by PD1 is converted to a voltage signal through resistor R12. The combination of capacitor C5 and resistor R12 provides low pass filtering for the raw PPG voltage signal generated at the output of operational amplifier U1A (at node A in FIG. 3). This configuration eliminates high frequency noise and high frequency spurious signals which may be present at the input to U1A. Goodman at 11:09 -21

’475 Patent	Goodman
	FIG. 6 shows how PPG sensor 12 could be associated with the user's earlobe 15 instead of the user's finger. As discussed, it is well known that the reflective wave originating in the aorta has a significant presence in the volume pulse contour obtained from a fingertip, ear or other points on the surface of the body. As is conventionally known, the volume pulse signal acquired from the ear lobe, like the finger, is similar to that acquired from the carotid artery. Specifically, it is contemplated that PPG sensor 12 operating in transmission mode could be implanted in a “clip” device 17 which would provide for skin contact between PPG sensor 12 and a user's earlobe 15. This embodiment would provide analogous pulse volume signal information from which various cardiovascular and respiratory indices could be obtained, while allowing for hands free functionality. Goodman at 13:59-14:06  FIG. 6 Goodman at Fig. 6 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:36 -48

’475 Patent	Goodman
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Goodman discloses or renders obvious a detector. *See* claim 1[e], above. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07 PPG sensor 12 is installed within the housing in depression 22 such that PPG.sensor 12 is positioned underneath the part of depression 22 that corresponds to a user's distal thumb and so that a user's thumb when positioned within depression 22 would be completely covered by; an elastic restraint 28. It has been determined that this is an optimal configuration, since the transmitted light can penetrate adequately into the skin at a user's fingertip and due to the fact that elastic restraint 28 shields PPG sensor 12 from ambient light. For convenient operation within user input device 20, the LED and photodiode pairs are installed within depression 22 approximately one centimeter apart from each other. Goodman at 10:36-48

’475 Patent	Goodman
	FIG. 3 shows the circuity of signal conditioner module 24. Signal conditioner module 24 uses two identical conditioning circuits to condition the current output of photodiodes PD1 and PD2 independently. The operation of the circuit which conditions the current signal of photodiode PD1 will be discussed, but it should be understood that the circuit which conditions photodiode PD2 operates identically. The components of the circuit which conditions the current signal output of photodiode. PD2 are identified with the same reference numbers as for the circuit for photodiode PD1, but with the part numbers primed. Goodman at 10:65 -11:08  FIG. 3 Goodman at Fig. 3 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning

’475 Patent	Goodman
	on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:36 -48 FIG. 6 shows how PPG sensor 12 could be associated with the user's earlobe 15 instead of the user's finger. As discussed, it is well known that the reflective wave originating in the aorta has a significant presence in the volume pulse contour obtained from a fingertip, ear or other points on the surface of the body. As is conventionally known, the volume pulse signal acquired from the ear lobe, like the finger, is similar to that acquired from the carotid artery. Specifically, it is contemplated that PPG sensor 12 operating in transmission mode could be implanted in a “clip” device 17 which would provide for skin contact between PPG sensor 12 and a user's earlobe 15. This embodiment would provide analogous pulse volume signal information from which various cardiovascular and respiratory indices could be obtained, while allowing for hands free functionality. Goodman at 13:59-14:06  FIG. 6 Goodman at Fig. 6 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it

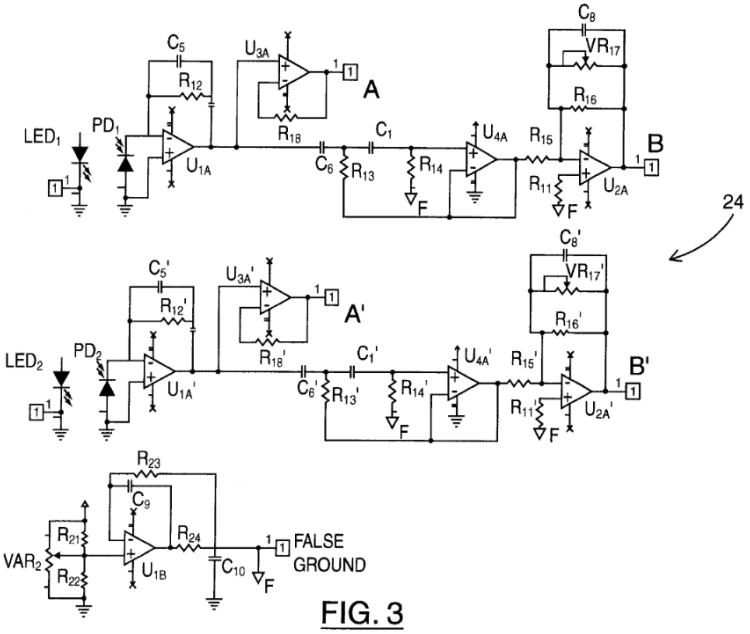
’475 Patent	Goodman
	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Goodman discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. *See* claim 1[k], above. Reference is first made to FIG. 1, which shows the overall configuration of the preferred embodiment of a physiological monitoring system 10, according to the present invention. System 10 comprises a conventional plethysmography (PPG) sensor 12 coupled to a processing device 14 which is in data communication with a Web site server 16 through a communication network 18 (i.e. the Internet). Goodman at 8:53-59  FIG. 1 Goodman at Fig. 1

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	PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse or some other computer peripheral (e.g. keyboard, touchpad, joystick) commonly associated with a computer processing device 14. It should be understood that it would be also possible to implement the invention by incorporating PPG sensor 12 within the casing of a personal digital assistant (PDA) or within some other type of stand alone data processing and transmitting device (e.g. a watch) or simply as a stand alone sensor device. Goodman at 08:60-09:05 Processing device 14 is preferably a conventional personal computer having a central processing unit (CPU) 5, display 7, keyboard 9 and printer 11. Processing device 14 also preferably has a standard Universal Serial Bus (USB), sufficient memory and processing power to run the application programs associated with system 10, and a data transmission controller for sending and receiving data over data transmission cable 13, all built integrally with processing device 14. An executable program is installed within the permanent memory of processing device 14 to instruct the user through interactive menus to utilize the PPG sensor 12 such that proper PPG signals can be obtained from the user and to provide the user with his/her own generated physiological information through graphical means. It should be understood that such an executable program could also be available for downloading online from Web site server 16. The executable program has the functionality to allow a user to observe his/her own physiological signals in real time such that biofeedback is facilitated. Also, it is contemplated that processing device 14 could be used to store a user's physiological signals for later retrieval, comparative and display purposes. Commercially available signal measurement and analysis display software such as LabVIEW™ (available from National Instruments of Austin, Tex.) is utilized to perform the necessary data analysis as well as display the results of the calculations in easy to understand format. It should be understood that processing device 14 could just as easily be a PDA, as discussed above. Goodman at 09:06-33 PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as

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	background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07 Following this filtering process, the PPG voltage signal is applied to a combined amplifier and low pass filter stage comprised of resistors R15, R11, and R16, variable resistor VAR17, capacitor C8 and operational amplifier U2A. The gain of the amplifier is set by adjusting variable resistor VAR17. The values of resistors R16, R17 and capacitor C8 determine the corner frequency which is typically 30 Hertz. The conditioned PPG voltage signal generated by this stage (at point B) is provided to the processing device 14. In this way signal conditioner module 24 improves the signal to noise ratio of the PPG signal prior to digitization. Goodman at 11:42-52 Further embodiments of the invention whereby PPG sensor 12 and processing device 14 are integrated together into a single unit with a compact design are also contemplated as processing speed and device memory increase as physical dimensions decrease. For example, it is likely that PPG sensor 12 and processing device 14, and all of its associated functionality, could feasibly be incorporated into a wrist watch device in the foreseeable future. It is contemplated that PPG sensor 12 could be integrated together with a computing means, wireless transmission means (e.g. well known convention radio frequency techniques as well as emerging radio frequency communication protocols such as the BlueTooth™ standard) and a battery in a small (e.g. 2 cm2) component that would adhere to a body skin area for extended periods of time (e.g. weeks) and would transmit data to a remote computing device on a continuous basis. Goodman at 13:43-58 1. A physiological signal monitoring system comprising:

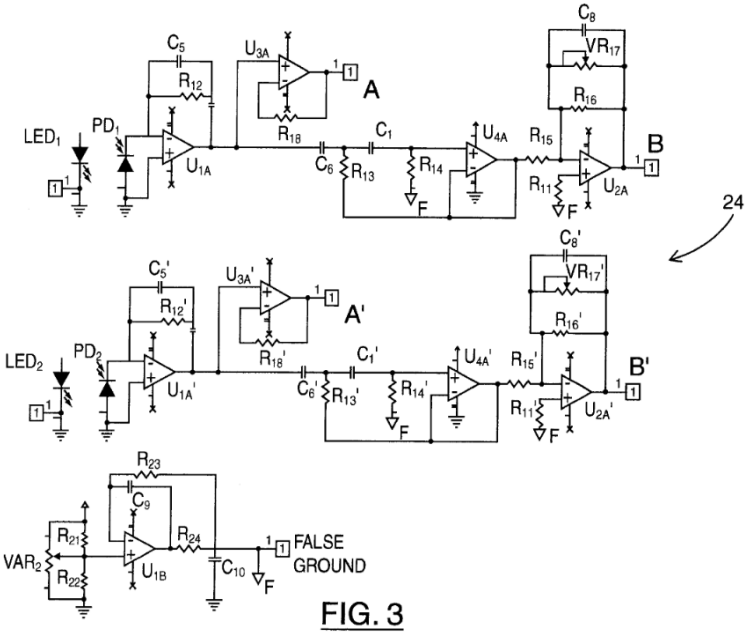
’475 Patent	Goodman
	(a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic, wherein said physiological characteristic comprises the user's blood volume contour; (b) first processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for conducting analysis of said physiological parameters, said first processing means comprising: (i) filtering means for filtering nonpulsatile and slowly pulsatile signals from the blood volume contour to obtain a filtered blood volume contour; (ii) extraction means for extracting characteristics of the user's aortic reflected wave contour from a volume contour chosen from one of the blood volume contour and the filtered blood volume contour, the characteristics of the user's aortic reflected wave contour being determined in part from a fourth derivative of said volume contour; (iii) computing means for determining the set of physiological parameters based on characteristics of said aortic reflected wave; and, (c) display means coupled to said first processing means for displaying said physiological parameters. Goodman at Claim 1 36. A physiological signal monitoring system for selectively providing a user with access to a resource, said system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic; (b) processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for extracting characteristics of an aortic reflected wave for the user from said data; (c) storage means for storing unique characteristics of an aortic reflected wave contour for the user; (d) verification means coupled to said processing means and said storage means for comparing said extracted characteristics of the aortic reflected wave with said unique characteristics of the aortic reflected wave and for providing the user with access to the resource only if said extracted characteristics of the user's aortic reflected wave is at least substantially identical to said unique characteristics of the aortic reflected wave; and, (e) display means coupled to said processing means for displaying said physiological parameters. Goodman at Claim 36

’475 Patent	Goodman
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Goodman discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. *See* claim 1[j], above. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07 PPG sensor 12 is installed within the housing in depression 22 such that PPG.sensor 12 is positioned underneath the part of depression 22 that corresponds to a user's distal thumb and so that a user's thumb when positioned within depression 22 would be completely covered by; an elastic restraint 28. It has been determined that this is an optimal configuration, since the transmitted light can penetrate adequately into the skin at a user's fingertip and due to the fact that elastic restraint 28 shields PPG sensor 12 from ambient light. For convenient operation within user input device 20, the LED and photodiode pairs are installed within depression 22 approximately one centimeter apart from each other.

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	Goodman at 10:36-48 FIG. 3 shows the circuity of signal conditioner module 24. Signal conditioner module 24 uses two identical conditioning circuits to condition the current output of photodiodes PD1 and PD2 independently. The operation of the circuit which conditions the current signal of photodiode PD1 will be discussed, but it should be understood that the circuit which conditions photodiode PD2 operates identically. The components of the circuit which conditions the current signal output of photodiode. PD2 are identified with the same reference numbers as for the circuit for photodiode PD1, but with the part numbers primed. Goodman at 10:65 -11:08  FIG. 3 Goodman at Fig. 3 Each circuit includes operational quad amplifiers U1A and U2A fabricated on a single IC (e.g. Texas Instruments brand TLC274 Precision Quad Operational Amplifier) as well as capacitors C1, C5, C6, and

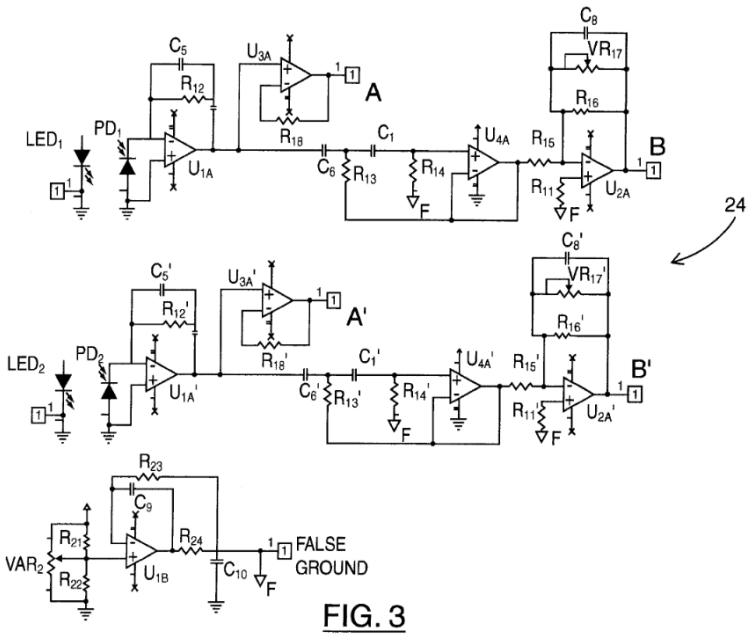
’475 Patent	Goodman
	C8, resistors R11, R12, R13, R14, R15, R16, and R18 and variable resistor VR17. The operational amplifier U1A, PD1, C5 and R12 form a transimpedance photodetector circuit. The raw PPG photo current signal generated by PD1 is converted to a voltage signal through resistor R12. The combination of capacitor C5 and resistor R12 provides low pass filtering for the raw PPG voltage signal generated at the output of operational amplifier U1A (at node A in FIG. 3). This configuration eliminates high frequency noise and high frequency spurious signals which may be present at the input to U1A. Goodman at 11:09-21 Following this filtering process, the PPG voltage signal is applied to a combined amplifier and low pass filter stage comprised of resistors R15, R11, and R16, variable resistor VAR17, capacitor C8 and operational amplifier U2A. The gain of the amplifier is set by adjusting variable resistor VAR17. The values of resistors R16, R17 and capacitor C8 determine the corner frequency which is typically 30 Hertz. The conditioned PPG voltage signal generated by this stage (at point B) is provided to the processing device 14. In this way signal conditioner module 24 improves the signal to noise ratio of the PPG signal prior to digitization. Goodman at 11:42-52 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:36 -48 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it

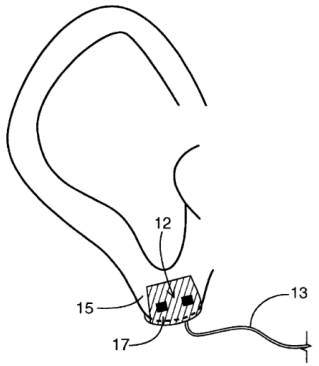
’475 Patent	Goodman
	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	Goodman discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. *See* claim 1[e], 1[h], 1[l], above. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07 PPG sensor 12 is installed within the housing in depression 22 such that PPG.sensor 12 is positioned underneath the part of depression 22 that corresponds to a user's distal thumb and so that a user's thumb when positioned within depression 22 would be completely covered by; an elastic restraint 28. It has been determined that this is an optimal configuration, since the transmitted light can penetrate adequately into the skin at a user's fingertip and due to the fact that elastic restraint 28 shields PPG sensor 12 from ambient light. For convenient operation within user input device 20, the LED and photodiode pairs are installed within depression 22 approximately one centimeter apart from each other. Goodman at 10:36-48

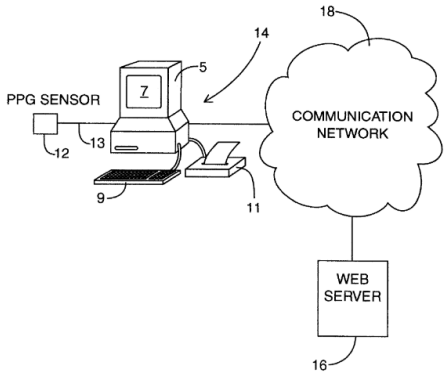
’475 Patent	Goodman
	FIG. 3 shows the circuity of signal conditioner module 24. Signal conditioner module 24 uses two identical conditioning circuits to condition the current output of photodiodes PD1 and PD2 independently. The operation of the circuit which conditions the current signal of photodiode PD1 will be discussed, but it should be understood that the circuit which conditions photodiode PD2 operates identically. The components of the circuit which conditions the current signal output of photodiode. PD2 are identified with the same reference numbers as for the circuit for photodiode PD1, but with the part numbers primed. Goodman at 10:65 -11:08  FIG. 3 Goodman at Fig. 3 Each circuit includes operational quad amplifiers U1A and U2A fabricated on a single IC (e.g. Texas Instruments brand TLC274 Precision Quad Operational Amplifier) as well as capacitors C1, C5, C6, and C8, resistors R11, R12, R13, R14, R15, R16, and R18 and variable resistor VR17. The operational amplifier U1A, PD1, C5 and R12 form a transimpedance photodetector circuit. The raw PPG photo current signal generated by PD1 is converted to a voltage signal through resistor R12. The combination

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	of capacitor C5 and resistor R12 provides low pass filtering for the raw PPG voltage signal generated at the output of operational amplifier U1A (at node A in FIG. 3). This configuration eliminates high frequency noise and high frequency spurious signals which may be present at the input to U1A. Goodman at 11:09-21 Following this filtering process, the PPG voltage signal is applied to a combined amplifier and low pass filter stage comprised of resistors R15, R11, and R16, variable resistor VAR17, capacitor C8 and operational amplifier U2A. The gain of the amplifier is set by adjusting variable resistor VAR17. The values of resistors R16, R17 and capacitor C8 determine the corner frequency which is typically 30 Hertz. The conditioned PPG voltage signal generated by this stage (at point B) is provided to the processing device 14. In this way signal conditioner module 24 improves the signal to noise ratio of the PPG signal prior to digitization. Goodman at 11:42-52 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:36 -48 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third	Goodman discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.

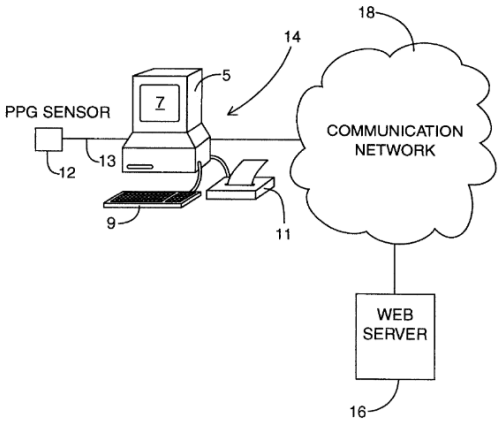
’475 Patent	Goodman
output signal, that the wearable device is being worn by the user.	*See* claim 1[m], above. PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07 PPG sensor 12 is installed within the housing in depression 22 such that PPG.sensor 12 is positioned underneath the part of depression 22 that corresponds to a user's distal thumb and so that a user's thumb when positioned within depression 22 would be completely covered by; an elastic restraint 28. It has been determined that this is an optimal configuration, since the transmitted light can penetrate adequately into the skin at a user's fingertip and due to the fact that elastic restraint 28 shields PPG sensor 12 from ambient light. For convenient operation within user input device 20, the LED and photodiode pairs are installed within depression 22 approximately one centimeter apart from each other. Goodman at 10:36-48 FIG. 3 shows the circuity of signal conditioner module 24. Signal conditioner module 24 uses two identical conditioning circuits to condition the current output of photodiodes PD1 and PD2 independently. The operation of the circuit which conditions the current signal of photodiode PD1 will be discussed, but it should be understood that the circuit which conditions photodiode PD2 operates identically. The components of the circuit which conditions the current signal output of photodiode. PD2 are identified with the same reference numbers as for the circuit for photodiode PD1, but with the part numbers primed.

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	Goodman at 10:65 -11:08  FIG. 3 Goodman at Fig. 3 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:35-47 FIG. 6 shows how PPG sensor 12 could be associated with the user's earlobe 15 instead of the user's finger. As discussed, it is well known that the reflective wave originating in the aorta has a significant presence in the volume pulse contour obtained from a fingertip, ear or other points on the surface of the body. As is conventionally known, the volume pulse signal acquired from the ear lobe, like the finger, is

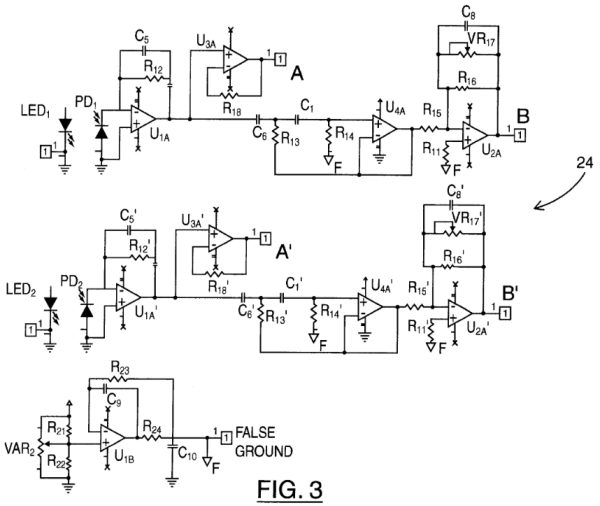
’475 Patent	Goodman
	similar to that acquired from the carotid artery. Specifically, it is contemplated that PPG sensor 12 operating in transmission mode could be implanted in a “clip” device 17 which would provide for skin contact between PPG sensor 12 and a user's earlobe 15. This embodiment would provide analogous pulse volume signal information from which various cardiovascular and respiratory indices could be obtained, while allowing for hands free functionality. Goodman at 13:59-14:06  FIG. 6 Goodman at Fig. 6 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700	See claim 8 above. Goodman discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.

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nanometers and about 2500 nanometers.	As previously discussed, PPG sensor 12 can utilize one or two LED's. While the PPG sensor 12 of the preferred embodiment of the invention includes two LED's it is possible to conduct the above noted analysis and obtain the above noted cardiovascular indices using just a single LED. However, it is only possible to obtain the measurement of blood oxygen saturation using a red LED1 and an infrared LED2 as will be discussed. Goodman at 32:22-29 Blood oxygen saturation is a physiological parameters of critical importance in many medical conditions. The non-invasive measurement of arterial oxygen saturation using PPG sensors known as pulse oximetry is well established in clinical use. The technique relies on the knowledge that haemoglobin and oxygenated haemoglobin absorb incident light to varying degrees as a function of wavelength. Goodman at 32:30-36  FIG. 1 Goodman at Fig. 1

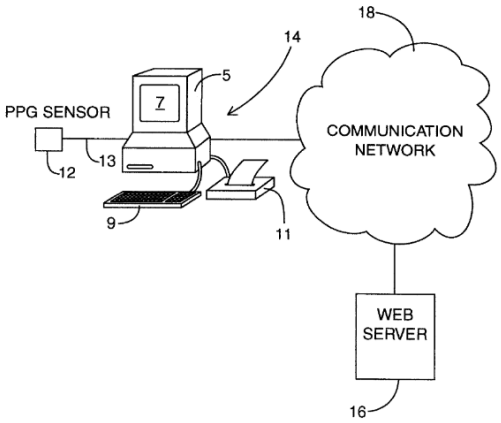
'475 Patent	Goodman
	In particular, at 658 nanometres (which corresponds to red light), the absorption coefficient for haemoglobin is ten times higher than that for oxyhemoglobin. At 880 nanometres (which corresponds to infrared light), there is a much smaller difference between the absorption coefficients between the two wavelengths. It is thus possible to derive the proportion of oxyhemoglobin and therefore the arterial oxygen saturation from a knowledge of the absorption characteristics of the arterial blood at these two wavelengths. That is, differential absorption of oxyhemoglobin and deoxyhaemoglobin at these two wavelengths allows the relative proportion of each to be determined as is well known to those skilled in the art of biomedical engineering. Goodman at 32:37-49 Alternatively, it would be possible to use two infrared LEDs which are close to the isobestic point of haemoglobin (i.e. approximately 880 nanometres). The isobestic point of haemoglobin is defined as being the wavelength at which the haemoglobin is relatively insensitive to the oxygenated status of the haemoglobin molecule. Light emitting at 880 nanometres is close to the point where the absorption of light by haemoglobin is not affected by the oxygenation status of the haemoglobin molecule. Goodman at 32:50-58 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. Goodman discloses or renders obvious the physiological parameter of the user is associated with a blood constituent or a blood flow of the user. Reference is first made to FIG. 1, which shows the overall configuration of the preferred embodiment of a physiological monitoring system 10, according to the present invention. System 10 comprises a

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	conventional plethysmography (PPG) sensor 12 coupled to a processing device 14 which is in data communication with a Web site server 16 through a communication network 18 (i.e. the Internet). Goodman at 8:53-59  FIG. 1 Goodman at Fig. 1 PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse or some other computer peripheral (e.g. keyboard, touchpad, joystick) commonly associated with a computer processing device 14. It should be understood that it would be also possible to implement the invention by incorporating PPG sensor 12 within the casing of a personal digital assistant (PDA) or within some other type of stand alone data processing and transmitting device (e.g. a watch) or simply as a stand alone sensor device. Goodman at 8:60-9:05

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	PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07 PPG sensor 12 is installed within the housing in depression 22 such that PPG.sensor 12 is positioned underneath the part of depression 22 that corresponds to a user's distal thumb and so that a user's thumb when positioned within depression 22 would be completely covered by; an elastic restraint 28. It has been determined that this is an optimal configuration, since the transmitted light can penetrate adequately into the skin at a user's fingertip and due to the fact that elastic restraint 28 shields PPG sensor 12 from ambient light. For convenient operation within user input device 20, the LED and photodiode pairs are installed within depression 22 approximately one centimeter apart from each other. Goodman at 10:36-48 FIG. 3 shows the circuity of signal conditioner module 24. Signal conditioner module 24 uses two identical conditioning circuits to condition the current output of photodiodes PD1 and PD2 independently. The operation of the circuit which conditions the current signal of photodiode PD1 will be discussed, but it should be understood that the circuit which conditions photodiode PD2 operates identically. The components of the circuit which conditions the current signal output of photodiode. PD2 are identified with the same reference numbers as for the circuit for photodiode PD1, but with the part numbers primed. Goodman at 10:65 -11:08

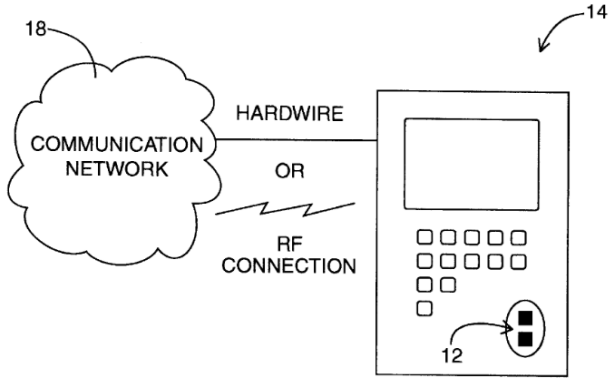
’475 Patent	Goodman
	 FIG. 3 Goodman at Fig. 3 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:36-48 The use of the derivative, high pass filtering, and respiratory matrix filtering techniques described above can be used to determine a variety of conventionally known indices from the systolic wave and the systolic reflected wave which are useful correlates of various cardiovascular parameters, including mean blood pressure, respiratory function, and aortic pulse wave velocity. Goodman at 23:63-24:2

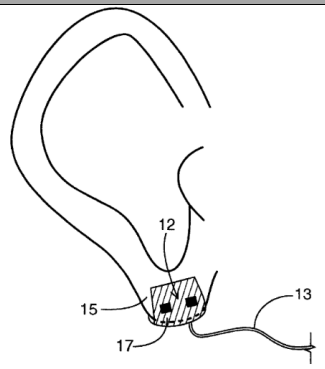
’475 Patent	Goodman
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	See claim 8 above. Goodman discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency. Reference is first made to FIG. 1, which shows the overall configuration of the preferred embodiment of a physiological monitoring system 10, according to the present invention. System 10 comprises a conventional plethysmography (PPG) sensor 12 coupled to a processing device 14 which is in data communication with a Web site server 16 through a communication network 18 (i.e. the Internet). Goodman at 8:53-59

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	 FIG. 1 Goodman at Fig. 1 PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse or some other computer peripheral (e.g. keyboard, touchpad, joystick) commonly associated with a computer processing device 14. It should be understood that it would be also possible to implement the invention by incorporating PPG sensor 12 within the casing of a personal digital assistant (PDA) or within some other type of stand alone data processing and transmitting device (e.g. a watch) or simply as a stand alone sensor device. Goodman at 08:60-09:05 Processing device 14 is preferably a conventional personal computer having a central processing unit (CPU) 5, display 7, keyboard 9 and printer 11. Processing device 14 also preferably has a standard Universal Serial Bus (USB), sufficient memory and processing power to run the application programs

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	associated with system 10, and a data transmission controller for sending and receiving data over data transmission cable 13, all built integrally with processing device 14. An executable program is installed within the permanent memory of processing device 14 to instruct the user through interactive menus to utilize the PPG sensor 12 such that proper PPG signals can be obtained from the user and to provide the user with his/her own generated physiological information through graphical means. It should be understood that such an executable program could also be available for downloading online from Web site server 16. The executable program has the functionality to allow a user to observe his/her own physiological signals in real time such that biofeedback is facilitated. Also, it is contemplated that processing device 14 could be used to store a user's physiological signals for later retrieval, comparative and display purposes. Commercially available signal measurement and analysis display software such as LabVIEW™ (available from National Instruments of Austin, Tex.) is utilized to perform the necessary data analysis as well as display the results of the calculations in easy to understand format. It should be understood that processing device 14 could just as easily be a PDA, as discussed above. Goodman at 09:06-33 PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light is transmitted into a body part and the amount of light reflected back is detected). The emitted monochromatic light emitted from LED1 and LED2 travels through a user's finger along a light path which passes through blood in a plurality of arteries as well as background tissue. As the monochromatic light travels along its light path it is partially absorbed by the background tissue and the blood. A portion of the monochromatic light is not absorbed and is reflected back to the appropriate photodiode PDor PD2. As is conventionally known, reflective mode PPG uses the reflected light from a site to estimate absorption of light and to generate a raw blood volume pulse contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07 Microcontroller 26 is also programmed to control the operation of LED1 and LED2 of PPG sensor 12 for optimal sensor operation. Microcontroller 26 is programmed to generate digital switching pulses to drive LED1 and LED2 of PPG sensor 12 alternately at a repetition rate of 1 KHz (i.e. each LED accomplishes sampling at a rate of 1 KHz). It has been determined that the sampling frequency should be 10 times the highest frequency of interest. The conditioned PPG signal has frequency components as

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	high as 30 Hertz. However, 60 Hertz noise from electrical sources in the environment necessitates sampling of the signal at a high enough rate to ensure the effectiveness of the associated noise filtering software of CPU 5. Goodman at 12:22-34 By driving LED1 and LED2 alternately, it is ensured that only one LED is turned on at any one time so that the light signals are isolated from each other's photodiode. Also, both LED1 and LED2 are periodically turned off to acquire a signal used to correct for ambient light effects. Specifically, ambient light effects are eliminated through subtraction of the signal generated when the applicable LED1 or LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling activity allows PPG sensor 12 to be active only when necessary. Goodman at 12:36-48 FIG. 5 shows another possible configuration of system 10 wherein processing device 14 is a PDA (e.g. Palm Pilot™) having PPG sensor 12 interfaced therein. PPG sensor 12 could be directly integrated into the shell of the PDA processing device 14. Alternatively, PPG sensor 12 could be implemented within a PDA accessory card or device, or adapted to interface with the PDA processing device 14 as an external wearable device. In the latter case, it would be possible for a user to wear a wearable user input device 12 such that blood volume pulse signal information could be collected by the PDA processing device 14 over the course of a day. It would be possible to arrange for periodic download of recorded volume pulse contour signal information collected by user input device 12 to processing device 14 and/or to Web site server 16 through processing device 14 over the communication network 18. Goodman at 13:26-42

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	 FIG. 5 Goodman at Fig. 5 FIG. 6 shows how PPG sensor 12 could be associated with the user's earlobe 15 instead of the user's finger. As discussed, it is well known that the reflective wave originating in the aorta has a significant presence in the volume pulse contour obtained from a fingertip, ear or other points on the surface of the body. As is conventionally known, the volume pulse signal acquired from the ear lobe, like the finger, is similar to that acquired from the carotid artery. Specifically, it is contemplated that PPG sensor 12 operating in transmission mode could be implanted in a “clip” device 17 which would provide for skin contact between PPG sensor 12 and a user's earlobe 15. This embodiment would provide analogous pulse volume signal information from which various cardiovascular and respiratory indices could be obtained, while allowing for hands free functionality. Goodman at 13:59-14:06

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	 FIG. 6 Goodman at Fig. 6 1. A physiological signal monitoring system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic, wherein said physiological characteristic comprises the user's blood volume contour; (b) first processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for conducting analysis of said physiological parameters, said first processing means comprising: (i) filtering means for filtering nonpulsatile and slowly pulsatile signals from the blood volume contour to obtain a filtered blood volume contour; (ii) extraction means for extracting characteristics of the user's aortic reflected wave contour from a volume contour chosen from one of the blood volume contour and the filtered blood volume contour, the characteristics of the user's aortic reflected wave contour being determined in part from a fourth derivative of said volume contour; (iii) computing means for determining the set of physiological parameters based on characteristics of said aortic reflected wave; and, (c) display means coupled to said first processing means for displaying said physiological parameters. Goodman at Claim 1

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	36. A physiological signal monitoring system for selectively providing a user with access to a resource, said system comprising: (a) a PPG sensor adapted to come into skin contact with a user's body part, for sensing a physiological characteristic of the user and for generating electrical signals which correspond to said physiological characteristic; (b) processing means operatively coupled to said sensor for receiving and converting said electrical signals into data, for computing a set of physiological parameters on the basis of said data and for extracting characteristics of an aortic reflected wave for the user from said data; (c) storage means for storing unique characteristics of an aortic reflected wave contour for the user; (d) verification means coupled to said processing means and said storage means for comparing said extracted characteristics of the aortic reflected wave with said unique characteristics of the aortic reflected wave and for providing the user with access to the resource only if said extracted characteristics of the user's aortic reflected wave is at least substantially identical to said unique characteristics of the aortic reflected wave; and, (e) display means coupled to said processing means for displaying said physiological parameters. Goodman at Claim 36 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Goodman, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Goodman, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

U.S. Pat. No. 12,268,475 in view of
WO Patent Publication No. 2012/099536 to Md. Irwan bin Kassim Md. ("Kassim")

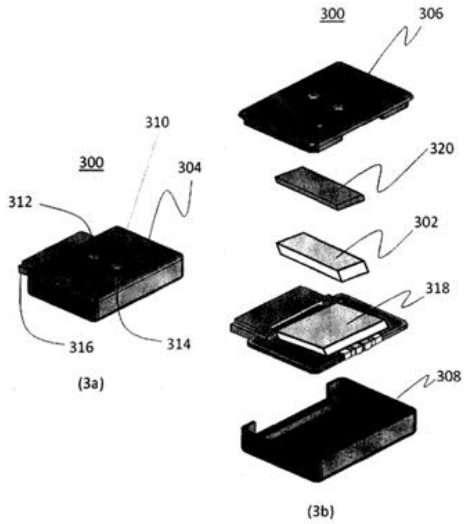
As described in detail below, Kassim (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Kassim. The cited portions of Kassim are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Kassim. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Kassim "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Kassim does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Kassim (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Kassim anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

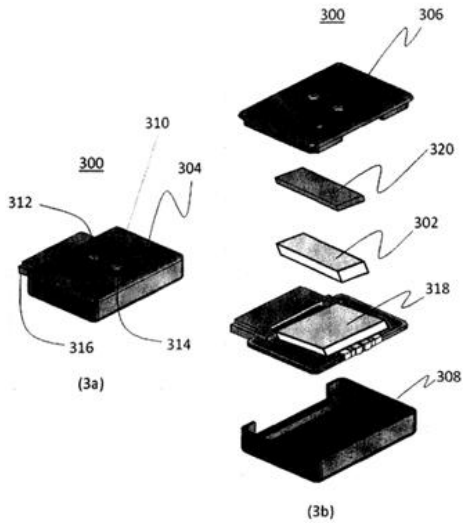
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kassim discloses or renders obvious an apparatus adapted to be worn by a user comprising. A device such as a pulse oximeter provides for measuring enhanced optical pulsatile signals emitted by the changes in the volume of blood flowing through a user. The pulse oximeter typically has a pair of small light emitting diodes (LEDs) facing a photodiode/ photodetector, with a translucent part of the user's body, usually a fingertip or an earlobe, positioned there between. Kassim at 1:24-28 For transmittance-type oximeters, a cuff or holder is typically provided to function primarily as a holder for the photodiode and also as a shield against ambient light. Kassim at 2:5-6 On the other hand, apart from transmittance-type oximeters, there also exist reflectance-type oximeters. For reflectance-type oximeters, the LEDs and the photodiode reside on the same side of the translucent part of the user's body. Light from the LEDs are reflected from the portion to be measured and detected by the photodiode. For reflectance- type oximeters, ambient light can be a significant factor in accuracy of light detection by the photodiode. Thus, reflectance-type oximeters typically still require a cuff or a holder/clip to provide shielding against ambient light from interfering with reflected light from the LEDs. Kassim at 2:8-14 Furthermore, for certain types of reflectance-type oximeters without clips, such as those in patch form, a shield is still required on the base of the oximeter to provide the ambient light shielding. Kassim at 16-18 In accordance with an aspect of the present invention, there is provided an optical measurement device, the device comprising an illumination assembly configured to output light to a surface portion of a user for measurement; a detection assembly configured to detect the output light reflected from said surface

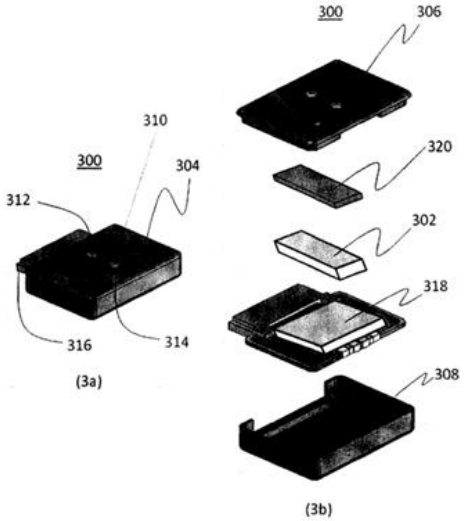
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	portion of the user as a signal; an amplifier module coupled to the detection assembly configured to apply a gain to an alternating- current component of the signal; a microcontroller coupled to the detection assembly configured to assess a direct-current voltage level of the signal; wherein the microcontroller is configured to control the light output at the illumination assembly based on said assessing the direct-current voltage level; and further wherein the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. Kassim at 02:34-03:09 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used.Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33

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	 Figure 3 Kassim at Fig. 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	Kassim discloses or renders obvious one or more biosensors adapted to be placed on the user. In accordance with an aspect of the present invention, there is provided an optical measurement device, the device comprising an illumination assembly configured to output light to a surface portion of a user for measurement; a detection assembly configured to detect the output light reflected from said surface portion of the user as a signal; an amplifier module coupled to the detection assembly configured to apply a gain to an alternating- current component of the signal; a microcontroller coupled to the detection assembly configured to assess a direct-current voltage level of the signal; wherein the microcontroller is configured to control the light output at the illumination assembly based on said assessing the direct-

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	current voltage level; and further wherein the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. Kassim at 02:34-03:09 The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculations/measurements. Kassim at 08:24-28 In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpO2 values determination. Kassim at 08:30-34 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used.Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in

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	combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33  Figure 3 Kassim at Fig. 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein	Kassim discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and

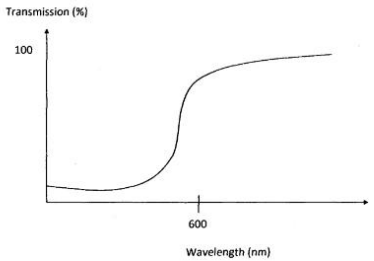
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measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculations/measurements. Kassim at 08:24-28 In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpO2 values determination. Kassim at 08:30-34 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used.Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used.

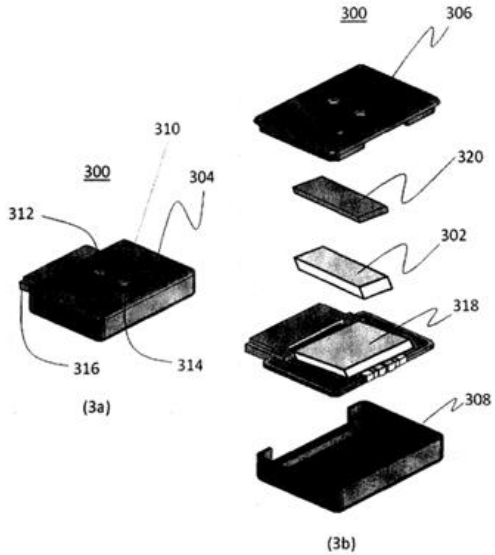
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	Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33  Figure 3 Kassim at Fig. 3 In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example

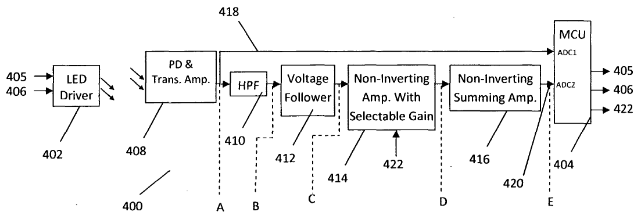
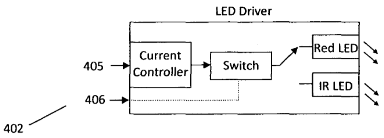
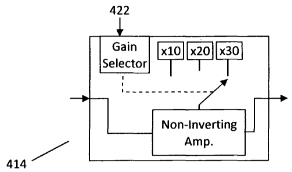
’475 Patent	Kassim
	embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 In an example embodiment, to detect a low perfusion scenario, the inventors have recognised that a lower LED intensity for both the Red and IR light sources is preferred. Lowering the intensity of both the Red and IR light sources can allow for signals of a better quality, i.e. a larger amplitude. For example, a normal measurement uses about 14-16mA and about 10-12mA of driving current for the Red and IR light sources' intensity to reach a 2.5V DC value at the detector/detection assembly. A person with low perfusion uses about 10-12mA and about 6-8mA of driving current for the Red and IR light sources' intensity to reach a similar 2.5V DC value at the detector/detection assembly. Thus, if the detected level is more than 2.5V DC, the circuitry is able to determine that the situation is a low perfusion scenario. The circuitry is able to tune/track the intensity setting and thus, select the appropriate gain. Kassim at 19:12-22 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21 With the ratio R, Sp02 or the saturation of hemoglobin with oxygen (in blood) can be determined. That is, in some examples, the ratio R can be used to refer to a proprietary lookup table provided by a manufacturer to determine the corresponding Sp02 value. The lookup table can be stored in a database that is in turn loaded onto the personal mobile processing device and the lookup operation is automated.

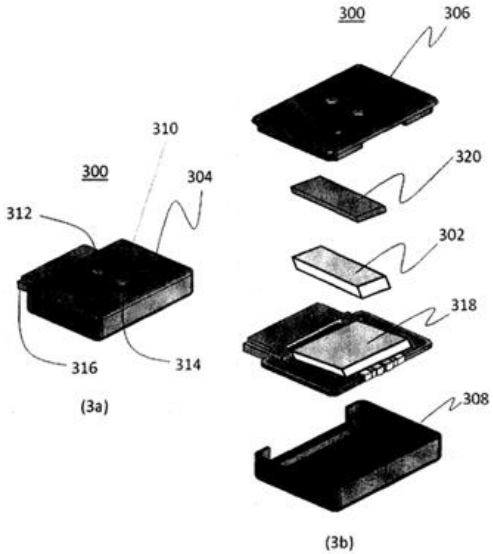
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	In example embodiments, optionally, it is possible to determine the quality of the signals so as to inform the user on the accuracy of, for example, a Sp02 measurement. The quality of a signal can be measured by a propagation error which takes in account the deviation of the 6 parameters used in the calculation of R. i.e. R = f{ACir , ACr , ACam , DCir , DCr , DCam) Kassim at 28:22-26 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	Kassim discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. In accordance with an aspect of the present invention, there is provided an optical measurement device, the device comprising an illumination assembly configured to output light to a surface portion of a user for measurement; a detection assembly configured to detect the output light reflected from said surface portion of the user as a signal; an amplifier module coupled to the detection assembly configured to apply a gain to an alternating- current component of the signal; a microcontroller coupled to the detection assembly configured to assess a direct-current voltage level of the signal; wherein the microcontroller is configured to control the light output at the illumination assembly based on said assessing the direct-current voltage level; and further wherein the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. Kassim at 02:34-03:09 In some example embodiments, saturation of peripheral oxygen (SP02) information of a user is derivable from detected output light information from both a red LED and an infra-red LED. Further, in the description herein, the term "light" as used herein is meant to be interpreted in a broad sense and is not

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	limited to visible light only. The term "light" as used herein can include, but is not limited to, X-ray light rays, visible light rays, ultraviolet light rays and infra-red light rays.Fig. 3(a) is a schematic illustration of an optical measurement device in an example embodiment.Fig. 3(b) shows schematically an exploded view of the optical measurement device. Kassim at 11:23-11:28 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used.Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33

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	 Figure 3 (c) Kassim at Fig. 3(c) Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment.Fig. 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment.Fig. 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. Kassim at 13:14-33

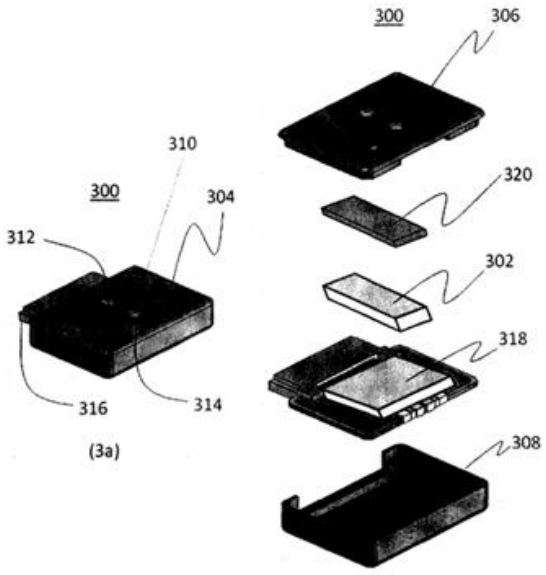
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	 Figure 3 Kassim at Fig. 3

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	 Figure 4(a)  Figure 4(b)  Figure 4(c) Kassim at Fig. 4(a), 4(b) & 4(c). One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least	Kassim discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin.

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a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculations/measurements. Kassim at 08:24-28 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25  Figure 3

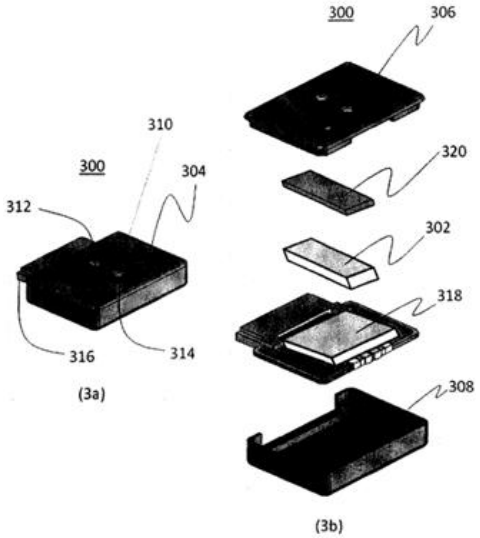
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	Kassim at Fig. 3 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used. Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the	Kassim discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio.

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tissue and to generate an output signal having a signal-to-noise ratio,	The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculations/measurements. Kassim at 08:24-28 The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Fig. 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 11:34-12:10

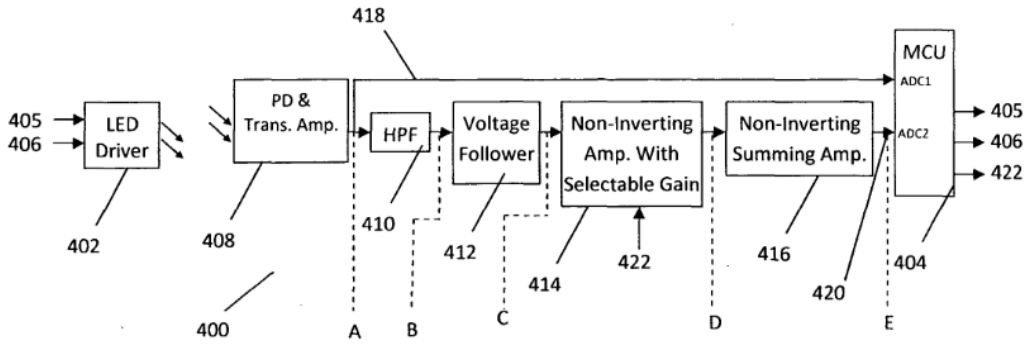
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	 Figure 3 Kassim at Fig. 3 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device

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	and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used. Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33 In the example embodiment, the light sources are toggled on/off for the detection assembly to detect the reflected output light as a single signal. The processing or signal conditioning described can then be carried out in a single path processing approach. In the example embodiment, an amplitude difference between a maximum point and a minimum point of the single signal is maintained below a predetermined level by the microcontroller controlling the light output at the illumination assembly. In some example embodiments, the predetermined level can be about 100mV. The predetermined level is obtained based on the alternating-current component of the signal being within a saturation level, upon the amplifier module applying the gain. Thus, for a gain of about 20 times in a coldfinger scenario, a difference of about 00mV becomes about 2V, compared to a saturation voltage level of e.g. about 3.3V. It will be appreciated that within each signal, there is an inherent AC component and this may be e.g. 10mV. Therefore, factoring a gain of 20 times, the amplified signals can have a span or a range of about 2.2V which is still within the 3.3V saturation range. This can ensure that the output from the circuitry is not saturated. Kassim at 20:33-21:11 It is appreciated that the detected light information or Vppg signal e.g. to be transmitted to a personal mobile processing device for further processing has a substantial extent of ambient light interference. Therefore, ambient light or noise cancellation can be performed e.g. at the personal mobile processing

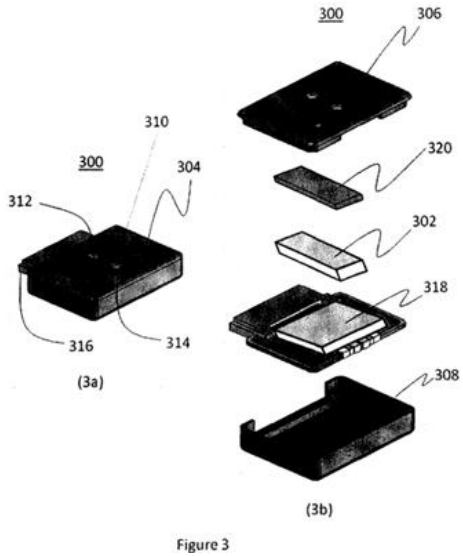
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	device. The description below relating to ambient noise cancellation for SP02 calculations can be implemented through software and/or hardware modules. The hardware modules can comprise electronic circuitry or dedicated application chips such as an ASIC chip. A graphical user interface (GUI) may be provided, such as an "app" or software application on a smartphone, to be run on the personal mobile processing device to implement and display the ambient noise cancellation. Kassim at 21:33-22:06 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Kassim discloses or renders obvious, the detection system is configured to be synchronized to the light source. The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculations/measurements. Kassim at 08:24-28 The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Fig. 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement

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	device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 11:34-12:10  Figure 3 Kassim at Fig. 3 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	Kassim discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Fig. 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 11:34-12:10 Fig. 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Fig. 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Fig. 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in

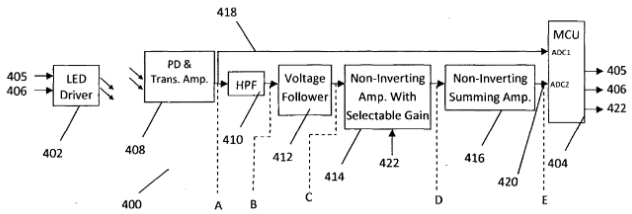
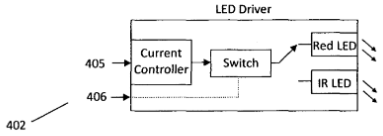
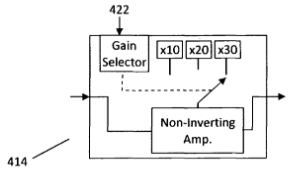
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	turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Fig. 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33  Figure 4(a) Kassim at Fig. 4(a) As seen in Fig. 4(a), ADC1 418 provides the DC portion of a measured signal and ADC2 420 provides the AC portion of a measured signal. Kassim at 14:01-02 In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning

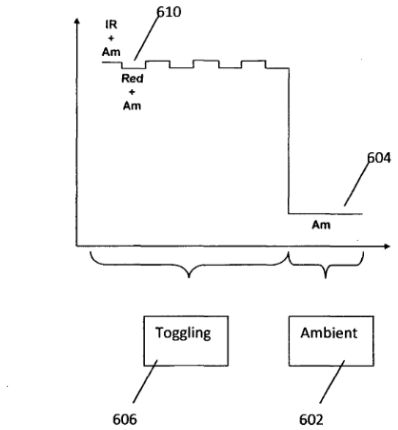
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	the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 It will be appreciated that in an ideal situation, e.g. with individual photodetectors and signal paths for all 3 conditions (IR, Red and Ambient), and perfectly noise free conditions, all peaks and troughs may in theory occur at the same points. In other words, t1 , t2 and t3 are the same when referring to the various conditions. In the present examples, because a single path is utilized, a peak sampled during the IR condition cannot be simultaneously measured for the R condition. As such, there are minor differences in peak and trough, e.g. t1 , t2 and t3, times. If sampling is on a basis of IR, Red and Ambient conditions i.e. one sample per condition, it can be expected that the peaks and troughs of the respective signals (IR, R and Ambient), e.g. at t1 , t2 and t3, may only be one sample off from each other. If the timings are too far off of each other (e.g. 2 or more samples apart), the particular set of samples can be rejected from the calculations if desired. Kassim at 26:18-28 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one	Kassim discloses or renders obvious the output signal is indicative of the one or more physiological parameters.

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or more physiological parameters;	The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculations/measurements. Kassim at 08:24-28 In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpO2 values determination. Kassim at 08:30-34  Figure 3 Kassim at Fig. 3

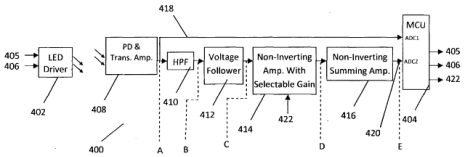
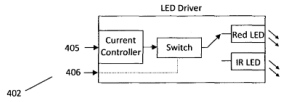
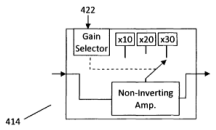
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	In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Kassim discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. In the example embodiment, the LEDs illumination intensity can be adjusted based on feedback at the MCU 404. The MCU 404 can adjust the respective current (at 405) to the LEDs so as to obtain respective raw PPG signals which are as close as possible in amplitude at point A, and e.g. between about 2-2.5V at the detection assembly 408. In the example embodiment, the LEDs can comprise a red LED and an infra-red LED. Each LED can be individually adjusted in illumination intensity. Kassim at 14:04-09 In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can

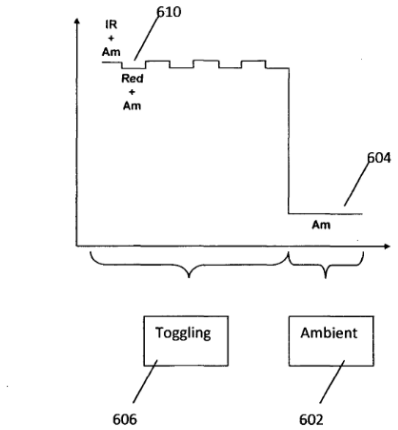
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	provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Kassim discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,. Fig. 6(a) is a schematic graphical illustration of output obtained at a light detector (compare 408 of Fig. 4) during a light emitting diode (LED) firing sequence in an example embodiment. During an Ambient (Am) or OFF condition 602, both the IR and RED LEDs are turned off, and an ambient PPG signal 604 can be obtained. During a toggling sequence 606, the IR and RED LEDs are alternatingly turned on. The MCU can then perform time based de-multiplexing to extract the respective IR and RED PPG signals. Kassim at 15:16-21

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	 Figure 4(a)  Figure 4(b)  Figure 4(c) Kassim at Fig. 4(a),4(b) & 4(c) .

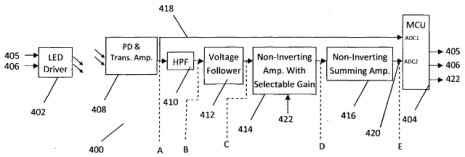
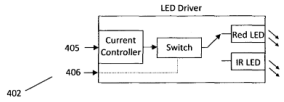
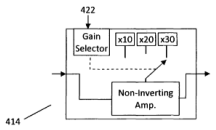
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	 Figure 6(a) Kassim at Fig. 6(a) In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 In the example embodiment, the light sources are toggled on/off for the detection assembly to detect the reflected output light as a single signal. The processing or signal conditioning described can then be carried out in a single path processing approach. In the example embodiment, an amplitude difference

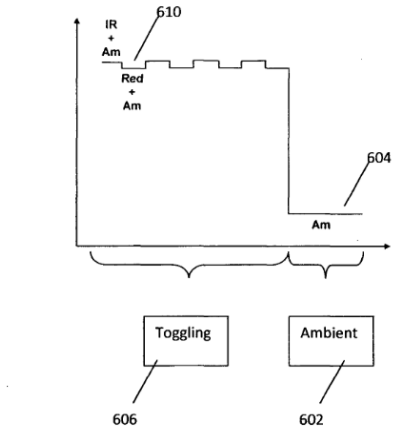
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	between a maximum point and a minimum point of the single signal is maintained below a predetermined level by the microcontroller controlling the light output at the illumination assembly. In some example embodiments, the predetermined level can be about 100mV. The predetermined level is obtained based on the alternating-current component of the signal being within a saturation level, upon the amplifier module applying the gain. Thus, for a gain of about 20 times in a coldfinger scenario, a difference of about 00mV becomes about 2V, compared to a saturation voltage level of e.g. about 3.3V. It will be appreciated that within each signal, there is an inherent AC component and this may be e.g. 10mV. Therefore, factoring a gain of 20 times, the amplified signals can have a span or a range of about 2.2V which is still within the 3.3V saturation range. This can ensure that the output from the circuitry is not saturated. Kassim at 20:33-21:11 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Kassim discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. Fig. 6(a) is a schematic graphical illustration of output obtained at a light detector (compare 408 of Fig. 4) during a light emitting diode (LED) firing sequence in an example embodiment. During an Ambient (Am) or OFF condition 602, both the IR and RED LEDs are turned off, and an ambient PPG signal 604 can be obtained. During a toggling sequence 606, the IR and RED LEDs are alternatingly turned on. The MCU can then perform time based de-multiplexing to extract the respective IR and RED PPG signals. Kassim at 15:16-21

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	 Figure 4(a)  Figure 4(b)  Figure 4(c) Kassim at Fig. 4(a),4(b) & 4(c)

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	 Figure 6(a) Kassim at Fig. 6(a) In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 In the example embodiment, the light sources are toggled on/off for the detection assembly to detect the reflected output light as a single signal. The processing or signal conditioning described can then be

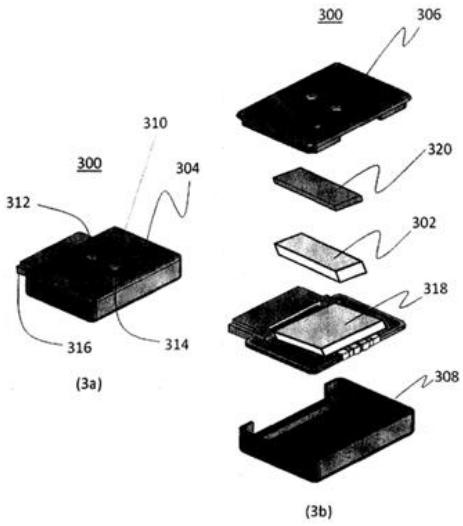
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	carried out in a single path processing approach. In the example embodiment, an amplitude difference between a maximum point and a minimum point of the single signal is maintained below a predetermined level by the microcontroller controlling the light output at the illumination assembly. In some example embodiments, the predetermined level can be about 100mV. The predetermined level is obtained based on the alternating-current component of the signal being within a saturation level, upon the amplifier module applying the gain. Thus, for a gain of about 20 times in a coldfinger scenario, a difference of about 00mV becomes about 2V, compared to a saturation voltage level of e.g. about 3.3V. It will be appreciated that within each signal, there is an inherent AC component and this may be e.g. 10mV. Therefore, factoring a gain of 20 times, the amplified signals can have a span or a range of about 2.2V which is still within the 3.3V saturation range. This can ensure that the output from the circuitry is not saturated. Kassim at 20:33-21:11 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Kassim discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. Fig. 6(a) is a schematic graphical illustration of output obtained at a light detector (compare 408 of Fig. 4) during a light emitting diode (LED) firing sequence in an example embodiment. During an Ambient (Am) or OFF condition 602, both the IR and RED LEDs are turned off, and an ambient PPG signal 604 can be obtained. During a toggling sequence 606, the IR and RED LEDs are alternatingly turned on. The MCU can then perform time based de-multiplexing to extract the respective IR and RED PPG signals. Kassim at 15:16-21

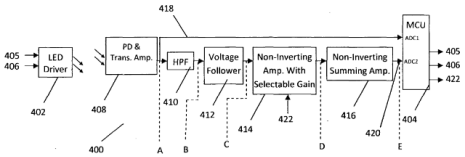
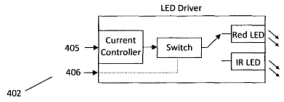
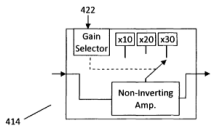
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	 Figure 4(a)  Figure 4(b)  Figure 4(c) Kassim at Fig. 4(a),4(b) & 4(c)

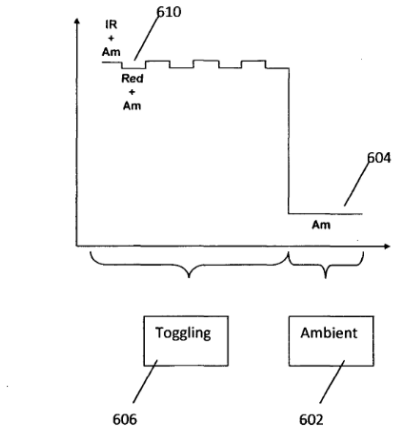
’475 Patent	Kassim
	 Figure 6(a) Kassim at Fig. 6(a) In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 In the example embodiment, the light sources are toggled on/off for the detection assembly to detect the reflected output light as a single signal. The processing or signal conditioning described can then be carried out in a single path processing approach. In the example embodiment, an amplitude difference

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	between a maximum point and a minimum point of the single signal is maintained below a predetermined level by the microcontroller controlling the light output at the illumination assembly. In some example embodiments, the predetermined level can be about 100mV. The predetermined level is obtained based on the alternating-current component of the signal being within a saturation level, upon the amplifier module applying the gain. Thus, for a gain of about 20 times in a coldfinger scenario, a difference of about 00mV becomes about 2V, compared to a saturation voltage level of e.g. about 3.3V. It will be appreciated that within each signal, there is an inherent AC component and this may be e.g. 10mV. Therefore, factoring a gain of 20 times, the amplified signals can have a span or a range of about 2.2V which is still within the 3.3V saturation range. This can ensure that the output from the circuitry is not saturated. Kassim at 20:33-21:11 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Kassim discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. In accordance with an aspect of the present invention, there is provided an optical measurement device, the device comprising an illumination assembly configured to output light to a surface portion of a user for measurement; a detection assembly configured to detect the output light reflected from said surface portion of the user as a signal; an amplifier module coupled to the detection assembly configured to apply a gain to an alternating- current component of the signal; a microcontroller coupled to the detection assembly configured to assess a direct-current voltage level of the signal; wherein the microcontroller is configured to control the light output at the illumination assembly based on said assessing the direct-current voltage level; and further wherein the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. Kassim at 02:34-03:09 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used.Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33

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	 Figure 3 Kassim at Fig. 3 Fig. 6(a) is a schematic graphical illustration of output obtained at a light detector (compare 408 of Fig. 4) during a light emitting diode (LED) firing sequence in an example embodiment. During an Ambient (Am) or OFF condition 602, both the IR and RED LEDs are turned off, and an ambient PPG signal 604 can be obtained. During a toggling sequence 606, the IR and RED LEDs are alternatingly turned on. The MCU can then perform time based de-multiplexing to extract the respective IR and RED PPG signals. Kassim at 15:16-21

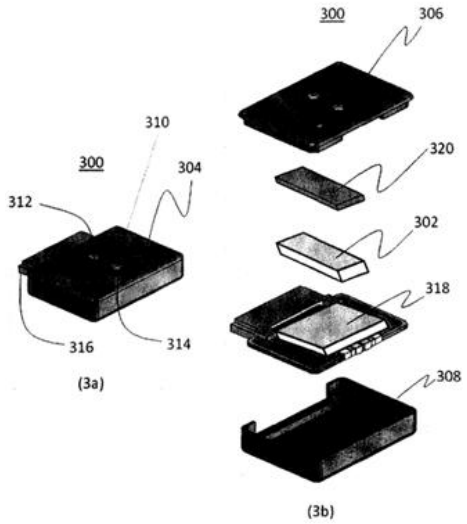
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	 Figure 4(a)  Figure 4(b)  Figure 4(c) Kassim at Fig. 4(a),4(b) & 4(c)

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	 Figure 6(a) Kassim at Fig. 6(a) In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform

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	obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.	See claim 1 above. Kassim discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal. In accordance with an aspect of the present invention, there is provided an optical measurement device, the device comprising an illumination assembly configured to output light to a surface portion of a user for measurement; a detection assembly configured to detect the output light reflected from said surface portion of the user as a signal; an amplifier module coupled to the detection assembly configured to apply a gain to an alternating- current component of the signal; a microcontroller coupled to the detection assembly configured to assess a direct-current voltage level of the signal; wherein the microcontroller is configured to control the light output at the illumination assembly based on said assessing the direct-

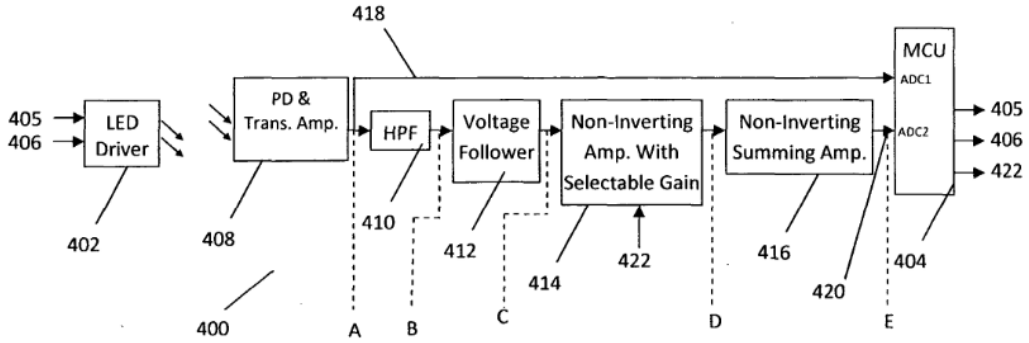
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	current voltage level; and further wherein the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. Kassim at 02:34-03:09 In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpO2 values determination. Kassim at 08:30-34 The description herein may be, in certain portions, explicitly or implicitly described as algorithms and/or functional operations that operate on data within a computer memory or an electronic circuit. These algorithmic descriptions and/or functional operations are usually used by those skilled in the information/data processing arts for efficient description. An algorithm is generally relating to a self-consistent sequence of steps leading to a desired result. The algorithmic steps can include physical manipulations of physical quantities, such as electrical, magnetic or optical signals capable of being stored, transmitted, transferred, combined, compared, and otherwise manipulated. Further, unless specifically stated otherwise, and would ordinarily be apparent from the following, a person skilled in the art will appreciate that throughout the present specification, discussions utilizing terms such as "scanning", "calculating", "determining", "replacing", "generating", "initializing", "outputting", and the like, refer to action and processes of a instructing processor/computer system, or similar electronic circuit/device/component, that manipulates/processes and transforms data represented as physical quantities within the described system into other data similarly represented as physical quantities within the system or other information storage, transmission or display devices etc. Kassim at 10:06-22 In one exemplary embodiment, the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is not exhaustive by any means. However, the feedback unit may not need to be portable, and could similarly be a computer or server. The feedback unit may be connected with the device 300 in a wired or wireless fashion, or

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	through a proprietary connector, such a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA). Kassim at 12:12-18 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used.Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33

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	 Figure 3 Kassim at Fig. 3 In an example embodiment, there is a further super low perfusion scenario, where even with the above approach, it is determined that the obtained AC signal is too small to identify the respective peaks of the signal. In other words, the maximum and minimum points of the AC signal cannot be accurately obtained. In such a case, the gain is increased to about 30 times. Thus, in the example embodiment, there is a first process to determine if the scenario is a cold finger scenario, wherein lowering the intensity of both the Red and IR sources can allow for signals of a better quality or larger amplitude of e.g. 2.5V. Next, a selection is made between the gain settings of e.g. 20 or 30. As described above, if it is determined that the obtained AC signal is too small to effectively identify the maximum and minimum points of the AC signal, then the higher gain setting of e.g. 30 is chosen. Thus, in the above described example embodiments, a signal processing circuitry can be provided that comprises a photodetector coupled with a transimpedance amplifier, a high-pass filter, a voltage follower module, an non-inverting amplifier with selectable gain and a non-inverting summing amplifier with unity gain. The circuitry can provide feedback using a microcontroller to intensity controls of one or more light sources. The circuitry can handle processing in a single path approach based on detection of light information relating to toggling of light sources. The circuitry can also handle low perfusion scenarios by selecting an appropriate gain and controlling intensities of light sources. In addition, the

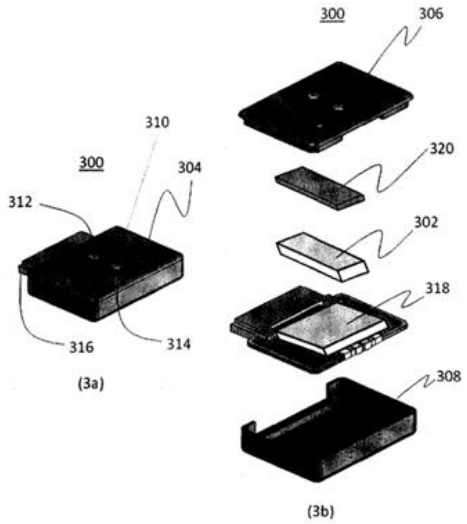
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	circuitry can allow effective measurement of low perfused human tissue conditions while maintaining a low power usage. Kassim at 19:24-20:11 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21 Figure 17 is a schematic flow diagram illustrating an ambient light detection process in an example embodiment. An optical measurement device is coupled to a personal mobile processing device. Kassim at 32:27-29 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	
6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and	See claim 1 above. Kassim discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.

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wherein the detection system comprises the plurality of detectors arranged along an arc.	The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Fig. 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 11:34-12:10 Fig. 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Fig. 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Fig. 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Fig. 4(c), the gain is selectable between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33

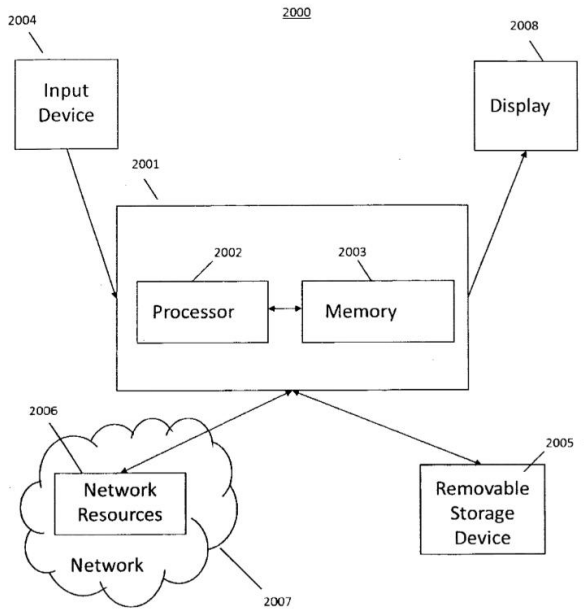
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	 Figure 4(a) It will be appreciated that in an ideal situation, e.g. with individual photodetectors and signal paths for all 3 conditions (IR, Red and Ambient), and perfectly noise free conditions, all peaks and troughs may in theory occur at the same points. In other words, t1 , t2 and t3 are the same when referring to the various conditions. In the present examples, because a single path is utilized, a peak sampled during the IR condition cannot be simultaneously measured for the R condition. As such, there are minor differences in peak and trough, e.g. t1 , t2 and t3, times. If sampling is on a basis of IR, Red and Ambient conditions i.e. one sample per condition, it can be expected that the peaks and troughs of the respective signals (IR, R and Ambient), e.g. at t1 , t2 and t3, may only be one sample off from each other. If the timings are too far off of each other (e.g. 2 or more samples apart), the particular set of samples can be rejected from the calculations if desired. Kassim at 26:18-28 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	See claim 6 above. Kassim discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. In accordance with an aspect of the present invention, there is provided an optical measurement device, the device comprising an illumination assembly configured to output light to a surface portion of a user for measurement; a detection assembly configured to detect the output light reflected from said surface portion of the user as a signal; an amplifier module coupled to the detection assembly configured to apply a gain to an alternating- current component of the signal; a microcontroller coupled to the detection assembly configured to assess a direct-current voltage level of the signal; wherein the microcontroller is configured to control the light output at the illumination assembly based on said assessing the direct-current voltage level; and further wherein the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. Kassim at 02:34-03:09 In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpO2 values determination. Kassim at 08:30-34 In one exemplary embodiment, the feedback unit may be a portable device, such as a mobile phone, smartphone, personal digital assistant (PDA), tablet, netbook or laptop, although this list is not exhaustive by any means. However, the feedback unit may not need to be portable, and could similarly be a computer or server. The feedback unit may be connected with the device 300 in a wired or wireless fashion, or through a proprietary connector, such a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA).

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	Kassim at 12:12-18 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used.Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33

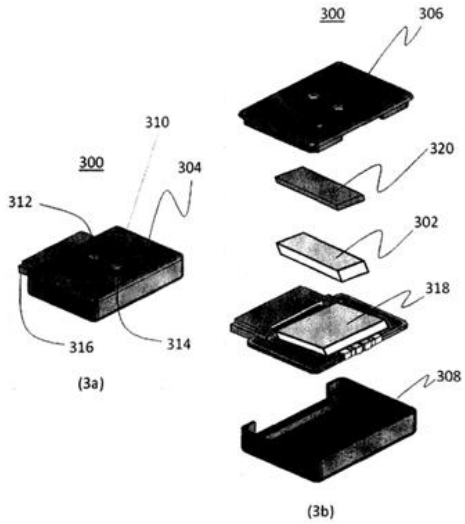
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	 Figure 3 Kassim at Fig. 3 In an example embodiment, there is a further super low perfusion scenario, where even with the above approach, it is determined that the obtained AC signal is too small to identify the respective peaks of the signal. In other words, the maximum and minimum points of the AC signal cannot be accurately obtained. In such a case, the gain is increased to about 30 times. Thus, in the example embodiment, there is a first process to determine if the scenario is a cold finger scenario, wherein lowering the intensity of both the Red and IR sources can allow for signals of a better quality or larger amplitude of e.g. 2.5V. Next, a selection is made between the gain settings of e.g. 20 or 30. As described above, if it is determined that the obtained AC signal is too small to effectively identify the maximum and minimum points of the AC signal, then the higher gain setting of e.g. 30 is chosen. Thus, in the above described example embodiments, a signal processing circuitry can be provided that comprises a photodetector coupled with a transimpedance amplifier, a high-pass filter, a voltage follower module, an non-inverting amplifier with selectable gain and a non-inverting summing amplifier with unity gain. The circuitry can provide feedback using a microcontroller to intensity controls of one or more light sources. The circuitry can handle processing in a single path approach based on detection of light information relating to toggling of light sources. The circuitry can also handle low perfusion scenarios by selecting an appropriate gain and controlling intensities of light sources. In addition, the

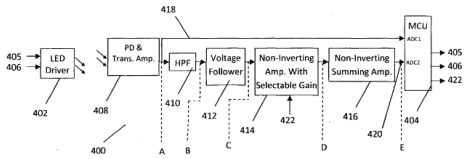
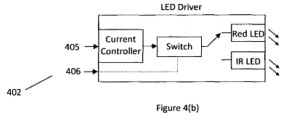
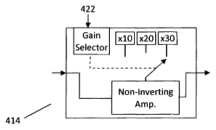
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	circuitry can allow effective measurement of low perfused human tissue conditions while maintaining a low power usage. Kassim at 19:24-20:11 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21 Fig. 20 is a block diagram that illustrates an embodiment of a computer/server system 2000 upon which an embodiment of the inventive methodology may be implemented. The system 2000 includes a computer/server platform 2001 including a processor 2002 and memory 2003 which operate to execute instructions, as known to one of skill in the art. The term "computer-readable medium" as used herein refers to any medium that participates in providing instructions to processor 2002 for execution. Additionally, the computer platform 2001 receives input from a plurality of input devices 2004, such as a keyboard, mouse, touch device or verbal command. The computer platform 2001 may additionally be connected to a removable storage device 2005, such as a portable hard drive, optical media (CD or DVD), disk media or any other medium from which a computer can read executable code. The computer platform may further be connected to network resources 2006 which connect to the Internet or other components of a local public or private network. The network resources 2006 may provide instructions and data to the computer platform from a remote location on a network 2007. The connections to the network resources 2006 may be via wireless protocols, such as the 802.11 standards, Bluetooth® or cellular protocols, or via physical transmission media, such as cables or fiber optics. The network

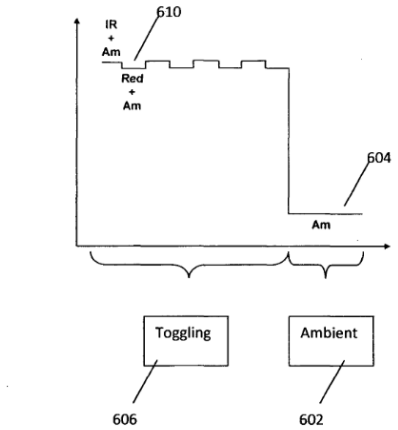
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	resources may include storage devices for storing data and executable instructions at a location separate from the computer platform 2001. The computer interacts with a display 2008 to output data and other information to a user, as well as to request additional instructions and input from the user. The display 2008 may therefore further act as an input device 2004 for interacting with a user. Kassim at 33:34-34:20  Figure 20 Kassim at Fig. 20. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kassim discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. A device such as a pulse oximeter provides for measuring enhanced optical pulsatile signals emitted by the changes in the volume of blood flowing through a user. The pulse oximeter typically has a pair of small light emitting diodes (LEDs) facing a photodiode/ photodetector, with a translucent part of the user's body, usually a fingertip or an earlobe, positioned there between. Kassim at 1:24-28 For transmittance-type oximeters, a cuff or holder is typically provided to function primarily as a holder for the photodiode and also as a shield against ambient light. Kassim at 2:5-6 On the other hand, apart from transmittance-type oximeters, there also exist reflectance-type oximeters. For reflectance-type oximeters, the LEDs and the photodiode reside on the same side of the translucent part of the user's body. Light from the LEDs are reflected from the portion to be measured and detected by the photodiode. For reflectance- type oximeters, ambient light can be a significant factor in accuracy of light detection by the photodiode. Thus, reflectance-type oximeters typically still require a cuff or a holder/clip to provide shielding against ambient light from interfering with reflected light from the LEDs. Kassim at 2:8-14 Furthermore, for certain types of reflectance-type oximeters without clips, such as those in patch form, a shield is still required on the base of the oximeter to provide the ambient light shielding. Kassim at 16-18

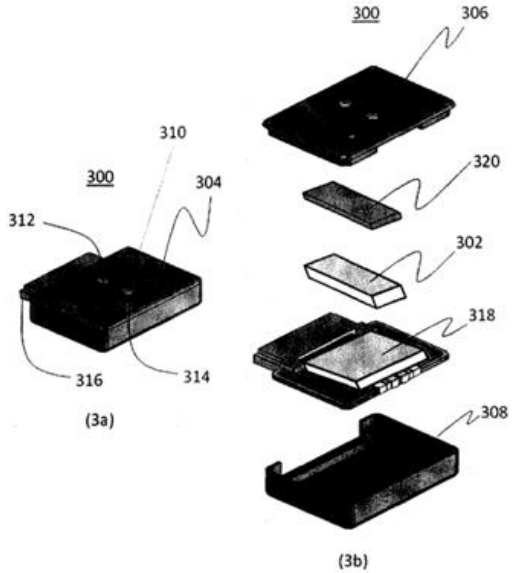
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	In accordance with an aspect of the present invention, there is provided an optical measurement device, the device comprising an illumination assembly configured to output light to a surface portion of a user for measurement; a detection assembly configured to detect the output light reflected from said surface portion of the user as a signal; an amplifier module coupled to the detection assembly configured to apply a gain to an alternating- current component of the signal; a microcontroller coupled to the detection assembly configured to assess a direct-current voltage level of the signal; wherein the microcontroller is configured to control the light output at the illumination assembly based on said assessing the direct-current voltage level; and further wherein the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. Kassim at 02:34-03:09 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used.Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33

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	 Figure 3 Kassim at Fig. 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Kassim discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;. Fig. 6(a) is a schematic graphical illustration of output obtained at a light detector (compare 408 of Fig. 4) during a light emitting diode (LED) firing sequence in an example embodiment. During an Ambient (Am) or OFF condition 602, both the IR and RED LEDs are turned off, and an ambient PPG signal 604 can be obtained. During a toggling sequence 606, the IR and RED LEDs are alternatingly turned on. The MCU can then perform time based de-multiplexing to extract the respective IR and RED PPG signals.

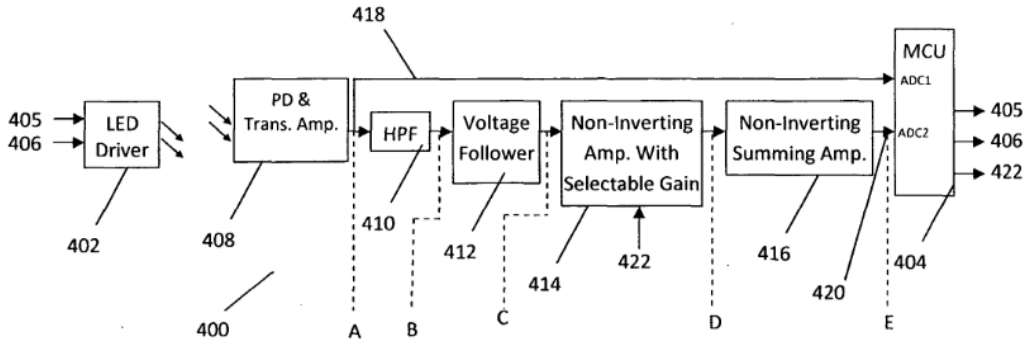
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	Kassim at 15:16-21  Figure 4(a)  Figure 4(b)  Figure 4(c) Kassim at Fig. 4(a),4(b) & 4(c)

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	 Figure 6(a) Kassim at Fig. 6(a) In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

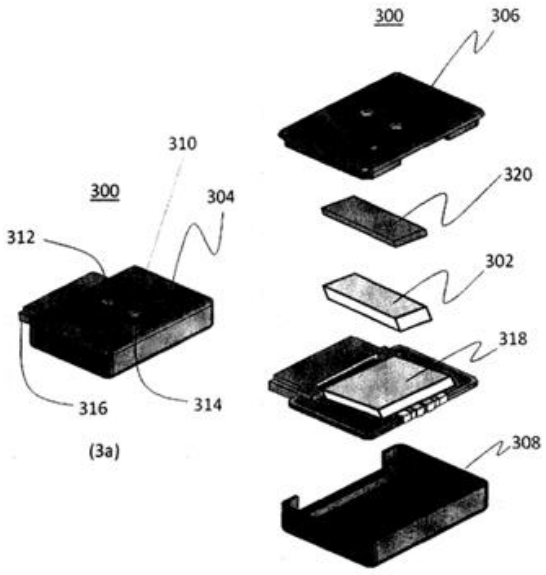
’475 Patent	Kassim
	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Kassim discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculations/measurements. Kassim at 08:24-28 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used. Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below

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	about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33  Figure 3 Kassim at Fig. 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Kassim discloses or renders obvious a detector. The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Fig. 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 11:34-12:10 Fig. 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Fig. 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Fig. 4(c) is a schematic block drawing illustrating a non-inverting amplifier with selectable gain in an example embodiment. An illumination assembly 402 is provided for propagating light through a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 404 (see control at numeral 405). In the example embodiment, the MCU 404 may also control the activation of the one or more light sources e.g. Red or IR LED, via the control at numeral 406. A detection assembly 408 is provided to detect light reflected/transmitted off the surface portion of the user. The detection assembly 408 can comprise a photodetector (PD) coupled to a transimpedance amplifier. The detection assembly 408 is coupled to a high-pass filter 410 that is in turn coupled to a voltage follower amplifier module 412. The high-pass filter 410 can be implemented using a capacitor and a resistor. The voltage follower amplifier module 412 is coupled to a non- inverting amplifier module 414 that can provide a selectable gain. As shown in Fig. 4(c), the gain is selectable

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	between a number of possible gain options, with the selection being controlled by the MCU 404 via the control signal 422. The non-inverting amplifier module 414 is coupled to a non-inverting summing amplifier module 416 that can provide a unity gain. Kassim at 13:14-33  Figure 4(a) It will be appreciated that in an ideal situation, e.g. with individual photodetectors and signal paths for all 3 conditions (IR, Red and Ambient), and perfectly noise free conditions, all peaks and troughs may in theory occur at the same points. In other words, t1 , t2 and t3 are the same when referring to the various conditions. In the present examples, because a single path is utilized, a peak sampled during the IR condition cannot be simultaneously measured for the R condition. As such, there are minor differences in peak and trough, e.g. t1 , t2 and t3, times. If sampling is on a basis of IR, Red and Ambient conditions i.e. one sample per condition, it can be expected that the peaks and troughs of the respective signals (IR, R and Ambient), e.g. at t1 , t2 and t3, may only be one sample off from each other. If the timings are too far off of each other (e.g. 2 or more samples apart), the particular set of samples can be rejected from the calculations if desired. Kassim at 26:18-28 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

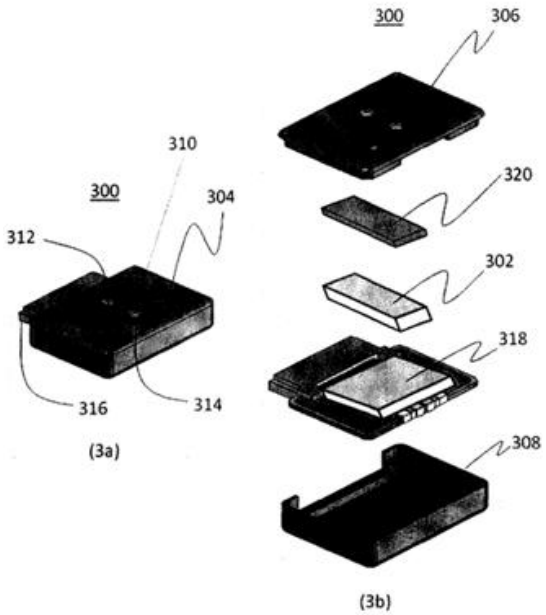
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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Kassim discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculations/measurements. Kassim at 08:24-28 The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Fig. 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 11:34-12:10

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	 Figure 3 Kassim at Fig. 3 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device

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	and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used. Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33 In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 In the example embodiment, the light sources are toggled on/off for the detection assembly to detect the reflected output light as a single signal. The processing or signal conditioning described can then be carried out in a single path processing approach. In the example embodiment, an amplitude difference between a maximum point and a minimum point of the single signal is maintained below a predetermined level by the microcontroller controlling the light output at the illumination assembly. In some example embodiments, the predetermined level can be about 100mV. The predetermined level is obtained based

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	on the alternating-current component of the signal being within a saturation level, upon the amplifier module applying the gain. Thus, for a gain of about 20 times in a coldfinger scenario, a difference of about 00mV becomes about 2V, compared to a saturation voltage level of e.g. about 3.3V. It will be appreciated that within each signal, there is an inherent AC component and this may be e.g. 10mV. Therefore, factoring a gain of 20 times, the amplified signals can have a span or a range of about 2.2V which is still within the 3.3V saturation range. This can ensure that the output from the circuitry is not saturated. Kassim at 20:33-21:11 It is appreciated that the detected light information or Vppg signal e.g. to be transmitted to a personal mobile processing device for further processing has a substantial extent of ambient light interference. Therefore, ambient light or noise cancellation can be performed e.g. at the personal mobile processing device. The description below relating to ambient noise cancellation for SP02 calculations can be implemented through software and/or hardware modules. The hardware modules can comprise electronic circuitry or dedicated application chips such as an ASIC chip. A graphical user interface (GUI) may be provided, such as an "app" or software application on a smartphone, to be run on the personal mobile processing device to implement and display the ambient noise cancellation. Kassim at 21:33-22:06 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms.

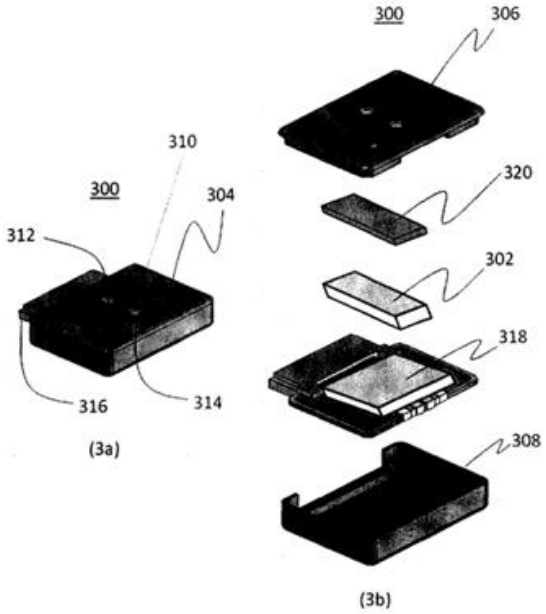
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	Kassim at 23:11-21 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Kassim discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculations/measurements. Kassim at 08:24-28 The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Fig. 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 11:34-12:10

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	 Figure 3 Kassim at Fig. 3 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device

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	and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used. Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33 In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 In the example embodiment, the light sources are toggled on/off for the detection assembly to detect the reflected output light as a single signal. The processing or signal conditioning described can then be carried out in a single path processing approach. In the example embodiment, an amplitude difference between a maximum point and a minimum point of the single signal is maintained below a predetermined level by the microcontroller controlling the light output at the illumination assembly. In some example embodiments, the predetermined level can be about 100mV. The predetermined level is obtained based

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	on the alternating-current component of the signal being within a saturation level, upon the amplifier module applying the gain. Thus, for a gain of about 20 times in a coldfinger scenario, a difference of about 00mV becomes about 2V, compared to a saturation voltage level of e.g. about 3.3V. It will be appreciated that within each signal, there is an inherent AC component and this may be e.g. 10mV. Therefore, factoring a gain of 20 times, the amplified signals can have a span or a range of about 2.2V which is still within the 3.3V saturation range. This can ensure that the output from the circuitry is not saturated. Kassim at 20:33-21:11 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21 It is appreciated that the detected light information or Vppg signal e.g. to be transmitted to a personal mobile processing device for further processing has a substantial extent of ambient light interference. Therefore, ambient light or noise cancellation can be performed e.g. at the personal mobile processing device. The description below relating to ambient noise cancellation for SP02 calculations can be implemented through software and/or hardware modules. The hardware modules can comprise electronic circuitry or dedicated application chips such as an ASIC chip. A graphical user interface (GUI) may be provided, such as an "app" or software application on a smartphone, to be run on the personal mobile processing device to implement and display the ambient noise cancellation Kassim at 21:33-22:06

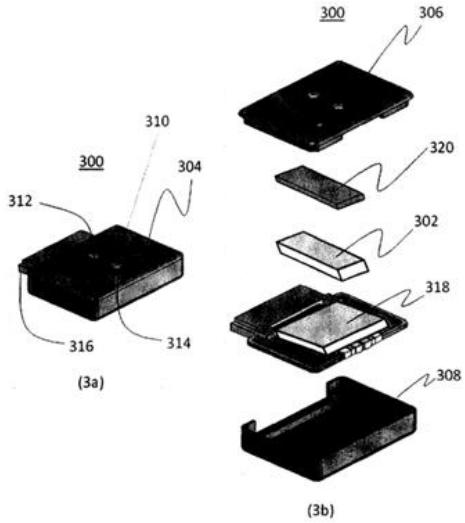
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	Kassim discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculations/measurements. Kassim at 08:24-28 The optical measurement device 300 is a reflectance-based device in the example embodiment. The optical measurement device 300 comprises an illumination and detection assembly 302 encased in a housing 304. In the exploded view in Fig. 3(b), the housing 304 is shown divided into a top casing 306 and a base casing 308. The top casing 306 comprises a measurement surface 310, shown schematically with dotted lines. The measurement site/surface 310 is coupled to a light source 312 and one or more light detectors e.g. 314 of the illumination and detection assembly 302. The optical measurement device 300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an interface port such as a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA) etc.

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	Kassim at 11:34-12:10  Figure 3 Kassim at Fig. 3 In the example embodiment, the light source 312 can propagate light through a surface portion of a user for measurement, e.g. a portion of living tissue of the user placed at the measurement site. The light detectors e.g. 314 can detect light reflected from the portion of living tissue of the user. The detected light information at the light detectors e.g. 314 can be transmitted via the coupling member 316 to a personal mobile processing device (not shown), for example, for further processing. Kassim at 12:20-25 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used,

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	for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used. Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33 In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 In the example embodiment, the light sources are toggled on/off for the detection assembly to detect the reflected output light as a single signal. The processing or signal conditioning described can then be carried out in a single path processing approach. In the example embodiment, an amplitude difference between a maximum point and a minimum point of the single signal is maintained below a predetermined level by the microcontroller controlling the light output at the illumination assembly. In some example

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	embodiments, the predetermined level can be about 100mV. The predetermined level is obtained based on the alternating-current component of the signal being within a saturation level, upon the amplifier module applying the gain. Thus, for a gain of about 20 times in a coldfinger scenario, a difference of about 00mV becomes about 2V, compared to a saturation voltage level of e.g. about 3.3V. It will be appreciated that within each signal, there is an inherent AC component and this may be e.g. 10mV. Therefore, factoring a gain of 20 times, the amplified signals can have a span or a range of about 2.2V which is still within the 3.3V saturation range. This can ensure that the output from the circuitry is not saturated. Kassim at 20:33-21:11 It is appreciated that the detected light information or Vppg signal e.g. to be transmitted to a personal mobile processing device for further processing has a substantial extent of ambient light interference. Therefore, ambient light or noise cancellation can be performed e.g. at the personal mobile processing device. The description below relating to ambient noise cancellation for SP02 calculations can be implemented through software and/or hardware modules. The hardware modules can comprise electronic circuitry or dedicated application chips such as an ASIC chip. A graphical user interface (GUI) may be provided, such as an "app" or software application on a smartphone, to be run on the personal mobile processing device to implement and display the ambient noise cancellation. Kassim at 21:33-22:06 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms.

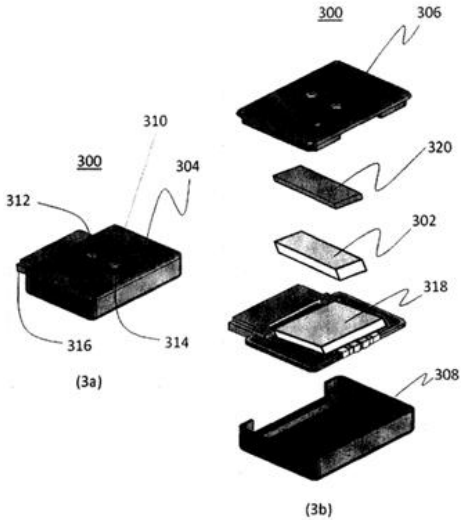
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	Kassim at 23:11-21 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.	Kassim discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user. In accordance with an aspect of the present invention, there is provided an optical measurement device, the device comprising an illumination assembly configured to output light to a surface portion of a user for measurement; a detection assembly configured to detect the output light reflected from said surface portion of the user as a signal; an amplifier module coupled to the detection assembly configured to apply a gain to an alternating- current component of the signal; a microcontroller coupled to the detection assembly configured to assess a direct-current voltage level of the signal; wherein the microcontroller is configured to control the light output at the illumination assembly based on said assessing the direct-current voltage level; and further wherein the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. Kassim at 02:34-03:09 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used.Fig. 3(c) is a diagram illustrating optical transmission characteristics of

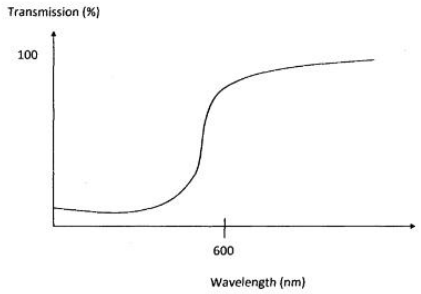
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	optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33  Figure 3 Kassim at Fig. 3 In the example embodiment, the light sources are toggled on/off for the detection assembly to detect the reflected output light as a single signal. The processing or signal conditioning described can then be carried out in a single path processing approach. In the example embodiment, an amplitude difference between a maximum point and a minimum point of the single signal is maintained below a predetermined level by the microcontroller controlling the light output at the illumination assembly. In some example embodiments, the predetermined level can be about 100mV. The predetermined level is obtained based

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	on the alternating-current component of the signal being within a saturation level, upon the amplifier module applying the gain. Thus, for a gain of about 20 times in a coldfinger scenario, a difference of about 00mV becomes about 2V, compared to a saturation voltage level of e.g. about 3.3V. It will be appreciated that within each signal, there is an inherent AC component and this may be e.g. 10mV. Therefore, factoring a gain of 20 times, the amplified signals can have a span or a range of about 2.2V which is still within the 3.3V saturation range. This can ensure that the output from the circuitry is not saturated. Kassim at 20:33-21:11 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	

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11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. Kassim discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 13:05-12 Thus, in the above described example embodiment, direct-current (DC) and alternating-current (AC) values of a first (e.g. red), second (e.g. IR) and third (e.g. ambient) signal waveforms can be obtained based on the respective maximum and minimum values. The DC and AC values of the third signal waveform can be average values obtained over a plurality of cycles and based on the maximum and minimum values of the third signal waveform. The ratio R can be determined based on using the DC and AC values of the first and second waveforms and the average values obtained from the third signal waveform; and wherein the ratio R is usable for referencing a lookup table. Kassim at 28:13-20 With the ratio R, Sp02 or the saturation of hemoglobin with oxygen (in blood) can be determined. That is, in some examples, the ratio R can be used to refer to a proprietary lookup table provided by a manufacturer to determine the corresponding Sp02 value. The lookup table can be stored in a database that is in turn loaded onto the personal mobile processing device and the lookup operation is automated. In example embodiments, optionally, it is possible to determine the quality of the signals so as to inform the user on the accuracy of, for example, a Sp02 measurement. The quality of a signal can be measured by a propagation error which takes in account the deviation of the 6 parameters used in the calculation of R. i.e. R = f{ACir , ACr , ACam , DCir , DCr , DCam)

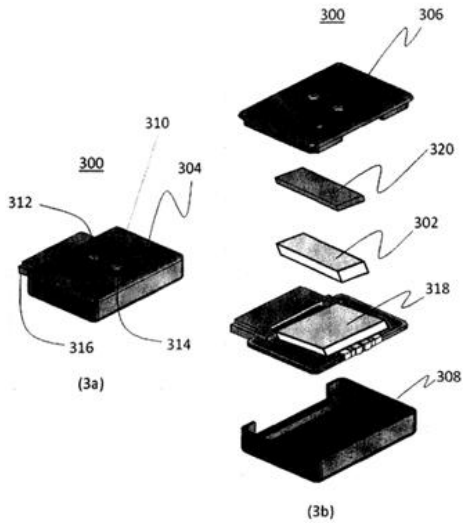
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	Kassim at 28:22-26 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. Kassim discloses or renders obvious the physiological parameter of the user is associated with a blood constituent or a blood flow of the user. The example embodiments described herein can provide an optical measurement device and method that can obtain a photoplethysmography (PPG) signal from a user in a low perfusion scenario. The measurements in the example embodiments are non-invasive optical physiological measurements. In the example embodiments, DC signals can be made available for saturation of peripheral oxygen (Sp02) calculations/measurements. Kassim at 08:24-28 In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpO2 values determination. Kassim at 08:30-34 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit

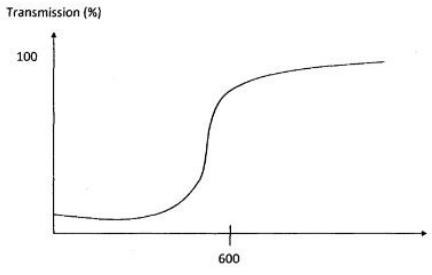
’475 Patent	Kassim
	to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used.Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33  Figure 3

’475 Patent	Kassim
	 Figure 3 (c) Kassim at Fig. 3. In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient light signals can be reduced as much as possible by tuning the intensities of the IR and Red LEDs to be maximized as long as the detection assembly has not reached saturation. In the example embodiment, the saturation voltage is based on the Vcc used and is about 3.3V. In the example embodiment, a detected output of about 2.5V is considered optimal as this can provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Thus, the inventors have recognized that ambient light interference can be minimized as compared to the IR and Red signals detected. Thus, in the example embodiment, detection of the ambient signal can be conducted in its own ambient detection period before or after the toggling sequence of the IR and Red light sources. Kassim at 16:27-35 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained

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	based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21 With the ratio R, Sp02 or the saturation of hemoglobin with oxygen (in blood) can be determined. That is, in some examples, the ratio R can be used to refer to a proprietary lookup table provided by a manufacturer to determine the corresponding Sp02 value. The lookup table can be stored in a database that is in turn loaded onto the personal mobile processing device and the lookup operation is automated. In example embodiments, optionally, it is possible to determine the quality of the signals so as to inform the user on the accuracy of, for example, a Sp02 measurement. The quality of a signal can be measured by a propagation error which takes in account the deviation of the 6 parameters used in the calculation of R. i.e. R = f{ACir , ACr , ACam , DCir , DCr , DCam) Kassim at 28:22-26 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the	See claim 8 above. Kassim discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency.

'475 Patent	Kassim
light source with a modulation frequency.	In accordance with an aspect of the present invention, there is provided an optical measurement device, the device comprising an illumination assembly configured to output light to a surface portion of a user for measurement; a detection assembly configured to detect the output light reflected from said surface portion of the user as a signal; an amplifier module coupled to the detection assembly configured to apply a gain to an alternating- current component of the signal; a microcontroller coupled to the detection assembly configured to assess a direct-current voltage level of the signal; wherein the microcontroller is configured to control the light output at the illumination assembly based on said assessing the direct-current voltage level; and further wherein the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. Kassim at 02:34-03:09 In an example implementation, an optical measurement device is used for illuminating a surface portion of the user and detecting reflected light from the surface portion. The measurement device can transmit the detected light information to another device, for e.g. a personal mobile processing device, to carry out further processing, e.g. for removal of ambient light interference for SpO2 values determination. Kassim at 08:30-34 In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not shown) an amount of pressure applied by a body part of a user to the measurement device 300 during optical measurement. The pressure information can be used, for example but not limited to, to detect whether a body part has been placed on the measurement device and/or whether the pressure exerted by a body part is sufficient for accurate readings to be obtained. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used.Fig. 3(c) is a diagram illustrating optical transmission characteristics of optical filtering in an example embodiment. In this example embodiment, wavelengths of light below about 600nm is filtered out and prevented from reaching the light detectors e.g. 314. This can be effective as the wavelengths of interest are that of e.g. about 600nm and about 940 nm only. Alternatively, filters which target specific wavelengths of interest can be used. For example, filters which, e.g. when used in

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	combination, allow transmission of light from about 600-700nm, and about 900-1 OOOnm can be used. Alternatively, a single filter which allow transmission of light from about 600-1 OOOnm can be used alone. Kassim at 12:27-33  Figure 3

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	 Figure 3 (c) Kassim at Fig. 3 In an example embodiment, there is a further super low perfusion scenario, where even with the above approach, it is determined that the obtained AC signal is too small to identify the respective peaks of the signal. In other words, the maximum and minimum points of the AC signal cannot be accurately obtained. In such a case, the gain is increased to about 30 times. Thus, in the example embodiment, there is a first process to determine if the scenario is a cold finger scenario, wherein lowering the intensity of both the Red and IR sources can allow for signals of a better quality or larger amplitude of e.g. 2.5V. Next, a selection is made between the gain settings of e.g. 20 or 30. As described above, if it is determined that the obtained AC signal is too small to effectively identify the maximum and minimum points of the AC signal, then the higher gain setting of e.g. 30 is chosen. Thus, in the above described example embodiments, a signal processing circuitry can be provided that comprises a photodetector coupled with a transimpedance amplifier, a high-pass filter, a voltage follower module, an non-inverting amplifier with selectable gain and a non-inverting summing amplifier with unity gain. The circuitry can provide feedback using a microcontroller to intensity controls of one or more light sources. The circuitry can handle processing in a single path approach based on detection of light information relating to toggling of light sources. The circuitry can also handle low perfusion scenarios by selecting an appropriate gain and controlling intensities of light sources. In addition, the circuitry can allow effective measurement of low perfused human tissue conditions while maintaining a low power usage.

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	Kassim at 19:24-20:11 A feedback unit/personal processing device can be provided for removal of ambient noise signal from an optical measurement in an example embodiment. The device can comprise a coupling member e.g. for coupling to an optical measurement device. The coupling member can receive a first signal waveform obtained based on detecting light based on a first light illumination, a second signal waveform obtained based on detecting light based on a second light illumination, and a third signal waveform obtained based on detecting ambient light. The device can also comprise a processor module that can obtain respective maximum and minimum values of at least two of the first, second and third signal waveforms; and the processor can derive signal values of the first and second signal waveforms with the removal of ambient noise by using the maximum and minimum values of at least two of the first, second and third signal waveforms. Kassim at 23:11-21 1. An optical measurement device, the device comprising, an illumination assembly configured to output light to a surface portion of a user for measurement; a detection assembly configured to detect the output light reflected from said surface portion of the user as a signal; an amplifier module coupled to the detection assembly configured to apply a gain to an alternating-current component of the signal; a microcontroller coupled to the detection assembly configured to assess a direct- current voltage level of the signal; wherein the microcontroller is configured to control the light output at the illumination assembly based on said assessing the direct-current voltage level; and further wherein the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. Kassim at Claim 1

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	2. The device as claimed in claim 1 , wherein the microcontroller is configured to determine that a measurement is a low perfusion measurement based on said assessing the direct-current voltage level, and wherein if there is a low perfusion measurement, the microcontroller controls the light output at the illumination assembly to a lower intensity than that producing the present direct-current voltage level and selects a large gain value as compared to normal measurements for said applying the gain. Kassim at Claim 2 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

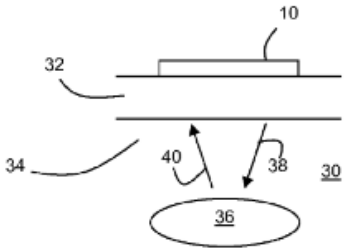
U.S. Pat. No. 12,268,475 in view of U.S. Patent No. 9,095,291 to Babs R. Soller ("Soller")

As described in detail below, Soller (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

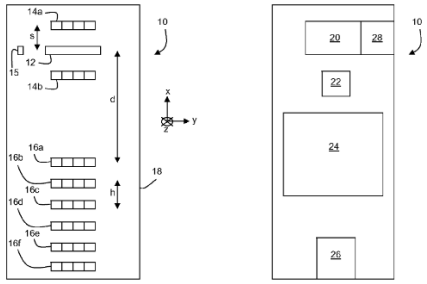
The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Soller. The cited portions of Soller are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Soller. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Soller "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Soller does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Soller (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Soller anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

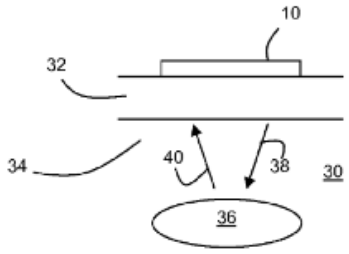
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

'475 Patent	Soller
Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Soller discloses or renders obvious An apparatus adapted to be worn by a user comprising. Disclosed herein are sensors that include: (a) a circuit board that includes an electronic processor; (b) a plurality of radiation sources, each source being attached to the circuit board; and (c) a spectral detector attached to the circuit board, the spectral detector being configured to analyze radiation derived from one or more of the plurality of radiation sources. **During use, the sensors are configured to be worn on a portion of a body of a subject**. The electronic processor is configured to cause two or more of the plurality of radiation sources to direct incident radiation to the subject, to cause the spectral detector to analyze radiation from the subject, and to determine one or more properties of the subject based on the radiation from the subject. Methods of making and using these sensors are also disclosed. Soller at [Abstract] **Disclosed herein are sensors and associated methods for determining properties of samples including, in particular, human subjects. The sensors are typically, but not exclusively, configured to measure near-infrared absorbance or reflectance spectra from the samples**, and to calculate one or more sample parameters based on the absorbance or reflectance spectra. The sensors are relatively small, and can include a circuit board upon which are mounted all sensor components. **As a result, the sensors are particularly amenable to prolonged wear by a human subject, even during periods of relatively high physical stress**. Soller at 13:11-21 FIG. 2 shows a schematic diagram of sensor 10 mounted on a sample 30. Sample 30 includes one or more layers of skin 32, a subcutaneous layer of fat 34, and underlying muscle tissue 36. Sensor 10 is configured to interrogate muscle tissue 36 by directing radiation 38, generated by at least one (e.g., all) of radiation sources l4a-b and at least one of the radiation sources l6a-f, to be incident on muscle tissue 36. Scattered radiation 40 is received and analyzed by detector 12 (not shown) to determine a spectrum of the scattered radiation. The scattered radiation spectrum is then processed by electronic processor 20 and/or processor 22 (not shown) to determine an absorbance spectrum of muscle tissue 36. Based on the absorbance spectrum, electronic processor 20 and/or 22 can determine one or more properties of sample 30 (and in particular, of muscle tissue 36 within sample 30).

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	Soller at 15:21-35  FIG. 2 Soller at Fig. 2 Sensor 10 can be configured to transmit and receive data over both wireless and wired communication interfaces to a variety of external devices. For example, data can be transmitted to external processing devices such as computers, personal digital assistants, cellular telephones and/or smartphones, and other dedicated processing devices. Data can also be transmitted to storage units, including flash drives, and magnetic and/or optical storage devices. Storage devices can also be portable storage devices that can be worn by a subject, for example (e.g., around the waist of a subject), or embedded in a subject's clothing (e.g., a chip-based storage device embedded in a shoe of the subject). Further, data can be transmitted to devices over one or more networks, including private networks, public networks, local and/or wide area networks, mobile telephone and/or data networks, and the internet. Soller at 27:46-61 Data can also be transmitted to one or more display devices that can be used by medical personnel, athletic trainers, **a subject wearing sensor 10,** and other personnel to observe the analyzed data. Typically, data which is transmitted to display devices includes one or more parameters derived from absorbance spectra of a sample. Data which is transmitted to net works and/or storage devices can include one or more calculated parameters and can also include, for example, measured absorbance spectra and sensor calibration and/or configuration information.

’475 Patent	Soller
	Soller at 27:62-28:4 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	Soller discloses or renders obvious one or more biosensors adapted to be placed on the user. Disclosed herein are sensors that include: (a) a circuit board that includes an electronic processor; (b) a plurality of radiation sources, each source being attached to the circuit board; and (c) a spectral detector attached to the circuit board, the spectral detector being configured to analyze radiation derived from one or more of the plurality of radiation sources. **During use, the sensors are configured to be worn on a portion of a body of a subject**. The electronic processor is configured to cause two or more of the plurality of radiation sources to direct incident radiation to the subject, to cause the spectral detector to analyze radiation from the subject, and to determine one or more properties of the subject based on the radiation from the subject. Methods of making and using these sensors are also disclosed. Soller at [Abstract] **Disclosed herein are sensors and associated methods for determining properties of samples including, in particular, human subjects. The sensors are typically, but not exclusively, configured to measure near-infrared absorbance or reflectance spectra from the samples, and to calculate one or more sample parameters based on the absorbance or reflectance spectra**. The sensors are relatively small, and can include a circuit board upon which are mounted all sensor components. As a result, the sensors are particularly amenable to prolonged wear by a human subject, even during periods of relatively high physical stress. Soller at 13:11-21 FIGS. lA and 1B are schematic diagrams showing bottom and top surfaces, respectively, of a sensor 10. Sensor 10 includes a spectral detector 12, two short-distance radiation sources 14a and 14b, and six long-distance radiation sources l6a, l6b, 16c, 16d, 16e, and 16/ Detector 12 and radiation sources 14a-band

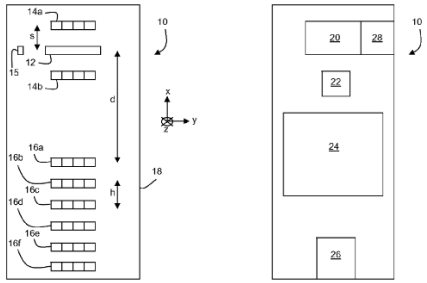
’475 Patent	Soller
	16a:f aremounted to circuit board 18. Each of short-distance radiation sources 14a and 14b can include one or more packages, and each package can include one or more elements that produce illumination radiation. Similarly, each oflong-distance radiation sources 16a:f can include one or more packages, and each package can include one or more elements that produce illumination radiation. Soller at 13:22-33  FIG. 1A FIG. 1B Soller at Fig. 1A & 1B FIG. 2 shows a schematic diagram of sensor 10 mounted on a sample 30. Sample 30 includes one or more layers of skin 32, a subcutaneous layer of fat 34, and underlying muscle tissue 36. Sensor 10 is configured to interrogate muscle tissue 36 by directing radiation 38, generated by at least one (e.g., all) of radiation sources l4a-b and at least one of the radiation sources l6a-f, to be incident on muscle tissue 36. Scattered radiation 40 is received and analyzed by detector 12 (not shown) to determine a spectrum of the scattered radiation. The scattered radiation spectrum is then processed by electronic processor 20 and/or processor 22 (not shown) to determine an absorbance spectrum of muscle tissue 36. Based on the absorbance spectrum, electronic processor 20 and/or 22 can determine one or more properties of sample 30 (and in particular, of muscle tissue 36 within sample 30). Soller at 15:21-35

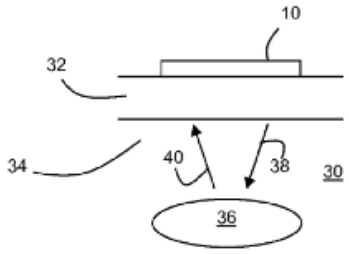
’475 Patent	Soller
	 FIG. 2 Soller at Fig. 2 In general, a variety of different collimating elements 56 can be used in sensor 10. Exemplary collimating elements include fiber faceplates (e.g., fiber optic windows), collimating hole devices, gradient index (GRIN) lenses, fiber bundles, lens arrays, optical windows (including shaped optical windows), and other similar devices. Sensor 10 typically includes a plurality of radiation sources. In some embodiments, some or all of the radiation sources include light emitting diodes (LEDs). Some (or all) of the radiation sources of sensor 10 can provide relatively broad bandwidth incident radiation for illuminating sample 30. To provide such radiation, the radiation sources can include one or more LEDs. For example, in certain embodiments, some radiation sources can include a single broadband LED. In some embodiments, certain radiation sources can include multiple LEDs. The multiple LEDs can each emit radiation having different central wavelengths and/or spectral bandwidths. In some embodiments, some of the multiple LEDs can emit radiation having the same central wavelength and/or bandwidth. Soller at 18:37-56 Sensor 10 can be configured to transmit and receive data over both wireless and wired communication interfaces to a variety of external devices. For example, data can be transmitted to external processing devices such as computers, personal digital assistants, cellular telephones and/or smartphones, and other dedicated processing devices. Data can also be transmitted to storage units, including flash drives, and magnetic and/or optical storage devices. Storage devices can also be portable storage devices that can be worn by a subject, for example (e.g., around the waist of a subject), or embedded in a subject's clothing (e.g., a chip-based storage device embedded in a shoe of the subject). Further, data can be transmitted to

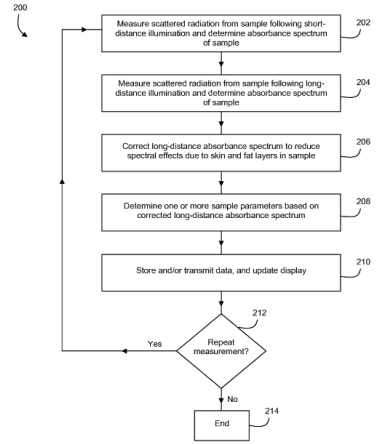
'475 Patent	Soller
	devices over one or more networks, including private networks, public networks, local and/or wide area networks, mobile telephone and/or data networks, and the internet. Soller at 27:46-61 Data can also be transmitted to one or more display devices that can be used by medical personnel, athletic trainers, a subject wearing sensor 10, and other personnel to observe the analyzed data. Typically, data which is transmitted to display devices includes one or more parameters derived from absorbance spectra of a sample. Data which is transmitted to net works and/or storage devices can include one or more calculated parameters and can also include, for example, measured absorbance spectra and sensor calibration and/or configuration information. Soller at 27:62-28:4 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	Soller discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. Disclosed herein are sensors that include: (a) a circuit board that includes an electronic processor; (b) a plurality of radiation sources, each source being attached to the circuit board; and (c) a spectral detector attached to the circuit board, the spectral detector being configured to analyze radiation derived from one or more of the plurality of radiation sources. **During use, the sensors are configured to be worn on a portion of a body of a subject. The electronic processor is configured to cause two or more of the plurality of radiation sources to direct incident radiation to the subject, to cause the spectral detector to analyze radiation from the subject, and to determine one or more properties of the subject based on the radiation from the subject**. Methods of making and using these sensors are also disclosed.

’475 Patent	Soller
	Soller at [Abstract] In general, **the scattered radiation spectrum measured by detector 12, which typically includes wavelength-dependent information about scattered radiation from sample 30, can be converted by an electronic processor to an absorbance spectrum of muscle tissue 36 using well-known methods**. Soller at 15:36-40 **In addition to converting scattered radiation information into absorbance and/or reflectance spectra, processor 20 and/or 22 can be configured (e.g., using calibration equations and/or data stored in memory units, magnetic storage units, and/or optical storage units) to analyze absorbance spectra to obtain measurements of physiologically important parameters for sample 30**. In general, processor 20 and/or 22 can be configured to perform any of the analysis steps that are discussed herein. Soller at 15:51-59 In general, a variety of different collimating elements 56 can be used in sensor 10. Exemplary collimating elements include fiber faceplates (e.g., fiber optic windows), collimating hole devices, gradient index (GRIN) lenses, fiber bundles, lens arrays, optical windows (including shaped optical windows), and other similar devices. Sensor 10 typically includes a plurality of radiation sources. In some embodiments, some or all of the radiation sources include light emitting diodes (LEDs). Some (or all) of the radiation sources of sensor 10 can provide relatively broad bandwidth incident radiation for illuminating sample 30. To provide such radiation, the radiation sources can include one or more LEDs. For example, in certain embodiments, some radiation sources can include a single broadband LED. In some embodiments, certain radiation sources can include multiple LEDs. The multiple LEDs can each emit radiation having different central wavelengths and/or spectral bandwidths. In some embodiments, some of the multiple LEDs can emit radiation having the same central wavelength and/or bandwidth. Soller at 18:37-56 When some or all of the radiation sources of sensor 10 include multiple radiation emitting elements, electronic processor 20 can be configured to adjust the radiation emitting elements to control the properties of the output radiation produced by the multiple elements. In particular, for example, when

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	certain radiation sources of sensor 10 include multiple LEDs, processor 20 can control the emitted radiation intensity from each of the individual LEDs to control the overall distribution of radiation produced by the sources. Control of the emitted radiation intensity can be achieved, for example, through a digital-to-analog converter (DAC) which converts a digital control signal from processor 20 and/or 22 into an analog control voltage applied to a given radiation source element. With a DAC of suitable resolution (e.g., 14-bit), relatively fine control over emission intensities of individual LEDs can be achieved, and continuous-wave emission can be implemented. Soller at 19:42-58 As another example, in some embodiments, the sensitivity of detector 12 to incident radiation can vary as a function of the wavelength of the radiation. Accordingly, the spectral profile of the illumination radiation can be selected to reduce or remove spectral features in measured scattered radiation spectra that arise from such variations in detector sensitivity. As above, selecting the spectral profile of the illumination radiation can include increasing and/or decreasing emitted radiation intensity from certain radiation emitters relative to other radiation emitters under the control of processor 20 and/or 22. As a further example, in some embodiments, the sample (e.g., sample 30) can include moieties that absorb incident radiation at one or more well-known wavelengths. To enhance a signal-to-noise ratio in measured scattered radiation (and even, to enable measurement of scattered radiation at the wavelengths of absorption), the emission intensities of certain radiation emitters can be increased and/or decreased relative to other radiation emitters. In particular, emission intensities of radiation emitters that emit radiation that falls within absorption bands can be increased relative to emission intensities of other emitters (or the intensities of the other emitters can be decreased relative to the emission intensities of the emitters that emit within the absorption bands). Soller at 20:35-58 Sensor 10 also includes a plurality of long-distance sources 16 a-f. In some embodiments, as shown in FIG. 1A, sensor 10 includes six long-distance sources 16 a-f. The depth to which incident radiation from a particular radiation source penetrates a sample and generates detected scattered radiation from a tissue of interest therein is generally related to a linear distance between the radiation source and the detector. Each of the long-distance sources of sensor 10 therefore generally corresponds to interrogation of the sample to a certain depth below the sample surface. Typically, an appropriate long-distance source is selected to illuminate muscle tissue 36 in sample 30 by selecting a long-distance source that produces

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	radiation that can penetrate through overlying layers to sufficiently illuminate muscle tissue 36 below the surface of sample 30 so that reflected light from the muscle can be adequately measured by detector 12. Sensor 10 can, in general, include any number of long-distance sources to enable measurement of tissues at a variety of depths below the surface of a sample. In certain embodiments, for example, sensor 10 can include one or more long-distance sources (e.g., two or more long-distance sources, three or more long-distance sources, four or more long-distance sources, five or more long-distance sources, seven or more long-distance sources, nine or more long-distance sources, or even more long-distance sources). All of the long-distance sources can be positioned at different distances measured along the x-direction from detector 12, as shown in FIG. 1A, or at least some of the sources can be positioned at the same distance from detector 12. Soller at 21:63-22:24  FIG. 1A FIG. 1B Soller at Fig. 1A & 1B As discussed previously, sensor 10 typically includes a plurality of long-distance radiation sources, each of which corresponds to interrogation of tissues (e.g., muscle tissue 36) at a different depth below a surface of sample 30. Prior to use, sensor 10 is typically calibrated (e.g., by performing a standardization check routine) relative to a standard, and then attached to a sample (such as a portion of a subject's body) and activated for use. Sensor 10 is typically configured, in an initial measurement step, to select an appropriate long-distance radiation source for sample illumination. Soller at 28:16-25

’475 Patent	Soller
	 FIG. 2 Soller at Fig. 2 **Following selection of a suitable long-distance radiation source (or sources), measurement of spectral data from the sample and calculation of one or more parameters from the spectral data can begin. FIG. 11 shows a flow chart 200 that includes a series of measurement steps**. In first step 202, the short-distance radiation sources are activated and a shortdistance absorbance spectrum of the sample is determined, as discussed in connection with step 106 of FIG. 10. Then, in step 204, the selected long-distance radiation source is activated and a long-distance absorbance spectrum of the sample is determined in a marmer similar to step 108 of FIG. 10. In step 206, the long-distance spectrum is corrected to reduce spectral effects due to skin and fat layers by orthogonalizing the long-distance spectral data against spectral components derived from the short-distance spectrum, in accordance with step 110 of FIG. 10. Soller at 36:47-63

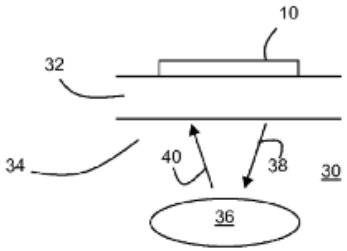
’475 Patent	Soller
	 FIG. 11 Soller at Fig. 11 **In step 208, one or more sample parameters are calculated by processor 20 based on the corrected long-distance spectral data**. **As discussed previously, calculated parameters can include one or more of oxygen saturation, oxygen tension, pH, hematocrit, hemoglobin concentration, anaerobic threshold, water content, and oxygen consumption of the sample**. The measured data and/or calculated parameters can be stored in one or more storage units and/or transmitted to one or more external devices or networks in step 210. If display 24 is present (or if another display is linked to sensor 10), the display can be updated with newly measured and/or calculated values. As discussed previously, trend informationincluding previously-measured values of the one or more parameters-can be displayed on display 24 for a user-selectable time window. Trend information can be updated on display 24 as additional values of the one or more parameters are measured by the sensor. Soller at 36:63-37:12 **Adjustments of one or more of signal acquisition time, electronic gain, and the selected long-distance source can also be used to compensate for changes in the sample during measurement of spectral data. For example, where the sample is tissue in a human subject, significant changes in blood flow and other physiological parameters can occur when the subject is exercising. Such changes can affect spectral measurements by either increasing or reducing the amount of scattered**

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	light measured by detector 12. The sensors disclosed herein can compensate for such changes by adjusting parameters such as signal acquisition time, electronic gain, and selected long-distance source to compensate for the effects of the changes. Soller at 39:06-18 In certain embodiments, the sensors can be used to monitor the condition of individuals engaged in dangerous and/or stressful activities. For example, the sensors can be used to monitor soldiers and/or astronauts. Hemorrhage is a major cause of soldier death. To help soldiers survive major injury, seriously injured soldiers should be quickly identified and appropriate resuscitation techniques applied. Significant blood loss leads to shock, which in turn produces inadequate organ perfusion and tissue oxygenation. Resuscitation from shock corrects the mismatch between available oxygen and oxygen demands of critical organs. Accordingly, rapid response to hemorrhage—including resuscitation from shock—within the first hour can prevent cardiovascular collapse and death. Traditional methods for assessing shock—including the measurement of parameters such as blood pressure, heart rate, urine output, and systemic measures of oxygen transport such as oxygen delivery and consumption, blood lactate, arterial pH, and base excess—may provide uncertain markers as to the onset and/or endpoint of shock and response to resuscitation. Measurements of the partial pressure of oxygen and/or oxygen saturation in peripheral muscle tissue are related to changes in central blood volume, as markers of the hemodynamic compensatory responses that shunt blood away from the skeletal muscles and internal organs (e.g., liver, stomach, intestines, kidney) to the heart and brain, preserving blood pressure. As such, these quantities can provide an indication of internal bleeding prior to the onset of shock (drop in blood pressure) and provide a more accurate and early indication of adequate resuscitation during hemorrhage. **The sensors disclosed herein can be used to provide real-time or near real-time measures of the partial pressure of oxygen and/or oxygen saturation in muscle tissue**, and can therefore be used for early identification of soldiers most at risk of developing hemorrhagic shock. If a reduction in muscle oxygenation is not rapidly reversed, the patient's muscle pH decreases. Resuscitation to restore normal muscle oxygen without restoring normal levels of muscle pH can lead to poor patient outcomes. **As such, the sensors disclosed herein permit continuous monitoring of muscle oxygen saturation/partial pressure, and/or pH, and data transmitted from sensors to control centers can be used, e.g., to alert support personnel to the need for medical attention when injuries are sustained. The sensors disclosed herein can, in some embodiments, be incorporated into clothing worn by soldiers and/or astronauts, making monitoring of these individuals even more unobtrusive**. When resuscitation occurs, the sensors can be used to monitor

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	muscle oxygen saturation/partial pressure and/or pH to direct the resuscitation therapy, in some cases by providing input into electronic controllers on therapeutic devices, thereby improving patient outcomes. Therapeutic devices that can receive input information and/or control signals from the sensors disclosed herein include, for example, infusion pumps (e.g., to deliver one or more drugs and/or fluids such as blood or saline solution), ventilators, and other devices configured to deliver fluids to a patient and/or monitor a patient's condition. Soller at 40:64-41:53 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	Soller discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. The sensors can include radiation sources at different source-detector distances. In particular, the sensors can include **multiple long-distance sources, each of which can illuminate a sample**, and following which illumination scattered radiation from the sample can be measured. Scattered radiation spectra derived from long-distance source illumination of the sample typically include spectral contributions from both muscle tissues within the sample, and from layers of skin and/or fat positioned between the sensor and the muscle tissues. Absorbance spectra can be generated from the scattered radiation spectra by comparing the scattered radiation spectra to incident radiation spectra from the long-distance sources. Soller at 1:58-2:03 Disclosed herein are sensors and associated methods for determining properties of samples including, in particular, human subjects. The sensors are typically, but not exclusively, configured to measure near-infrared absorbance or reflectance spectra from the samples, and to calculate one or more sample parameters based on the absorbance or reflectance spectra. The sensors are relatively small, and can include a circuit board upon which are mounted all sensor components. As a result, the sensors are

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	particularly amenable to prolonged wear by a human subject, even during periods of relatively high physical stress. Soller at 13:11-21 **Sensor 10 typically includes a plurality of radiation sources. In some embodiments, some or all of the radiation sources include light emitting diodes (LEDs**). Some (or all) of the radiation sources of sensor 10 can provide relatively broad bandwidth incident radiation for illuminating sample 30. To provide such radiation, the radiation sources can include one or more LEDs. For example, in certain embodiments, some radiation sources can include a single broadband LED. **In some embodiments, certain radiation sources can include multiple LEDs. The multiple LEDs can each emit radiation having different central wavelengths and/or spectral bandwidths. In some embodiments, some of the multiple LEDs can emit radiation having the same central wavelength and/or bandwidth**. Soller at 18:43-56 **Typically, for example, each radiation source of sensor 10 emits radiation that includes multiple radiation wavelengths**. In some embodiments, a FWHM spectral bandwidth of the emitted radiation from each source is 10 nm or more (e.g., 15 nm or more, 20 nm or more, 50 nm or more, 100 nm or more, 200 nm or more, 300 nm or more, 400 nm or more, 500 nm or more, 700 nm or more). The usable range of the radiation emitted by each source can be determined by a transmission range of detector 12. In certain embodiments, for example, detector 12 includes a LVF with a transmission range of from 600 nm to 1100 nm. The usable range of the emitted radiation can also depend, in some embodiments, on the spectral response of a detector coupled to the wavelength dispersive element in detector 12. For example, photodiode arrays, CCD arrays, and CMOS arrays that are formed of silicon typically have a usable spectral response that reaches an upper limit at about 1100 nm. Detectors formed of other materials can be used to measure sample responses at even longer wavelengths. Soller at 20:59-21:10 Data can also be transmitted to one or more display devices that can be used by medical personnel, athletic trainers, a subject wearing sensor 10, and other personnel to observe the analyzed data. Typically, data which is transmitted to display devices includes one or more parameters derived from absorbance spectra of a sample. Data which is transmitted to net works and/or storage devices can include one or

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	more calculated parameters and can also include, for example, measured absorbance spectra and sensor calibration and/or configuration information. Soller at 27:62-28:4 The rabbit spectra were obtained directly from muscle tissue, while in this study, the muscle spectra were obtained by illuminating the muscle tissue through layers of skin and fat, and correcting the measured spectra to reduce or eliminate contributions from the skin and fat layers prior to model development. This further suggests that the sensors disclosed herein can be used to obtain accurate estimates of a wide variety of physiological parameters, including parameters that are relatively sensitive to the optical arrangement used to measure the reflectance spectra. Soller at 55:12-21 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	Soller discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin. **FIG. 2 shows a schematic diagram of sensor 10 mounted on a sample 30. Sample 30 includes one or more layers of skin 32, a subcutaneous layer of fat 34, and underlying muscle tissue 36. Sensor 10 is configured to interrogate muscle tissue 36 by directing radiation 38, generated by at least one (e.g., all) of radiation sources l4a-b and at least one of the radiation sources l6a-f, to be incident on muscle tissue 36**. Scattered radiation 40 is received and analyzed by detector 12 (not shown) to determine a spectrum of the scattered radiation. The scattered radiation spectrum is then processed by electronic processor 20 and/or processor 22 (not shown) to determine an absorbance spectrum of muscle tissue 36. Based on the absorbance spectrum, electronic processor 20 and/or 22 can determine one or more properties of sample 30 (and in particular, of muscle tissue 36 within sample 30).

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	Soller at 15:21-35  FIG. 2 Soller at Fig. 2 In general, a variety of different collimating elements 56 can be used in sensor 10. **Exemplary collimating elements include fiber faceplates (e.g., fiber optic windows), collimating hole devices, gradient index (GRIN) lenses, fiber bundles, lens arrays, optical windows (including shaped optical windows), and other similar devices**. Sensor 10 typically includes a plurality of radiation sources. **In some embodiments, some or all of the radiation sources include light emitting diodes (LEDs). Some (or all) of the radiation sources of sensor 10 can provide relatively broad bandwidth incident radiation for illuminating sample 30**. To provide such radiation, the radiation sources can include one or more LEDs. For example, in certain embodiments, some radiation sources can include a single broadband LED. In some embodiments, certain radiation sources can include multiple LEDs. The multiple LEDs can each emit radiation having different central wavelengths and/or spectral bandwidths. In some embodiments, some of the multiple LEDs can emit radiation having the same central wavelength and/or bandwidth. Soller at 18:37-56 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	Soller discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. In general, a variety of different collimating elements 56 can be used in sensor 10. **Exemplary collimating elements include fiber faceplates (e.g., fiber optic windows), collimating hole devices, gradient index (GRIN) lenses, fiber bundles, lens arrays, optical windows (including shaped optical windows), and other similar devices**. Sensor 10 typically includes a plurality of radiation sources. In some embodiments, some or all of the radiation sources include light emitting diodes (LEDs). Some (or all) of the radiation sources of sensor 10 can provide relatively broad bandwidth incident radiation for illuminating sample 30. To provide such radiation, the radiation sources can include one or more LEDs. For example, in certain embodiments, some radiation sources can include a single broadband LED. In some embodiments, certain radiation sources can include multiple LEDs. The multiple LEDs can each emit radiation having different central wavelengths and/or spectral bandwidths. In some embodiments, some of the multiple LEDs can emit radiation having the same central wavelength and/or bandwidth. Soller at 18:37-56 The number and positions of detectors in FIG. 34 can generally be selected as desired. **Any number of detectors can be positioned on the bottom surface of sensor 10, in analogous fashion to the placement of radiation sources in the 15 embodiments shown in FIGS. 31-33. Detectors 23a-f can generally have a wide variety of shapes, including circular, annular, rectangular, square, and other regular and/or irregular shapes.** The numbers, positions, and shapes of detectors 23a-f are chosen to be consistent with the functionality of sensor 10 disclosed herein.Soller at 40:11-20 **When some or all of the radiation sources of sensor 10 include multiple radiation emitting elements, electronic processor 20 can be configured to adjust the radiation emitting elements to control the properties of the output radiation produced by the multiple elements**. In particular, for example, when certain radiation sources of sensor 10 include multiple LEDs, **processor 20 can control the emitted radiation intensity from each of the individual LEDs to control the overall distribution of radiation produced by the sources**. Control of the emitted radiation intensity can be achieved, for example, through a digital-to-analog converter (DAC) which converts a digital control signal from processor 20 and/or 22 into an analog control voltage applied to a given radiation source element. With

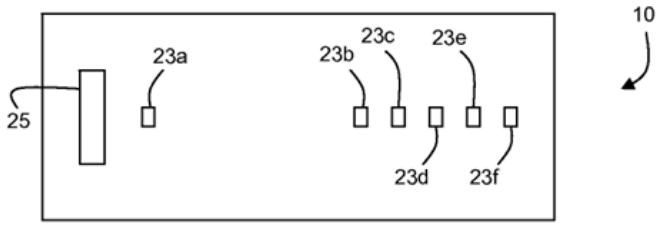
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	a DAC of suitable resolution (e.g., 14-bit), relatively fine control over emission intensities of individual LEDs can be achieved, and continuous-wave emission can be implemented. Soller at 19:42-58 As another example, in some embodiments, **the sensitivity of detector 12 to incident radiation can vary as a function of the wavelength of the radiation**. Accordingly, **the spectral profile of the illumination radiation can be selected to reduce or remove spectral features in measured scattered radiation spectra that arise from such variations in detector sensitivity**. As above, **selecting the spectral profile of the illumination radiation can include increasing and/or decreasing emitted radiation intensity from certain radiation emitters relative to other radiation emitters under the control of processor 20 and/or 22**. Soller at 20:35-45 As a further example, in some embodiments, the sample (e.g., sample 30) can include moieties that absorb incident radiation at one or more well-known wavelengths. **To enhance a signal-to-noise ratio in measured scattered radiation (and even, to enable measurement of scattered radiation at the wavelengths of absorption), the emission intensities of certain radiation emitters can be increased and/or decreased relative to other radiation emitters**. In particular, emission intensities of radiation emitters that emit radiation that falls within absorption bands can be increased relative to emission intensities of other emitters (or the intensities of the other emitters can be decreased relative to the emission intensities of the emitters that emit within the absorption bands). Soller at 20:46-58 Sensor 10 also includes a plurality of long-distance sources 16 a-f. In some embodiments, as shown in FIG. 1A, sensor 10 includes six long-distance sources 16 a-f. The depth to which incident radiation from a particular radiation source penetrates a sample and generates detected scattered radiation from a tissue of interest therein is generally related to a linear distance between the radiation source and the detector. Each of the long-distance sources of sensor 10 therefore generally corresponds to interrogation of the sample to a certain depth below the sample surface. Typically, **an appropriate long-distance source is selected to illuminate muscle tissue 36 in sample 30 by selecting a long-distance source that produces radiation that can penetrate through overlying layers to sufficiently illuminate muscle tissue 36 below the surface of sample 30 so that reflected light from the muscle can be adequately**

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	measured by detector 12. Sensor 10 can, in general, include any number of long-distance sources to enable measurement of tissues at a variety of depths below the surface of a sample. In certain embodiments, for example, sensor 10 can include one or more long-distance sources (e.g., two or more long-distance sources, three or more long-distance sources, four or more long-distance sources, five or more long-distance sources, seven or more long-distance sources, nine or more long-distance sources, or even more long-distance sources). All of the long-distance sources can be positioned at different distances measured along the x-direction from detector 12, as shown in FIG. 1A, or at least some of the sources can be positioned at the same distance from detector 12. Soller at 21:63-22:24 As discussed previously, sensor 10 typically includes a plurality of long-distance radiation sources, each of which corresponds to interrogation of tissues (e.g., muscle tissue 36) at a different depth below a surface of sample 30. Prior to use, sensor 10 is typically calibrated (e.g., by performing a standardization check routine) relative to a standard, and then attached to a sample (such as a portion of a subject's body) and activated for use. Sensor 10 is typically configured, in an initial measurement step, to select an appropriate long-distance radiation source for sample illumination. Soller at 28:16-25 The number and positions of detectors in FIG. 34 can generally be selected as desired. Any number of detectors can be positioned on the bottom surface of sensor 10, in analogous fashion to the placement of radiation sources in the 15 embodiments shown in FIGS. 31-33. Detectors 23a-f can generally have a wide variety of shapes, including circular, annular, rectangular, square, and other regular and/or irregular shapes. The numbers, positions, and shapes of detectors 23a-f are chosen to be consistent with the functionality of sensor 10 disclosed herein. Soller at 40:11-20 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Soller discloses or renders obvious, the detection system is configured to be synchronized to the light source. In general, a variety of different collimating elements 56 can be used in sensor 10. **Exemplary collimating elements include fiber faceplates (e.g., fiber optic windows), collimating hole devices, gradient index (GRIN) lenses, fiber bundles, lens arrays, optical windows (including shaped optical windows), and other similar devices**. Sensor 10 typically includes a plurality of radiation sources. In some embodiments, some or all of the radiation sources include light emitting diodes (LEDs). Some (or all) of the radiation sources of sensor 10 can provide relatively broad bandwidth incident radiation for illuminating sample 30. To provide such radiation, the radiation sources can include one or more LEDs. For example, in certain embodiments, some radiation sources can include a single broadband LED. In some embodiments, certain radiation sources can include multiple LEDs. The multiple LEDs can each emit radiation having different central wavelengths and/or spectral bandwidths. In some embodiments, some of the multiple LEDs can emit radiation having the same central wavelength and/or bandwidth. Soller at 18:37-56 The number and positions of detectors in FIG. 34 can generally be selected as desired. **Any number of detectors can be positioned on the bottom surface of sensor 10, in analogous fashion to the placement of radiation sources in the 15 embodiments shown in FIGS. 31-33. Detectors 23a-f can generally have a wide variety of shapes, including circular, annular, rectangular, square, and other regular and/or irregular shapes.** The numbers, positions, and shapes of detectors 23a-f are chosen to be consistent with the functionality of sensor 10 disclosed herein.Soller at 40:11-20 **When some or all of the radiation sources of sensor 10 include multiple radiation emitting elements, electronic processor 20 can be configured to adjust the radiation emitting elements to control the properties of the output radiation produced by the multiple elements**. In particular, for example, when certain radiation sources of sensor 10 include multiple LEDs, **processor 20 can control the emitted radiation intensity from each of the individual LEDs to control the overall distribution of radiation produced by the sources**. Control of the emitted radiation intensity can be achieved, for example, through a digital-to-analog converter (DAC) which converts a digital control signal from processor 20 and/or 22 into an analog control voltage applied to a given radiation source element. With

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	a DAC of suitable resolution (e.g., 14-bit), relatively fine control over emission intensities of individual LEDs can be achieved, and continuous-wave emission can be implemented. Soller at 19:42-58 As another example, in some embodiments, **the sensitivity of detector 12 to incident radiation can vary as a function of the wavelength of the radiation**. Accordingly, **the spectral profile of the illumination radiation can be selected to reduce or remove spectral features in measured scattered radiation spectra that arise from such variations in detector sensitivity**. As above, **selecting the spectral profile of the illumination radiation can include increasing and/or decreasing emitted radiation intensity from certain radiation emitters relative to other radiation emitters under the control of processor 20 and/or 22**. Soller at 20:35-45 As a further example, in some embodiments, the sample (e.g., sample 30) can include moieties that absorb incident radiation at one or more well-known wavelengths. **To enhance a signal-to-noise ratio in measured scattered radiation (and even, to enable measurement of scattered radiation at the wavelengths of absorption), the emission intensities of certain radiation emitters can be increased and/or decreased relative to other radiation emitters**. In particular, emission intensities of radiation emitters that emit radiation that falls within absorption bands can be increased relative to emission intensities of other emitters (or the intensities of the other emitters can be decreased relative to the emission intensities of the emitters that emit within the absorption bands). Soller at 20:46-58 Sensor 10 also includes a plurality of long-distance sources 16 a-f. In some embodiments, as shown in FIG. 1A, sensor 10 includes six long-distance sources 16 a-f. The depth to which incident radiation from a particular radiation source penetrates a sample and generates detected scattered radiation from a tissue of interest therein is generally related to a linear distance between the radiation source and the detector. Each of the long-distance sources of sensor 10 therefore generally corresponds to interrogation of the sample to a certain depth below the sample surface. Typically, **an appropriate long-distance source is selected to illuminate muscle tissue 36 in sample 30 by selecting a long-distance source that produces radiation that can penetrate through overlying layers to sufficiently illuminate muscle tissue 36 below the surface of sample 30 so that reflected light from the muscle can be adequately**

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	measured by detector 12. Sensor 10 can, in general, include any number of long-distance sources to enable measurement of tissues at a variety of depths below the surface of a sample. In certain embodiments, for example, sensor 10 can include one or more long-distance sources (e.g., two or more long-distance sources, three or more long-distance sources, four or more long-distance sources, five or more long-distance sources, seven or more long-distance sources, nine or more long-distance sources, or even more long-distance sources). All of the long-distance sources can be positioned at different distances measured along the x-direction from detector 12, as shown in FIG. 1A, or at least some of the sources can be positioned at the same distance from detector 12. Soller at 21:63-22:24 As discussed previously, **sensor 10 typically includes a plurality of long-distance radiation sources, each of which corresponds to interrogation of tissues (e.g., muscle tissue 36) at a different depth below a surface of sample 30**. Prior to use, sensor 10 is typically calibrated (e.g., by performing a standardization check routine) relative to a standard, and then attached to a sample (such as a portion of a subject's body) and activated for use. Sensor 10 is typically configured, in an initial measurement step, to select an appropriate long-distance radiation source for sample illumination. Soller at 28:16-25 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	Soller discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. In a further aspect, the invention features sensors that include: (a) a circuit board including at least one electronic processor; (b) a radiation source attached to the circuit board; (c) and a plurality of spectral detectors attached to the circuit board, each spectral detector being configured to analyze radiation derived from the radiation source. The electronic processor(s) can be configured to cause the radiation

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	source to direct incident radiation to a sample, to cause two or more of the plurality of spectral detectors to analyze radiation scattered from the sample, and to determine one or more properties of the sample based on the scattered radiation. Soller at 3:16-27  FIG. 34 Soller at Fig. 34 In general, **the scattered radiation spectrum measured by detector 12, which typically includes wavelength-dependent information about scattered radiation from sample 30, can be converted by an electronic processor to an absorbance spectrum of muscle tissue 36 using well-known methods**. Soller at 15:36-40 When some or all of the radiation sources of sensor 10 include multiple radiation emitting elements, electronic processor 20 can be configured to adjust the radiation emitting elements to control the properties of the output radiation produced by the multiple elements. In particular, for example, when certain radiation sources of sensor 10 include multiple LEDs, processor 20 can control the emitted radiation intensity from each of the individual LEDs to control the overall distribution of radiation produced by the sources. Control of the emitted radiation intensity can be achieved, for example, through a digital-to-analog converter (DAC) which converts a digital control signal from processor 20 and/or 22 into an analog control voltage applied to a given radiation source element. With a DAC of suitable resolution (e.g., 14-bit), relatively fine control over emission intensities of individual LEDs can be achieved, and continuous-wave emission can be implemented. Soller at 19:42-58

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	The number and positions of detectors in FIG. 34 can generally be selected as desired. **Any number of detectors can be positioned on the bottom surface of sensor 10, in analogous fashion to the placement of radiation sources in the 15 embodiments shown in FIGS. 31-33. Detectors 23a-f can generally have a wide variety of shapes, including circular, annular, rectangular, square, and other regular and/or irregular shapes**. The numbers, positions, and shapes of detectors 23a-f are chosen to be consistent with the functionality of sensor 10 disclosed herein. Soller at 40:11-20 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	Soller discloses or renders obvious the output signal is indicative of the one or more physiological parameters. In general, **the scattered radiation spectrum measured by detector 12, which typically includes wavelength-dependent information about scattered radiation from sample 30, can be converted by an electronic processor to an absorbance spectrum of muscle tissue 36 using well-known methods**. Soller at 15:36-40 In addition to converting scattered radiation information into absorbance and/or reflectance spectra, **processor 20 and/or 22 can be configured (e.g., using calibration equations and/or data stored in memory units, magnetic storage units, and/or optical storage units) to analyze absorbance spectra to obtain measurements of physiologically important parameters for sample 30. In general, processor 20 and/or 22 can be configured to perform any of the analysis steps** that are discussed herein. Soller at 15:51-59

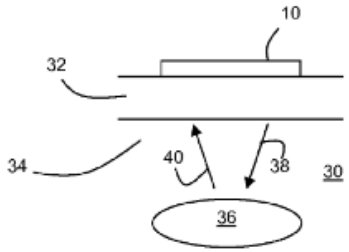
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	Following selection of a suitable long-distance radiation source (or sources), measurement of spectral data from the sample and calculation of one or more parameters from the spectral data can begin. **FIG. 11 shows a flow chart 200 that includes a series of measurement steps. In first step 202, the short-distance radiation sources are activated and a shortdistance absorbance spectrum of the sample is determined, as discussed in connection with step 106 of FIG. 10. Then, in step 204, the selected long-distance radiation source is activated and a long-distance absorbance spectrum of the sample is determined in a marmer similar to step 108 of FIG. 10. In step 206, the long-distance spectrum is corrected to reduce spectral effects due to skin and fat layers by orthogonalizing the long-distance spectral data against spectral components derived from the short-distance spectrum, in accordance with step 110 of FIG. 10**. Soller at 36:47-63 In step 208, one or more sample parameters are calculated by processor 20 based on the corrected long-distance spectral data. As discussed previously, **calculated parameters can include one or more of oxygen saturation, oxygen tension, pH, hematocrit, hemoglobin concentration, anaerobic threshold, water content, and oxygen consumption of the sample**. The measured data and/or calculated parameters can be stored in one or more storage units and/or transmitted to one or more external devices or networks in step 210. If display 24 is present (or if another display is linked to sensor 10), the display can be updated with newly measured and/or calculated values. As discussed previously, trend informationincluding previously-measured values of the one or more parameters-can be displayed on display 24 for a user-selectable time window. Trend information can be updated on display 24 as additional values of the one or more parameters are measured by the sensor. Soller at 36:63-37:12 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Soller discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. As a further example, in some embodiments, **the sample (e.g., sample 30) can include moieties that absorb incident radiation at one or more well-known wavelengths. To enhance a signal-to-noise ratio in measured scattered radiation (and even, to enable measurement of scattered radiation at the wavelengths of absorption), the emission intensities of certain radiation emitters can be increased and/or decreased relative to other radiation emitters. In particular, emission intensities of radiation emitters that emit radiation that falls within absorption bands can be increased relative to emission intensities of other emitters (or the intensities of the other emitters can be decreased relative to the emission intensities of the emitters that emit within the absorption bands)**. Soller at 20:46-58 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Soller discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,. Alternatively, in some embodiments, direct digital control of individual LEDs can be achieved via pulse width modulation (PWM) of the LEDs by processor 20 and/or 22. **Pulse width modulation provides a modulated (e.g., pulsed) LED output. Under PWM control, the integrated intensity of LED output over a selected temporal window is controlled, from a maximum value (always on) to zero (always off), as defined by the duty cycle of the modulated signal**. Emission intensities between these limits are realized by high frequency pulsing of the LEDs by processor 20 and/or 22. By controlling the rate at which pulses are emitted by the LEDs, the duty cycle of the LEDs can be adjusted. For example, to reduce the emission intensity of a particular LED from its maximum value to a half-maximum value, the duty cycle of the LED is reduced to 50%.

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	Soller at 19:59-20:06 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Soller discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. Alternatively, in some embodiments, direct digital control of individual LEDs can be achieved via pulse width modulation (PWM) of the LEDs by processor 20 and/or 22. **Pulse width modulation provides a modulated (e.g., pulsed) LED output. Under PWM control, the integrated intensity of LED output over a selected temporal window is controlled, from a maximum value (always on) to zero (always off), as defined by the duty cycle of the modulated signal**. Emission intensities between these limits are realized by high frequency pulsing of the LEDs by processor 20 and/or 22. By controlling the rate at which pulses are emitted by the LEDs, the duty cycle of the LEDs can be adjusted. For example, to reduce the emission intensity of a particular LED from its maximum value to a half-maximum value, the duty cycle of the LED is reduced to 50%. Soller at 19:59-20:06 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Soller discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal.

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	Alternatively, in some embodiments, direct digital control of individual LEDs can be achieved via pulse width modulation (PWM) of the LEDs by processor 20 and/or 22. Pulse width modulation provides a modulated (e.g., pulsed) LED output. Under PWM control, the integrated intensity of LED output over a selected temporal window is controlled, from a maximum value (always on) to zero (always off), as defined by the duty cycle of the modulated signal. Emission intensities between these limits are realized by high frequency puls ing of the LEDs by processor 20 and/or 22. **By controlling the rate at which pulses are emitted by the LEDs, the duty cycle of the LEDs can be adjusted**. For example, to reduce the emission intensity of a particular LED from its maximum value to a half-maximum value, the duty cycle of the LED is reduced to 50%. Soller at 19:59-20:06 As another example, in some embodiments, **the sensitivity of detector 12 to incident radiation can vary as a function of the wavelength of the radiation. Accordingly, the spectral profile of the illumination radiation can be selected to reduce or remove spectral features in measured scattered radiation spectra that arise from such variations in detector sensitivity. As above, selecting the spectral profile of the illumination radiation can include increasing and/or decreasing emitted radiation intensity from certain radiation emitters relative to other radiation emitters under the control of processor 20 and/or 22**. As a further example, **in some embodiments, the sample (e.g., sample 30) can include moieties that absorb incident radiation at one or more well-known wavelengths. To enhance a signal-to-noise ratio in measured scattered radiation (and even, to enable measurement of scattered radiation at the wavelengths of absorption), the emission intensities of certain radiation emitters can be increased and/or decreased relative to other radiation emitters**. In particular, emission intensities of radiation emitters that emit radiation that falls within absorption bands can be increased relative to emission intensities of other emitters (or the intensities of the other emitters can be decreased relative to the emission intensities of the emitters that emit within the absorption bands). Soller at 20:35-58 The measured reflected radiation intensity values are then compared to reference intensity values for each radiation source that are stored, for example, in applications processor 22. The reference intensity values can correspond to values that were measured at the time of manufacture of sensor 10. If the integrated radiation intensity and/or the wavelength-dependent intensity of any of the radiation sources

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	have changed, correction factors can be calculated and stored for use during later processing of measured data derived from illumination of a sample with radiation from the sources with changed emission properties. Soller at 28:42-52 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Soller discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. Disclosed herein are sensors that include: (a) a circuit board that includes an electronic processor; (b) a plurality of radiation sources, each source being attached to the circuit board; and (c) a spectral detector attached to the circuit board, the spectral detector being configured to analyze radiation derived from one or more of the plurality of radiation sources. During use, the sensors are configured to be worn on a portion of a body of a subject. **The electronic processor is configured to cause two or more of the plurality of radiation sources to direct incident radiation to the subject, to cause the spectral detector to analyze radiation from the subject, and to determine one or more properties of the subject based on the radiation from the subject**. Methods of making and using these sensors are also disclosed. Soller at [Abstract] Disclosed herein are sensors and associated methods for determining properties of samples including, in particular, human subjects. **The sensors are typically, but not exclusively, configured to measure near-infrared absorbance or reflectance spectra from the samples, and to calculate one or more sample parameters based on the absorbance or reflectance spectra**. The sensors are relatively small, and can include a circuit board upon which are mounted all sensor components. As a result, the sensors are particularly amenable to prolonged wear by a human subject, even during periods of relatively high physical stress.

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	Soller at 13:11-21 **FIG. 2 shows a schematic diagram of sensor 10 mounted on a sample 30. Sample 30 includes one or more layers of skin 32, a subcutaneous layer of fat 34, and underlying muscle tissue 36. Sensor 10 is configured to interrogate muscle tissue 36 by directing radiation 38, generated by at least one (e.g., all) of radiation sources l4a-b and at least one of the radiation sources l6a-f, to be incident on muscle tissue 36**. Scattered radiation 40 is received and analyzed by detector 12 (not shown) to determine a spectrum of the scattered radiation. The scattered radiation spectrum is then processed by electronic processor 20 and/or processor 22 (not shown) to determine an absorbance spectrum of muscle tissue 36. Based on the absorbance spectrum, electronic processor 20 and/or 22 can determine one or more properties of sample 30 (and in particular, of muscle tissue 36 within sample 30). Soller at 15:21-35  FIG. 2 Soller at Fig. 2 Data can also be transmitted to one or more display devices that can be used by medical personnel, athletic trainers, a subject wearing sensor 10, and other personnel to observe the analyzed data. Typically, data which is transmitted to display devices includes one or more parameters derived from absorbance spectra of a sample. Data which is transmitted to networks and/or storage devices can include one or more calculated parameters and can also include, for example, measured absorbance spectra and sensor calibration and/or configuration information.

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	Soller at 27:62-28:4 The rabbit spectra were obtained directly from muscle tissue, while in this study, the muscle spectra were obtained by illuminating the muscle tissue through layers of skin and fat, and correcting the measured spectra to reduce or eliminate contributions from the skin and fat layers prior to model development. This further suggests that the sensors disclosed herein can be used to obtain accurate estimates of a wide variety of physiological parameters, including parameters that are relatively sensitive to the optical arrangement used to measure the reflectance spectra. Soller at 55:12-21 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.	See claim 1 above. Soller discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal. FIG. 2 shows a schematic diagram of sensor 10 mounted on a sample 30. Sample 30 includes one or more layers of skin 32, a subcutaneous layer of fat 34, and underlying muscle tissue 36. Sensor 10 is configured to interrogate muscle tissue 36 by directing radiation 38, generated by at least one (e.g., all) of radiation sources l4a-b and at least one of the radiation sources l6a-f, to be incident on muscle tissue 36. Scattered radiation 40 is received and analyzed by detector 12 (not shown) to determine a spectrum of the scattered radiation**. The scattered radiation spectrum is then processed by electronic processor 20 and/or processor 22 (not shown) to determine an absorbance spectrum of muscle tissue 36.**

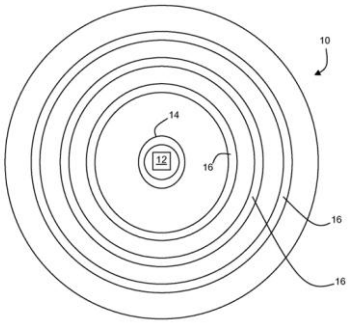
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	Based on the absorbance spectrum, electronic processor 20 and/or 22 can determine one or more properties of sample 30 (and in particular, of muscle tissue 36 within sample 30). Soller at 15:21-35 In general, the scattered radiation spectrum measured by detector 12, which typically includes wavelength-dependent information about scattered radiation from sample 30, **can be converted by an electronic processor to an absorbance spectrum of muscle tissue 36 using well-known methods**. Soller at 15:36-40 In addition to converting scattered radiation information into absorbance and/or reflectance spectra, processor 20 and/or 22 can be configured (e.g., using calibration equations and/or data stored in memory units, magnetic storage units, and/or optical storage units) to analyze absorbance spectra to obtain measurements of physiologically important parameters for sample 30**. In general, processor 20 and/or 22 can be configured to perform any of the analysis steps that are discussed herein**. Soller at 15:51-59 When some or all of the radiation sources of sensor 10 include multiple radiation emitting elements, electronic processor 20 can be configured to adjust the radiation emitting elements to control the properties of the output radiation produced by the multiple elements. In particular, for example, when certain radiation sources of sensor 10 include multiple LEDs, processor 20 can control the emitted radiation intensity from each of the individual LEDs to control the overall distribution of radiation produced by the sources. Control of the emitted radiation intensity can be achieved, for example, through a digital-to-analog converter (DAC) which converts a digital control signal from processor 20 and/or 22 into an analog control voltage applied to a given radiation source element. With a DAC of suitable resolution (e.g., 14-bit), relatively fine control over emission intensities of individual LEDs can be achieved, and continuous-wave emission can be implemented. Soller at 19:42-58 As another example, in some embodiments, the sensitivity of detector 12 to incident radiation can vary as a function of the wavelength of the radiation. Accordingly, the spectral profile of the illumination radiation can be selected to reduce or remove spectral features in measured scattered radiation spectra

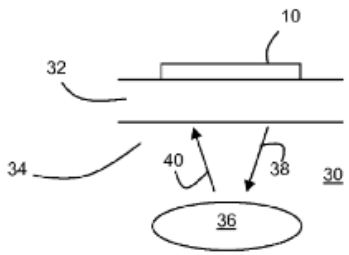
’475 Patent	Soller
	that arise from such variations in detector sensitivity. As above, selecting the spectral profile of the illumination radiation can include increasing and/or decreasing emitted radiation intensity from certain radiation emitters relative to other radiation emitters under the control of processor 20 and/or 22. As a further example, in some embodiments, the sample (e.g., sample 30) can include moieties that absorb incident radiation at one or more well-known wavelengths. To enhance a signal-to-noise ratio in measured scattered radiation (and even, to enable measurement of scattered radiation at the wavelengths of absorption), the emission intensities of certain radiation emitters can be increased and/or decreased relative to other radiation emitters. In particular, emission intensities of radiation emitters that emit radiation that falls within absorption bands can be increased relative to emission intensities of other emitters (or the intensities of the other emitters can be decreased relative to the emission intensities of the emitters that emit within the absorption bands). Soller at 20:35-58 **In general, the methods disclosed herein are performed by processor 20 and/or one or more applications processors 22**. In particular, any of the configuration, control, or analysis steps can be performed automatically by one or more processors of sensor 10. Processor 20 and/or one or more applications processors 22 can be configured to measure absorbance spectra of sample 30, and to derive from the absorbance spectra one or more properties of sample 30, including oxygen tension, oxygen saturation, pH, hematocrit, hemoglobin concentration, anaerobic threshold, and oxygen consumption of the sample. Soller at 26:42-52 In some embodiments, sensor 10 can include a display 24. Display 24 can generally be any type of display, such as a low-power liquid crystal or organic LED display, for example. Display 24 can receive data from processor 20 or any of applications processors 22, and can display the data to a subject wearing the sensor and/or to an operator monitoring the subject. The data received and displayed can include sample information, calibration information, values of various parameters calculated from absorbance spectra of the sample, and other types of data. The display can be integrated into housing 11 and/or can be located remote from housing 11 and configured to communicate with one or more processors of sensor 10 via communication interface 28 (e.g., which can include a signal cable and/or a wireless transmitter-receiver combination).

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	Soller at 26:60-27:7 **Processor 20 determines a suitable signal acquisition time for each source by applying an appropriate scaling factor to the predetermined time interval, where the scaling factor is based on the intensity of scattered radiation during the predetermined time interval**. As an example, for a selected radiation source, exposure of a sample for a predetermined time interval of 50 ms and measurement of scattered radiation from the sample during the time interval might yield a total radiation intensity of 700 counts. To reach an intensity of approximately 3500 counts for the selected radiation source, processor 20 calculates that a scaling factor of 3500/700=5 should be applied to the predetermined time interval. Accordingly, processor 20 determines that an appropriate signal acquisition time for the selected radiation source is 5×50 ms=250 ms. Processor 20 can repeat the determination of an appropriate signal acquisition time for some or all of the other short- and/or long-distance sources on the sensor. The predetermined time interval and/or the target scattered radiation intensity (e.g., 3500 counts) can be selected automatically by processor 20, or this information can be entered manually by a system operator. Soller at 29:37-57 In general, Taylor series model fitting errors increase with increasing source-detector distance. Accordingly, if a long-distance source was selected based entirely on a minimum fitting error criterion, the long-distance source nearest detector 12 might have the highest a priori probability of being selected. To eliminate path-length related effects from the long-distance source selection algorithm, the illumination spectra can be normalized prior to fitting to fitting to the Taylor series-based model. A variety of different normalization methods can be implemented by processor 20. In some embodiments, for example, processor 20 normalizes the illumination spectra by dividing each absorbance value in a particular spectrum by the maximum absorbance value in the spectrum. Other normalization methods can also be implemented by processor 20, including normalization by signal acquisition time and normalization by the mean value in each particular spectrum. Soller at 33:22-40 The method steps and procedures described herein can be implemented in hardware or in software, or in a combination of both. In particular, processor 20 (and/or other processors of sensor 10 such as processor 22) can include software and/or hardware instructions to perform any of the methods discussed above. The methods can be implemented in computer programs using standard programming techniques

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	following the method steps and figures disclosed herein. Program code is applied to input data to perform the functions described herein. The output information is applied to one or more output devices such as a printer, or a display device, or a web page on a computer monitor with access to a website, e.g., for remote monitoring. Soller at 42:37-47 Each program is preferably implemented in a high level procedural or object oriented programming language to communicate with a processor. However, the programs can be implemented in assembly or machine language, if desired. In any case, the language can be a compiled or interpreted language. Each computer program can be stored on a storage medium or device (e.g., an electronic memory) readable by the processor, for configuring and operating the processor to perform the procedures described herein. Soller at 42:48-56 Processor 20 determines a root mean square (RMS) value of the Taylor series model fitting error for each spectrum (e.g., each spectrum corresponding to a particular long-distance source) by calculating a sum of squared differences between the Taylor series model fitting errors and the average value of the Taylor series model fitting errors over all measurement wavelengths, dividing the sum of squared differences by the number of measurement wavelengths, and taking the square root of the quotient. Processor 20 compares the RMS value of the Taylor series model fitting error for a particular spectrum to the average value μ of the Taylor series model fitting errors. If the RMS value lies within an error interval centered at the average value μ and having a width of 3σ on either side of the average value (e.g., within an interval $(\mu-3\sigma, \mu+3\sigma)$, processor 20 concludes that, for at least a 99% level of confidence, sample spectra measured by illuminating the sample with radiation from the long-distance source corresponding to the particular spectrum being analyzed are of suitable quality to make accurate determinations of one or more quantities for the sample. The long-distance source corresponding to the particular spectrum being analyzed can then be used to collect data from the sample by measuring scattered radiation from the sample in response to illumination with radiation from the long-distance source. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	
6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	See claim 1 above. Soller discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. The sensors can include radiation sources at different source-detector distances. In particular, the sensors can include **multiple long-distance sources, each of which can illuminate a sample**, and following which illumination scattered radiation from the sample can be measured. Scattered radiation spectra derived from long-distance source illumination of the sample typically include spectral contributions from both muscle tissues within the sample, and from layers of skin and/or fat positioned between the sensor and the muscle tissues. Absorbance spectra can be generated from the scattered radiation spectra by comparing the scattered radiation spectra to incident radiation spectra from the long-distance sources. Soller at 1:58-2:03 FIG. 33 is a schematic diagram of an embodiment of a sensor that includes annular radiation sources. Soller at 12:66–67 The number and positions of detectors in FIG. 34 can generally be selected as desired. **Any number of detectors can be positioned on the bottom surface of sensor 10, in analogous fashion to the placement of radiation sources in the embodiments shown in FIGS. 31-33. Detectors 23 a-f can generally have a wide variety of shapes, including circular, annular, rectangular, square, and other regular and/or irregular shapes**. The numbers, positions, and shapes of detectors 23 a-f are chosen to be consistent with the functionality of sensor 10 disclosed herein. Soller at 40:11–20.

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	 FIG. 33 Soller at Fig. 33. Disclosed herein are sensors and associated methods for determining properties of samples including, in particular, human subjects. The sensors are typically, but not exclusively, configured to measure near-infrared absorbance or reflectance spectra from the samples, and to calculate one or more sample parameters based on the absorbance or reflectance spectra. The sensors are relatively small, and can include a circuit board upon which are mounted all sensor components. As a result, the sensors are particularly amenable to prolonged wear by a human subject, even during periods of relatively high physical stress. Soller at 13:11-21 FIG. 2 shows a schematic diagram of sensor 10 mounted on a sample 30. Sample 30 includes one or more layers of skin 32, a subcutaneous layer of fat 34, and underlying muscle tissue 36. Sensor 10 is configured to interrogate muscle tissue 36 by directing radiation 38, generated by at least one (e.g., all) of radiation sources l4a-b and **at least one of the radiation sources l6a-f**, to be incident on muscle tissue 36. Scattered radiation 40 is received and analyzed by detector 12 (not shown) to determine a spectrum of the scattered radiation. The scattered radiation spectrum is then processed by electronic processor 20 and/or processor 22 (not shown) to determine an absorbance spectrum of muscle tissue 36. Based on the absorbance spectrum, electronic processor 20 and/or 22 can determine one or more properties of sample 30 (and in particular, of muscle tissue 36 within sample 30). Soller at 15:21-35

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	 FIG. 2 Soller at Fig. 2 Sensor 10 typically **includes a plurality of radiation sources. In some embodiments, some or all of the radiation sources include light emitting diodes (LEDs). Some (or all) of the radiation sources of sensor 10 can provide relatively broad bandwidth incident radiation for illuminating sample 30. To provide such radiation, the radiation sources can include one or more LEDs. For example, in certain embodiments, some radiation sources can include a single broadband LED. In some embodiments, certain radiation sources can include multiple LEDs. The multiple LEDs can each emit radiation having different central wavelengths and/or spectral bandwidths. In some embodiments, some of the multiple LEDs can emit radiation having the same central wavelength and/or bandwidth**. Soller at 18:43-56 Typically, for example, each radiation source of sensor 10 emits radiation that includes multiple radiation wavelengths. In some embodiments, a FWHM spectral bandwidth of the emitted radiation from each source is 10 nm or more (e.g., 15 nm or more, 20 nm or more, 50 nm or more, 100 nm or more, 200 nm or more, 300 nm or more, 400 nm or more, 500 nm or more, 700 nm or more). **The usable range of the radiation emitted by each source can be determined by a transmission range of detector 12. In certain embodiments, for example, detector 12 includes a LVF with a transmission range of from 600 nm to 1100 nm. The usable range of the emitted radiation can also depend, in some embodiments, on the spectral response of a detector coupled to the wavelength dispersive element**

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	in detector 12. For example, photodiode arrays, CCD arrays, and CMOS arrays that are formed of silicon typically have a usable spectral response that reaches an upper limit at about 1100 nm. Detectors formed of other materials can be used to measure sample responses at even longer wavelengths. Soller at 20:59-21:10 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	See claim 6 above. Soller discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. The sensors **can include a display unit**. The display unit can be positioned on a surface of the sensor opposite to a surface through which the incident radiation is emitted by the plurality of radiation sources. Soller at 8:45-48 In certain embodiments, **the sensors can include, or also include, a communication interface. The communication interface can include a wireless transmitter and receiver configured to transmit data from, and receive data sent to, the sensor. The communication interface can include a port configured to transmit data from, and receive data sent to, the sensor. The sensors can be configured to transmit data to an external device through the communication interface. The sensors can be configured to transmit data to a network through the communication interface. The network can be the internet. The network can be a mobile telephone network. The support**

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	apparatus can include a communication interface, and the sensors can be configured to transmit data to the support apparatus during charging of the battery Soller at 8:49-62 In addition to converting scattered radiation information into absorbance and/or reflectance spectra, processor 20 and/or 22 can be configured (e.g., using calibration equations and/or data stored in memory units, magnetic storage units, and/or optical storage units) to analyze absorbance spectra to obtain measurements of physiologically important parameters for sample 30. In general, processor 20 and/or 22 can be configured to perform any of the analysis steps that are discussed herein. Soller at 15:51-59 In some embodiments, sensor 10 can include a display 24. Display 24 can generally be any type of display, such as a low-power liquid crystal or organic LED display, for example. Display 24 can receive data from processor 20 or any of applications processors 22, and can display the data to a subject wearing the sensor and/or to an operator monitoring the subject. The data received and displayed can include sample information, calibration information, values of various parameters calculated from absorbance spectra of the sample, and other types of data. **The display can be integrated into housing 11 and/or can be located remote from housing 11 and configured to communicate with one or more processors of sensor 10 via communication interface 28 (e.g., which can include a signal cable and/or a wireless transmitter-receiver combination)**. Soller at 26:60-27:7 **Sensor 10 can be configured to transmit and receive data over both wireless and wired communication interfaces to a variety of external devices. For example, data can be transmitted to external processing devices such as computers, personal digital assistants, cellular telephones and/or smartphones, and other dedicated processing devices**. Data can also be transmitted to storage units, including flash drives, and magnetic and/or optical storage devices. Storage devices can also be portable storage devices that can be worn by a subject, for example (e.g., around the waist of a subject), or embedded in a subject's clothing (e.g., a chip-based storage device embedded in a shoe of the subject). Further, data can be transmitted to devices over one or more networks, including private networks, public networks, local and/or wide area networks, mobile telephone and/or data networks, and the internet.

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	Soller at 27:46-61 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Soller discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. *See* claim 1[pre], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Soller discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;. *See* claim 1[c], 1[j], 1[k], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Soller discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. *See* claim 1[d], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Soller discloses or renders obvious a detector. *See* claim 1[e], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Soller discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. *See* claim 1[k], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Soller discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. *See* claim 1[j], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	Soller discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. *See* claim 1[e], 1[h], 1[l], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.	Soller discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user. *See* claim 1[m], above.

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. Soller discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. **Sensor 10 typically includes a plurality of radiation sources. In some embodiments, some or all of the radiation sources include light emitting diodes (LEDs). Some (or all) of the radiation sources of sensor 10 can provide relatively broad bandwidth incident radiation for illuminating sample 30. To provide such radiation, the radiation sources can include one or more LEDs**. For example, in certain embodiments, some radiation sources can include a single broadband LED. In some embodiments, certain radiation sources can include multiple LEDs. The multiple LEDs can each emit radiation having different central wavelengths and/or spectral bandwidths. In some embodiments, some of the multiple LEDs can emit radiation having the same central wavelength and/or bandwidth. Soller at 18:43-56 **Typically, for example, each radiation source of sensor 10 emits radiation that includes multiple radiation wavelengths**. In some embodiments, **a FWHM spectral bandwidth of the emitted radiation from each source is 10 nm or more** (e.g., 15 nm or more, 20 nm or more, 50 nm or more, 100 nm or more, 200 nm or more, 300 nm or more, 400 nm or more, 500 nm or more, **700 nm or more**). The usable range of the radiation emitted by each source can be determined by a transmission range of detector 12. In certain embodiments, for example, **detector 12 includes a LVF with a transmission range of from 600 nm to 1100 nm. The usable range of the emitted radiation can also depend, in some embodiments, on the spectral response of a detector coupled to the wavelength dispersive element in detector 12. For example, photodiode arrays, CCD arrays, and CMOS arrays that are formed of silicon typically have a usable spectral response that reaches an upper limit at about 1100 nm**.

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	Detectors formed of other materials can be used to measure sample responses at even longer wavelengths. Soller at 20:59-21:10 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. *See* claim 1[b], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	See claim 8 above. Soller discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency. In general, the scattered radiation spectrum measured by detector 12, which typically includes wavelength-dependent information about scattered radiation from sample 30, can be converted by an electronic processor to an absorbance spectrum of muscle tissue 36 using well-known methods. Soller at 15:36-40

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	When some or all of the radiation sources of sensor 10 include multiple radiation emitting elements, electronic processor 20 can be configured to adjust the radiation emitting elements to control the properties of the output radiation produced by the multiple elements. In particular, for example, when certain radiation sources of sensor 10 include multiple LEDs, processor 20 can control the emitted radiation intensity from each of the individual LEDs to control the overall distribution of radiation produced by the sources. Control of the emitted radiation intensity can be achieved, for example, through a digital-to-analog converter (DAC) which converts a digital control signal from processor 20 and/or 22 into an analog control voltage applied to a given radiation source element. With a DAC of suitable resolution (e.g., 14-bit), relatively fine control over emission intensities of individual LEDs can be achieved, and continuous-wave emission can be implemented. Soller at 19:42-58 **Alternatively, in some embodiments, direct digital control of individual LEDs can be achieved via pulse width modulation (PWM) of the LEDs by processor 20 and/or 22. Pulse width modulation provides a modulated (e.g., pulsed) LED output. Under PWM control, the integrated intensity of LED output over a selected temporal window is controlled, from a maximum value (always on) to zero (always off), as defined by the duty cycle of the modulated signal. Emission intensities between these limits are realized by high frequency pulsing of the LEDs by processor 20 and/or 22. By controlling the rate at which pulses are emitted by the LEDs, the duty cycle of the LEDs can be adjusted. For example, to reduce the emission intensity of a particular LED from its maximum value to a half-maximum value, the duty cycle of the LED is reduced to 50%**. Soller at 19:59-20:06 As another example, in some embodiments, the sensitivity of detector 12 to incident radiation can vary as a function of the wavelength of the radiation. Accordingly, the spectral profile of the illumination radiation can be selected to reduce or remove spectral features in measured scattered radiation spectra that arise from such variations in detector sensitivity. As above, selecting the spectral profile of the illumination radiation can include increasing and/or decreasing emitted radiation intensity from certain radiation emitters relative to other radiation emitters under the control of processor 20 and/or 22. As a further example, in some embodiments, the sample (e.g., sample 30) can include moieties that absorb incident radiation at one or more well-known wavelengths. To enhance a signal-to-noise ratio in

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	measured scattered radiation (and even, to enable measurement of scattered radiation at the wavelengths of absorption), the emission intensities of certain radiation emitters can be increased and/or decreased relative to other radiation emitters. In particular, emission intensities of radiation emitters that emit radiation that falls within absorption bands can be increased relative to emission intensities of other emitters (or the intensities of the other emitters can be decreased relative to the emission intensities of the emitters that emit within the absorption bands). Soller at 20:35-58 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Soller, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Soller, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

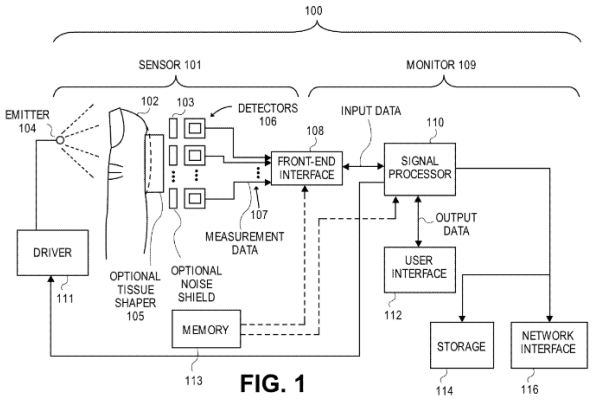
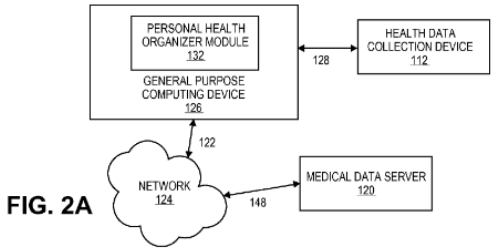
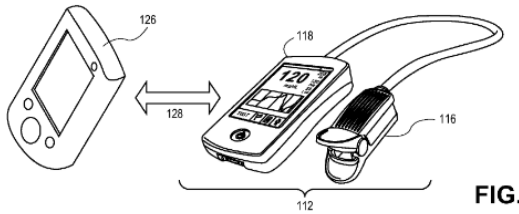
U.S. Pat. No. 12,268,475 in view of US Patent Publication No. 20110082711 to Jeroen Poeze ("Poeze")

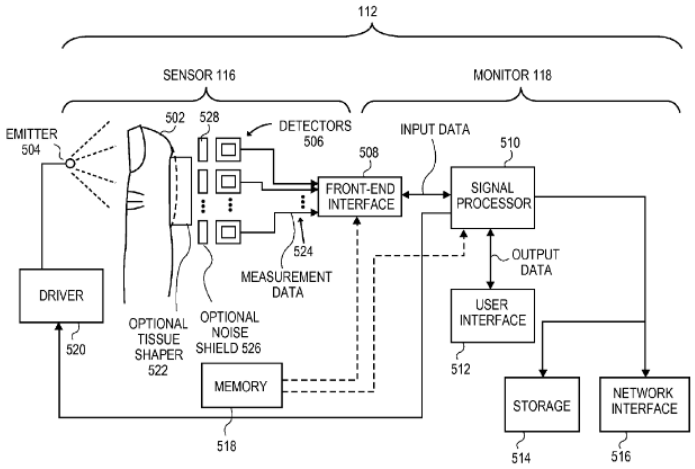
As described in detail below, Poeze (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Poeze. The cited portions of Poeze are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Poeze. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Poeze "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Poeze does not expressly disclose certain limitations in the Asserted Claims, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Poeze (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Poeze anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

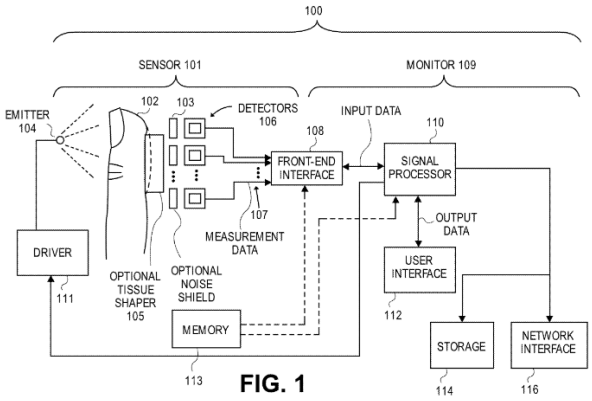
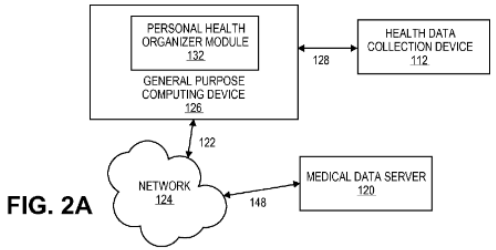
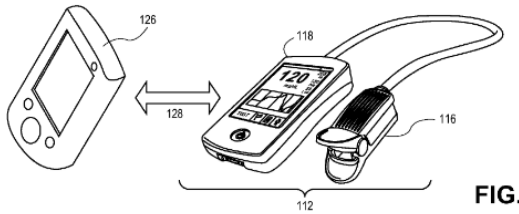
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

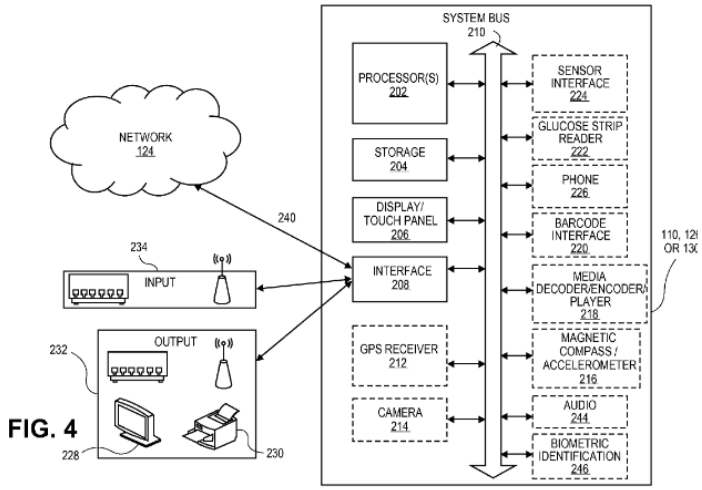
’475 Patent	Poeze
Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Poeze discloses or renders obvious An apparatus adapted to be worn by a user comprising. Embodiments of the present disclosure provide a portable health organizer that enables patients and healthcare personnel to manage health data, and in particular, physiological reading data from one or more health data collection devices such as a glucometer or pulse oximeter. In an embodiment, the personal health organizer is a dedicated portable device that is adapted to retrieve reading data from a health data collection device, which is a noninvasive device in an embodiment and an invasive device in another embodiment. Poeze at [0009] FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034]

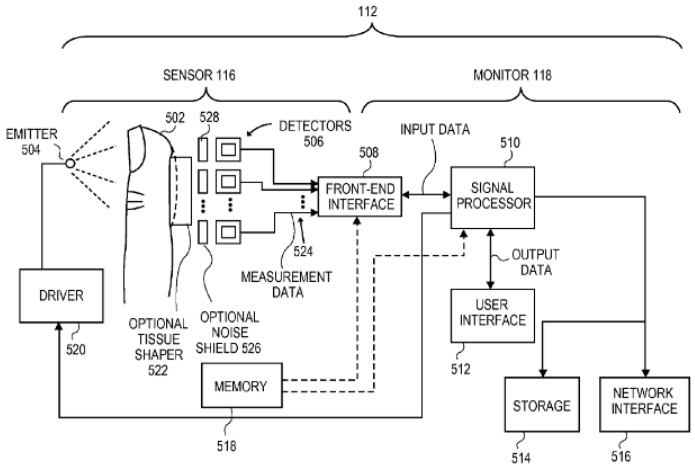
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	 FIG. 1  FIG. 2A  FIG. 2B Poeze at Fig. 1, 2A & 2B FIG. 8 is a block diagram that illustrates the components of an example of a health data collection device 112. In certain embodiments, the health data collection device 112 noninvasively measures a blood analyte, such as oxygen, carbon monoxide, methemoglobin, total hemoglobin, glucose, proteins, glucose, lipids, a percentage thereof (e.g., saturation) or for measuring many other physiologically relevant patient

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	characteristics. The device 112 can also measure additional blood analytes and/or other physiological parameters useful in determining a state or trend of wellness of a patient. Poeze at [0098]  FIG. 8 Poeze at Fig. 8 The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

’475 Patent	Poeze
	incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	Poeze discloses or renders obvious one or more biosensors adapted to be placed on the user. Embodiments of the present disclosure provide a portable health organizer that enables patients and healthcare personnel to manage health data, and in particular, physiological reading data from one or more health data collection devices such as a glucometer or pulse oximeter. In an embodiment, the personal health organizer is a dedicated portable device that is adapted to retrieve reading data from a health data collection device, which is a noninvasive device in an embodiment and an invasive device in another embodiment. Poeze at [0009] FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034]

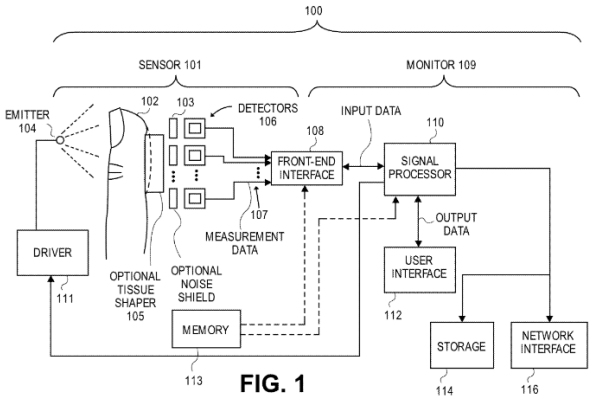
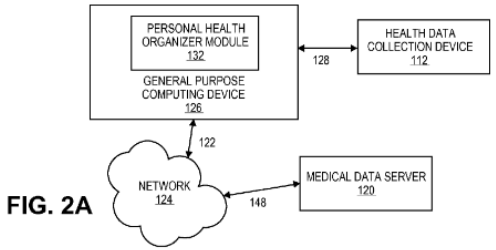
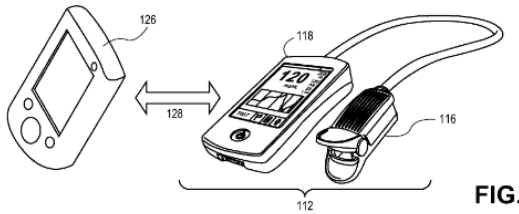
’475 Patent	Poeze
	 FIG. 1  FIG. 2A  FIG. 2B Poeze at Fig. 1, 2A & 2B As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the following components: one or more computer processor(s) 202, a storage 204, a display/touch panel 206, and an interface 208. One or more of these components can be connected together via a system bus 210. In an embodiment, the storage 204 includes (1) data storage such as a hard disk and/or removable

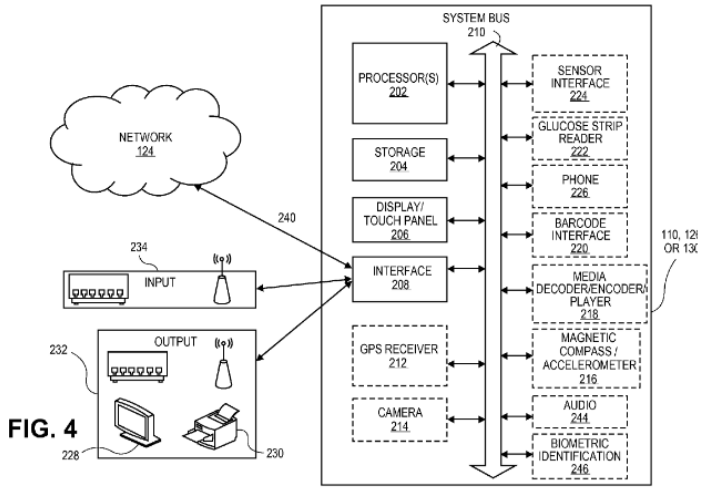
’475 Patent	Poeze
	media such as a flash drive, and/or (2) memory storage such as RAM or ROM. The processor(s) 202 can process signals received from a sensor such as the sensor 116 shown in FIGS. 1B, 2B, and 3B and derive physiological readings such as blood glucose level or other parameters from the signals. The storage 204 can include instructions or data for performing one or more methods disclosed herein. In one or more embodiments, the storage 204 includes a media card reader interface that accepts a media card such as an SD card, a microSD card, a memory stick, a CF card and the like. The portable media card can be used to store patient information and enable the personal health organizer device to be shared, with the settings and data for the individual user stored in the user's media card. The personal health organizer can also include a biometric identification module (such as a vein pattern or finger print scanner) 246 to distinguish one user from another or provide security for information stored. Poeze at [0040]  FIG. 4 Poeze at Fig. 4 FIG. 8 is a block diagram that illustrates the components of an example of a health data collection device 112. In certain embodiments, the health data collection device 112 noninvasively measures a blood analyte, such as oxygen, carbon monoxide, methemoglobin, total hemoglobin, glucose, proteins, glucose, lipids, a percentage thereof (e.g., saturation) or for measuring many other physiologically relevant patient

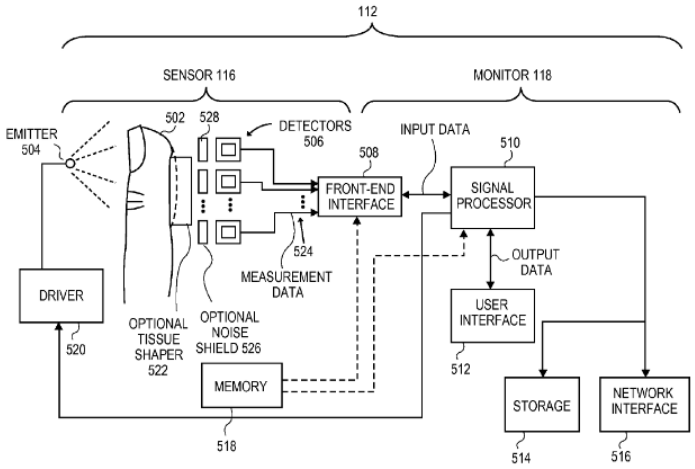
’475 Patent	Poeze
	characteristics. The device 112 can also measure additional blood analytes and/or other physiological parameters useful in determining a state or trend of wellness of a patient. Poeze at [0098]  FIG. 8 Poeze at Fig. 8 The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB) or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose. Poeze at [0100] The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described

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	primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] In the depicted embodiment shown in FIG. 8, the sensor 116 includes an emitter 504, a tissue shaper 522, a set of detectors 506, and a front-end interface 508. The emitter 504 can serve as the source of optical radiation transmitted towards measurement site 102. As will be described in further detail below, the emitter 504 can include one or more sources of optical radiation, such as LEDs, laser diodes, incandescent bulbs with appropriate frequency-selective filters, combinations of the same, or the like. In an embodiment, the emitter 504 includes sets of optical sources that are capable of emitting visible and near-infrared optical radiation. Poeze at [0106] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein	Poeze discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and

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measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. Embodiments of the present disclosure provide a portable health organizer that enables patients and healthcare personnel to manage health data, and in particular, physiological reading data from one or more health data collection devices such as a glucometer or pulse oximeter. In an embodiment, the personal health organizer is a dedicated portable device that is adapted to retrieve reading data from a health data collection device, which is a noninvasive device in an embodiment and an invasive device in another embodiment. Poeze at [0009] FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034]

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	 FIG. 1  FIG. 2A  FIG. 2B Poeze at Fig. 1, 2A & 2B As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the following components: one or more computer processor(s) 202, a storage 204, a display/touch panel 206, and an interface 208. One or more of these components can be connected together via a system bus 210. In an embodiment, the storage 204 includes (1) data storage such as a hard disk and/or removable

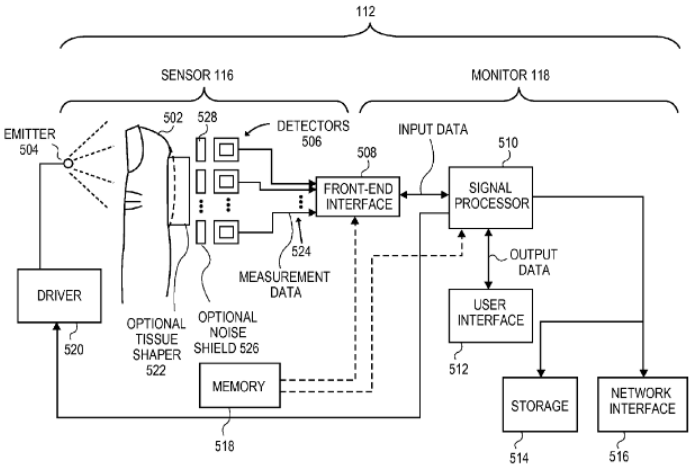
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	media such as a flash drive, and/or (2) memory storage such as RAM or ROM. The processor(s) 202 can process signals received from a sensor such as the sensor 116 shown in FIGS. 1B, 2B, and 3B and derive physiological readings such as blood glucose level or other parameters from the signals. The storage 204 can include instructions or data for performing one or more methods disclosed herein. In one or more embodiments, the storage 204 includes a media card reader interface that accepts a media card such as an SD card, a microSD card, a memory stick, a CF card and the like. The portable media card can be used to store patient information and enable the personal health organizer device to be shared, with the settings and data for the individual user stored in the user's media card. The personal health organizer can also include a biometric identification module (such as a vein pattern or finger print scanner) 246 to distinguish one user from another or provide security for information stored. Poeze at [0040]  FIG. 4 Poeze at Fig. 4 FIG. 8 is a block diagram that illustrates the components of an example of a health data collection device 112. In certain embodiments, the health data collection device 112 noninvasively measures a blood analyte, such as oxygen, carbon monoxide, methemoglobin, total hemoglobin, glucose, proteins, glucose, lipids, a percentage thereof (e.g., saturation) or for measuring many other physiologically relevant patient

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	characteristics. The device 112 can also measure additional blood analytes and/or other physiological parameters useful in determining a state or trend of wellness of a patient. Poeze at [0098]  FIG. 8 Poeze at Fig. 8 The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB) or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose. Poeze at [0100] The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described

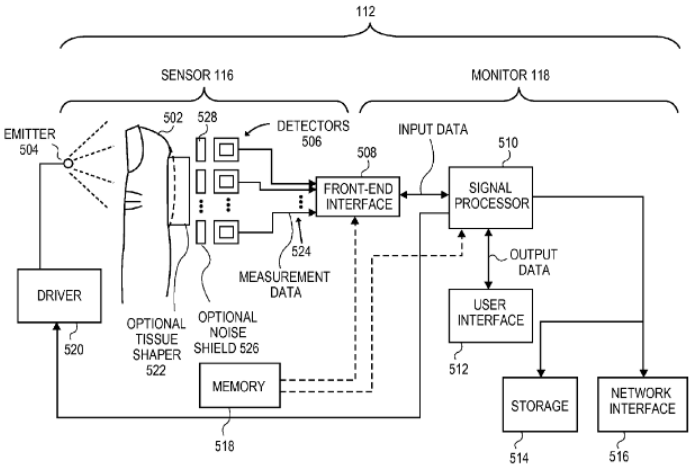
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	primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] In the depicted embodiment shown in FIG. 8, the sensor 116 includes an emitter 504, a tissue shaper 522, a set of detectors 506, and a front-end interface 508. The emitter 504 can serve as the source of optical radiation transmitted towards measurement site 102. As will be described in further detail below, the emitter 504 can include one or more sources of optical radiation, such as LEDs, laser diodes, incandescent bulbs with appropriate frequency-selective filters, combinations of the same, or the like. In an embodiment, the emitter 504 includes sets of optical sources that are capable of emitting visible and near-infrared optical radiation. Poeze at [0106] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122]

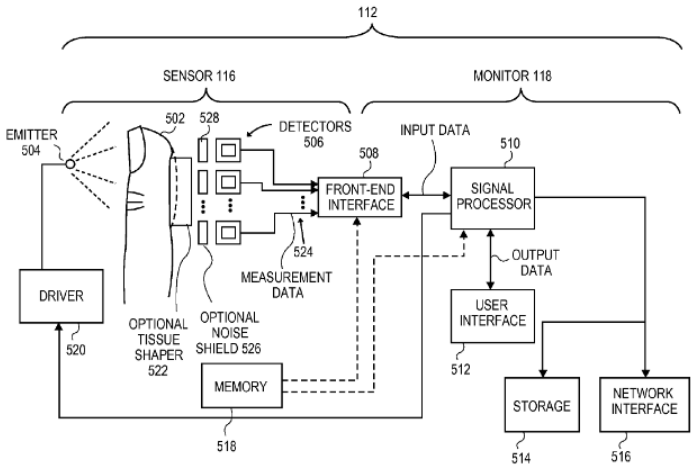
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	Poeze discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. In the depicted embodiment shown in FIG. 8, the sensor 116 includes an emitter 504, a tissue shaper 522, a set of detectors 506, and a front-end interface 508. The emitter 504 can serve as the source of optical radiation transmitted towards measurement site 102. As will be described in further detail below, the emitter 504 can include one or more sources of optical radiation, such as LEDs, laser diodes, incandescent bulbs with appropriate frequency-selective filters, combinations of the same, or the like. In an embodiment, the emitter 504 includes sets of optical sources that are capable of emitting visible and near-infrared optical radiation. Poeze at [0106] For example, the emitter 504 can emit optical radiation across other spectra for other analytes. In particular, the emitter 504 can employ light wavelengths to measure various blood analytes or percentages (e.g., saturation) thereof. For example, in an embodiment, the emitter 504 can emit optical radiation in the form of pulses at wavelengths about 905 nm, about 1050 nm, about 1200 nm, about 1300 nm, about 1330 nm, about 1610 nm, about 1640 nm, and about 1665 nm. In another embodiment, the emitter 504 can emit optical radiation ranging from about 860 nm to about 950 nm, about 950 nm to about 1100 nm, about 1100 nm to about 1270 nm, about 1250 nm to about 1350 nm, about 1300 nm to about 1360 nm, and about 1590 nm to about 1700 nm. Of course, the emitter 504 can transmit any of a variety of wavelengths of visible or near-infrared optical radiation. Poeze at [0111] Due to the different responses of analytes to the different wavelengths, certain embodiments of the data collection device 112 can advantageously use the measurements at these different wavelengths to

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	improve the accuracy of measurements. For example, the measurements of water from visible and infrared light can be used to compensate for water absorbance that is exhibited in the near-infrared wavelengths. Poeze at [0112] As briefly described above, the emitter 504 can include sets of light-emitting diodes (LEDs) as its optical source. The emitter 504 can use one or more top-emitting LEDs. In particular, in some embodiments, the emitter 504 can include top-emitting LEDs emitting light at about 850 nm to 1350 nm. Poeze at [0113] The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116]

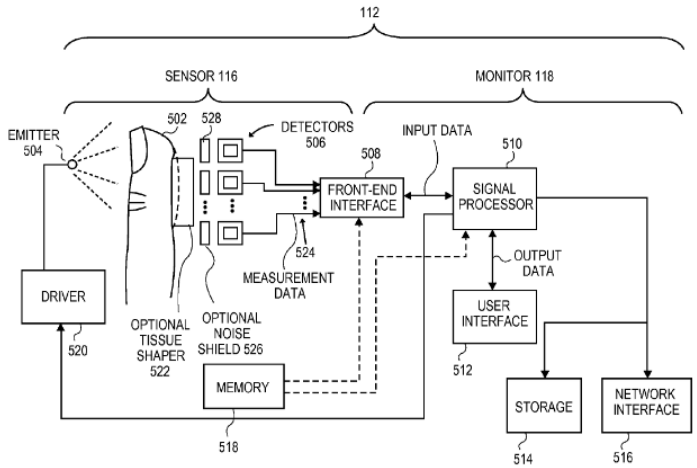
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	 FIG. 8 Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	Poeze discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin. The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101]

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	In the depicted embodiment, the device 112 includes an optional tissue thickness adjuster or tissue shaper 522, which can include one or more protrusions, bumps, lenses, or other suitable tissue-shaping mechanisms. In certain embodiments, the tissue shaper 522 is a flat or substantially flat surface that can be positioned proximate the measurement site 502 and that can apply sufficient pressure to cause the tissue of the measurement site 502 to be flat or substantially flat. In other embodiments, the tissue shaper 522 is a convex or substantially convex surface with respect to the measurement site 502. Many other configurations of the tissue shaper 522 are possible. Advantageously, in certain embodiments, the tissue shaper 522 reduces thickness of the measurement site 502 while preventing or reducing occlusion at the measurement site 502. Reducing thickness of the site can advantageously reduce the amount of attenuation of the light because there is less tissue through which the light must travel. Shaping the tissue in to a convex (or alternatively concave) surface can also provide more surface area from which light can be detected. Poeze at [0102] In addition, in some embodiments, in order to assist in achieving a comparative balance of desired power output between the LEDs, some of the LEDs in the emitter 504 can have a filter or covering that reduces and/or cleans the optical radiation from particular LEDs or groups of LEDs. For example, since some wavelengths of light can penetrate through tissue relatively well, LEDs, such as some or all of the top-emitting LEDs can use a filter or covering, such as a cap or painted dye. This can be useful in allowing the emitter 504 to use LEDs with a higher output and/or to equalize intensity of LEDs. Poeze at [0115] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118]

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	 FIG. 8 Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	Poeze discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB) or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose. Poeze at [0100]

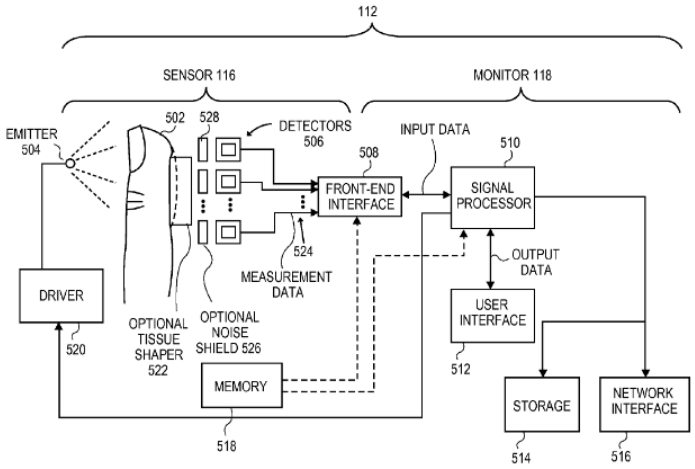
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	The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118]  FIG. 8 Poeze at Fig. 8

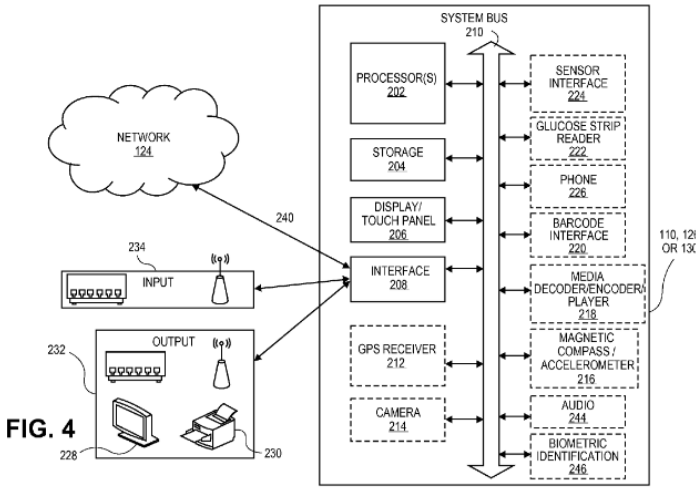
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	The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Poeze discloses or renders obvious, the detection system is configured to be synchronized to the light source. The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on

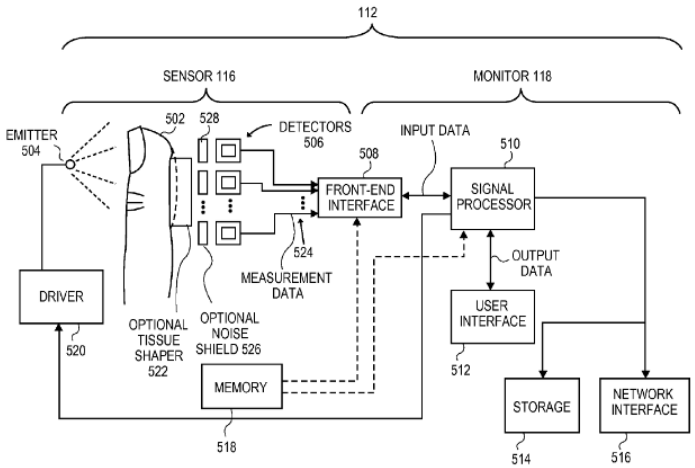
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	a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118]  FIG. 8 Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	Poeze discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118] In addition, the detectors 506 can be arranged with a spatial configuration to provide a variation of path lengths among at least some of the detectors 506. That is, some of the detectors 506 can have the substantially, or from the perspective of the processing algorithm, effectively, the same path length from the emitter 504. However, according to an embodiment, at least some of the detectors 506 can have a different path length from the emitter 504 relative to other of the detectors 506. Variations in path lengths can be helpful in allowing the use of a bulk signal stream from the detectors 506. In some embodiments, the detectors 506 may employ a linear spacing, a logarithmic spacing, or a two or three dimensional matrix of spacing, or any other spacing scheme in order to provide an appropriate variation in path lengths. Poeze at [0119] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based

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	on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] The front-end interface 508 can be coupled to the detectors 506 and to the signal processor 510 using a bus, wire, electrical or optical cable, flex circuit, or some other form of signal connection. The front-end interface 508 can also be at least partially integrated with various components, such as the detectors 506. For example, the front-end interface 508 can include one or more integrated circuits that are on the same circuit board as the detectors 506. Other configurations can also be used. Poeze at [0121] The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122]

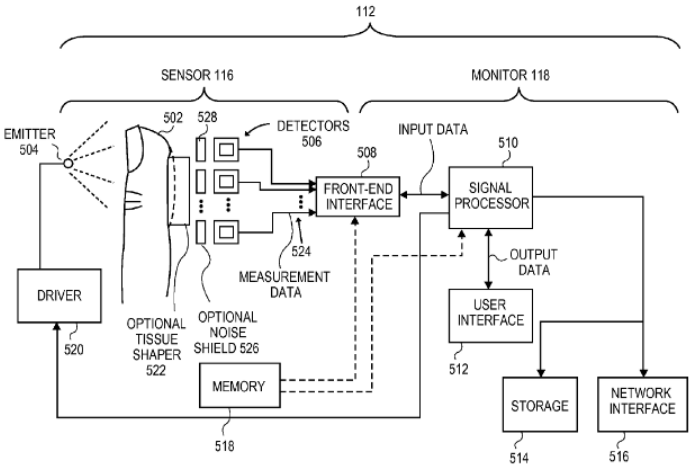
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	 FIG. 8 Poeze at Fig. 8 The ADC or ADCs can provide one or more outputs into multiple channels of digital information for processing by the signal processor 510 of the monitor 118. Each channel can correspond to a signal output from a detector 506. Poeze at [0123] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one	Poeze discloses or renders obvious the output signal is indicative of the one or more physiological parameters.

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or more physiological parameters;	As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the following components: one or more computer processor(s) 202, a storage 204, a display/touch panel 206, and an interface 208. One or more of these components can be connected together via a system bus 210. In an embodiment, the storage 204 includes (1) data storage such as a hard disk and/or removable media such as a flash drive, and/or (2) memory storage such as RAM or ROM. The processor(s) 202 can process signals received from a sensor such as the sensor 116 shown in FIGS. 1B, 2B, and 3B and derive physiological readings such as blood glucose level or other parameters from the signals. The storage 204 can include instructions or data for performing one or more methods disclosed herein. In one or more embodiments, the storage 204 includes a media card reader interface that accepts a media card such as an SD card, a microSD card, a memory stick, a CF card and the like. The portable media card can be used to store patient information and enable the personal health organizer device to be shared, with the settings and data for the individual user stored in the user's media card. The personal health organizer can also include a biometric identification module (such as a vein pattern or finger print scanner) 246 to distinguish one user from another or provide security for information stored. Poeze at [0040]  FIG. 4

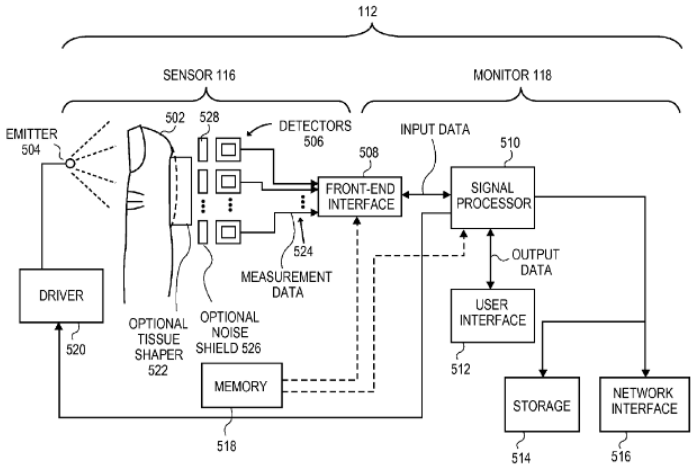
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	Poeze at Fig. 4 FIG. 8 is a block diagram that illustrates the components of an example of a health data collection device 112. In certain embodiments, the health data collection device 112 noninvasively measures a blood analyte, such as oxygen, carbon monoxide, methemoglobin, total hemoglobin, glucose, proteins, glucose, lipids, a percentage thereof (e.g., saturation) or for measuring many other physiologically relevant patient characteristics. The device 112 can also measure additional blood analytes and/or other physiological parameters useful in determining a state or trend of wellness of a patient. Poeze at [0098]  FIG. 8 Poeze at Fig. 8 In the depicted embodiment shown in FIG. 8, the sensor 116 includes an emitter 504, a tissue shaper 522, a set of detectors 506, and a front-end interface 508. The emitter 504 can serve as the source of optical radiation transmitted towards measurement site 102. As will be described in further detail below, the emitter 504 can include one or more sources of optical radiation, such as LEDs, laser diodes, incandescent bulbs with appropriate frequency-selective filters, combinations of the same, or the like. In

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	an embodiment, the emitter 504 includes sets of optical sources that are capable of emitting visible and near-infrared optical radiation. Poeze at [0106] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Poeze discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. The embodiment of the data collection device 112 shown also includes an optional noise shield 526. In an embodiment, the noise shield 526 can be advantageously adapted to reduce electromagnetic noise while increasing the transmittance of light from the measurement site 502 to one or more detectors 506 (described below). For example, the noise shield 526 can advantageously include a conductive coated glass or metal grid electrically communicating with one or more other shields of the sensor 116 or electrically grounded. In an embodiment where the noise shield 526 includes conductive coated glass, the coating can advantageously include indium tin oxide. In an embodiment, the indium tin oxide includes a surface resistivity ranging from approximately 30 ohms per square inch to about 500 ohms per square inch. In an embodiment, the resistivity is approximately 30, 200, or 500 ohms per square inch. As would be understood by a person of skill in the art from the present disclosure, other resistivities can also be used which are less than about 30 ohms or more than about 500 ohms. Other conductive materials transparent or substantially transparent to light can be used instead. Poeze at [0103] In contrast, the emitter 504 of the data collection device 112 can emit, in certain embodiments, combinations of optical radiation in various bands of interest. For example, in some embodiments, for analytes like glucose, the emitter 504 can emit optical radiation at three (3) or more wavelengths between about 1600 nm to about 1700 nm. In particular, the emitter 504 can emit optical radiation at or about 1610 nm, about 1640 nm, and about 1665 nm. In some circumstances, the use of three wavelengths

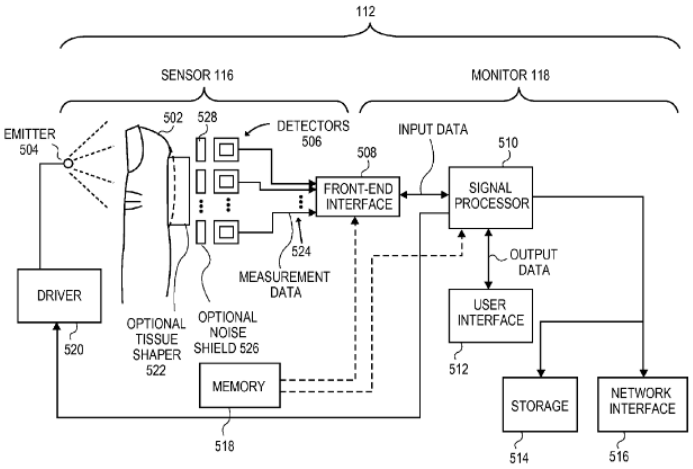
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	within about 1600 nm to about 1700 nm enable sufficient SNRs of about 100 dB, which can result in a measurement accuracy of about 20 mg/dL or better for analytes like glucose. Poeze at [0109] In other embodiments, the emitter 504 can use two (2) wavelengths within about 1600 nm to about 1700 nm to advantageously enable SNRs of about 85 dB, which can result in a measurement accuracy of about 25-30 mg/dL or better for analytes like glucose. Furthermore, in some embodiments, the emitter 504 can emit light at wavelengths above about 1670 nm. Measurements at these wavelengths can be advantageously used to compensate or confirm the contribution of protein, water, and other non-hemoglobin species exhibited in measurements for analytes like glucose conducted between about 1600 nm and about 1700 nm. Of course, other wavelengths and combinations of wavelengths can be used to measure analytes and/or to distinguish other types of tissue, fluids, tissue properties, fluid properties, combinations of the same or the like. Poeze at [0110] The emitter 504 can also use super luminescent LEDs (SLEDs) or side-emitting LEDs. In some embodiments, the emitter 504 can employ SLEDs or side-emitting LEDs to emit optical radiation at about 1600 nm to about 1700 nm. Emitter 504 can use SLEDs or side-emitting LEDs to transmit near infrared optical radiation because these types of sources can transmit at high power or relatively high power, e.g., about 40 mW to about 100 mW. This higher power capability can be useful to compensate or overcome the greater attenuation of these wavelengths of light in tissue and water. For example, the higher power emission can effectively compensate and/or normalize the absorption signal for light in the mentioned wavelengths to be similar in amplitude and/or effect as other wavelengths that can be detected by one or more photodetectors after absorption. However, the embodiments of the present disclosure do not necessarily require the use of high power optical sources. For example, some embodiments may be configured to measure analytes, such as total hemoglobin (tHb), oxygen saturation (SpO2), carboxyhemoglobin, methemoglobin, etc., without the use of high power optical sources like side emitting LEDs. Instead, such embodiments may employ other types of optical sources, such as top emitting LEDs. Alternatively, the emitter 504 can use other types of sources of optical radiation, such as a laser diode, to emit near-infrared light into the measurement site 502. Poeze at [0114]

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	 **FIG. 8** Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Poeze discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off. The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in

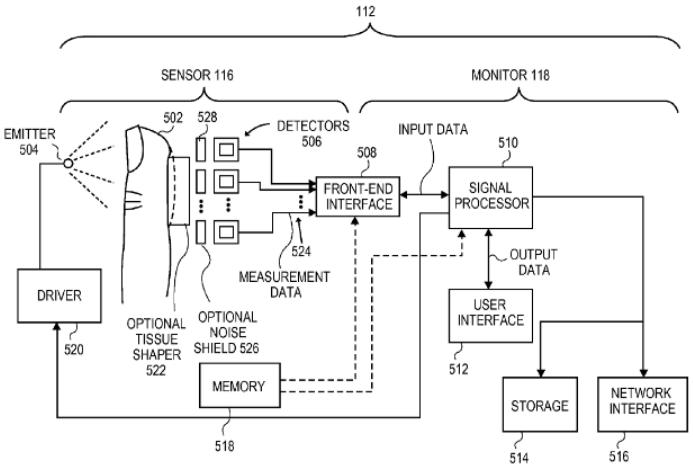
’475 Patent	Poeze
	tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver 520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million. Poeze at [0117] The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127]

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	 FIG. 8 Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Poeze discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in

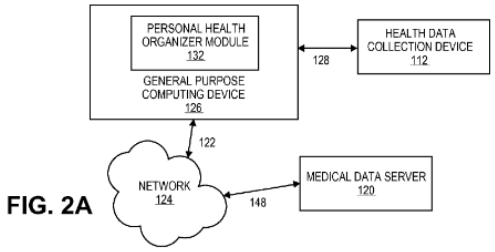
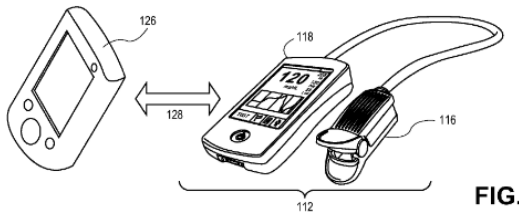
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	tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver 520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million. Poeze at [0117] The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127]

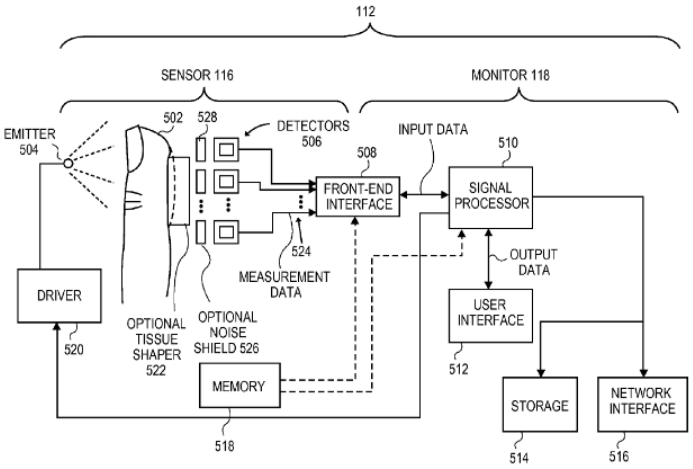
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	 FIG. 8 Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Poeze discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in

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	tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver 520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million. Poeze at [0117] The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127]

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	 FIG. 8 Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Poeze discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. Embodiments of the present disclosure provide a portable health organizer that enables patients and healthcare personnel to manage health data, and in particular, physiological reading data from one or more health data collection devices such as a glucometer or pulse oximeter. In an embodiment, the personal health organizer is a dedicated portable device that is adapted to retrieve reading data from a health data collection device, which is a noninvasive device in an embodiment and an invasive device in another embodiment.

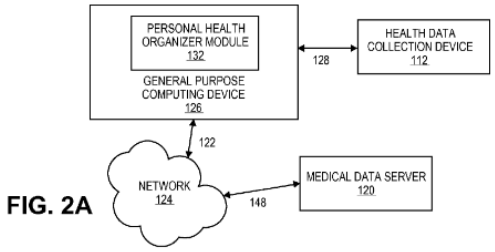
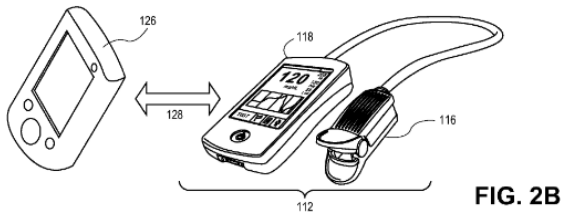
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	Poeze at [0009] FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034]

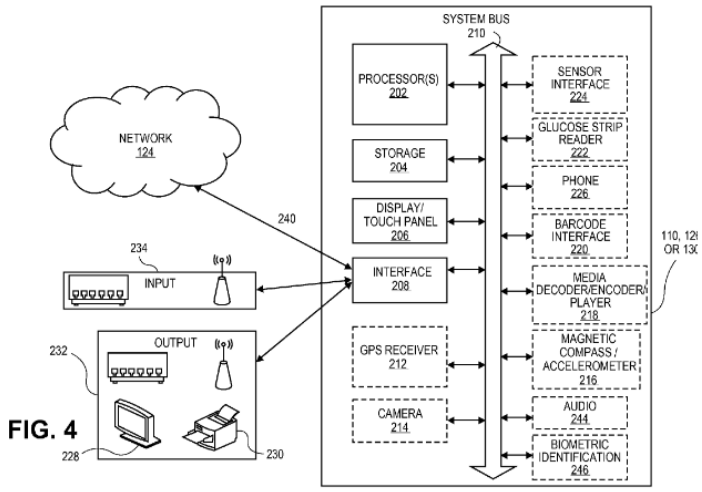
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	 FIG. 2A  FIG. 2B Poeze at Fig. 2A & 2B FIG. 8 is a block diagram that illustrates the components of an example of a health data collection device 112. In certain embodiments, the health data collection device 112 noninvasively measures a blood analyte, such as oxygen, carbon monoxide, methemoglobin, total hemoglobin, glucose, proteins, glucose, lipids, a percentage thereof (e.g., saturation) or for measuring many other physiologically relevant patient characteristics. The device 112 can also measure additional blood analytes and/or other physiological parameters useful in determining a state or trend of wellness of a patient. Poeze at [0098]

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	 FIG. 8 Poeze at Fig. 8 The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	

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5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.	See claim 1 above. Poeze discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal. The present disclosure provides a personal health organizer that enables patients and healthcare personnel to manage health data. The personal health organizer can be a portable device adapted to receive physiological reading data from a health data collection device or derive reading data from signals acquired by a sensor, or a software module/platform for performing same that is configured to be executed on a general purpose computing device such as a mobile phone/computer. The personal health organizer integrates reading data with applications that assist and promote health management, including reminders, alerts and health data tracking. The reading data obtained can be forwarded to healthcare providers so they can provide feedback such as alerts and diagnoses to the user. The personal health organizer can also support electronic medical record integration via networked computing so that locally stored medical data are automatically synchronized with remotely stored medical data records. Poeze at [Abstract] In addition to the forgoing, embodiments of the present disclosure also provide electronic medical record (EMR) integration in conjunction with support for medical record synchronization across networked locations (e.g. via a cloud computing network). Medical data (including reading data and other patient-entered data such as medication schedule and activity/food in-take logs) from the personal health organizer device are automatically synchronized with the corresponding records located at a remote entity (e.g. in a centralized EMR storage or at the healthcare providers' data storage). For example, newly obtained reading data can be synchronized with a shared, synchronized calendar so that both the physician and the patient user can adjust an appointment if the reading requires a change in the appointment schedule. As another example, prescription information can be synchronized so that reimbursements can be handled automatically when the user finishes a current prescription and purchases a new refill. In another example, the personal health organizer can initiate the prescription refill process after verifying drug interaction and consent of the user and the physician. Poeze at [0012] In other embodiments, the personal health organizer includes an accelerometer that detects user motion and the motion can assist in the collection of and/or display of medical/reading data. For example, the

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	accelerometer can detect a user's intent to use the device via touch/motion and automatically start the collection of data when the user places his or her finger into a sensor associated with a health collection data device. In another example, the personal health organizer can begin health data collection once the user places his or her finger into a sensor associated with a health collection data device and/or provides a gesture via a touch-screen input associated with the personal health organizer. In yet another example, the personal health organizer begins the data collection when the user places a finger into the sensor. The LEDs and photo diodes in the sensor can detect the presence of the finger and initiate data collection. The presence of a finger can be determined, for example, by determining when there is a significant reduction in detected light. Such a reduction in detected light can indicate the presence of a finger and start the data collection process. Poeze at [0012-0013] FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034]

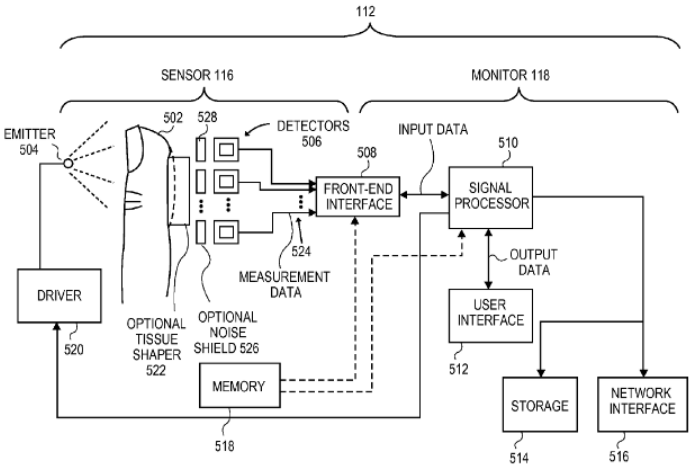
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	 FIG. 2A  FIG. 2B Poeze at Fig. 2A & 2B As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the following components: one or more computer processor(s) 202, a storage 204, a display/touch panel 206, and an interface 208. One or more of these components can be connected together via a system bus 210. In an embodiment, the storage 204 includes (1) data storage such as a hard disk and/or removable media such as a flash drive, and/or (2) memory storage such as RAM or ROM. The processor(s) 202 can process signals received from a sensor such as the sensor 116 shown in FIGS. 1B, 2B, and 3B and derive physiological readings such as blood glucose level or other parameters from the signals. The storage 204 can include instructions or data for performing one or more methods disclosed herein. In one or more embodiments, the storage 204 includes a media card reader interface that accepts a media card such as an SD card, a microSD card, a memory stick, a CF card and the like. The portable media card can be used to store patient information and enable the personal health organizer device to be shared, with the settings and data for the individual user stored in the user's media card. The personal health organizer can also include a biometric identification module (such as a vein pattern or finger print scanner) 246 to distinguish one user from another or provide security for information stored. Poeze at [0040]

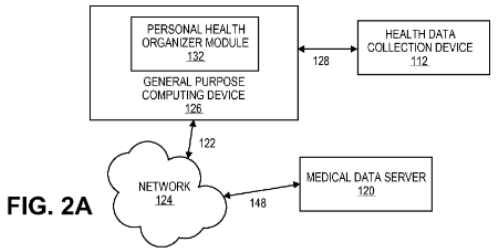
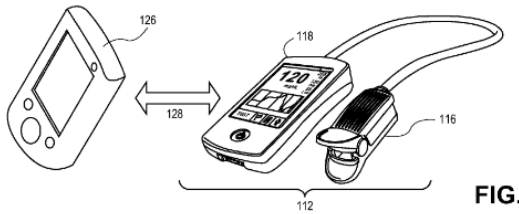
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	 FIG. 4 Poeze at Fig. 4 As another example, the medical data analysis module 326 can track the glycemic index (GI), which describes the effect of carbohydrates on glucose level, and is sometimes used for medical nutrition therapy. In another embodiment, the medical data analysis module 326 can maintain a log of insulin injections given and/or received to show a patient's compliance with medications. The insulin injections can be input by the user into the personal health organizer via the user interface on the display 206 or input automatically with digital syringe. The medical data analysis module 326 can also generate hypoglycemia or hyperglycemia alerts. For example, when the received reading data indicates that blood glucose is too low or too high, the medical data analysis module 326 can alert the patient and prompt the patient to log any symptoms of hypoglycemia or hyperglycemia. Moreover, the medical data analysis module 326 can have threshold reading values and/or accompanying symptom checklists configurable by a physician or a patient, so that if blood glucose values are detrimentally low or high and/or certain accompanying symptoms appear, alerts will be automatically sent to the patient's physician or emergency medical personnel. Similarly, the medical data analysis module 326 can determine if a user has missed a reading and it can send alerts (via SMS, email, automated voice call, etc.) to a friend, family member, or a caretaker to check on the user.

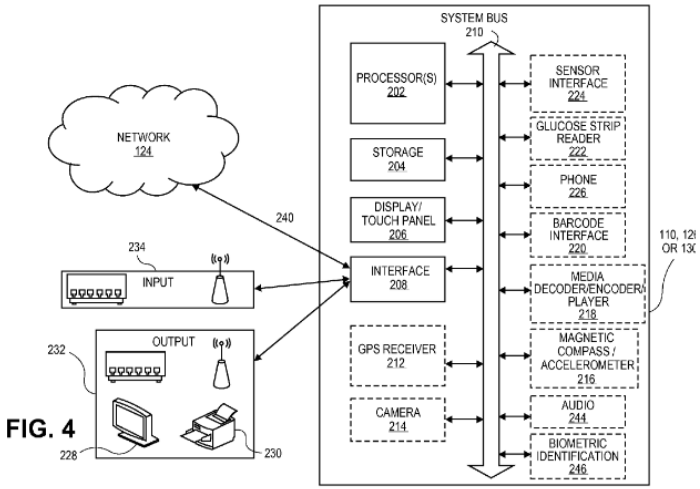
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	Poeze at [0063] In addition to analyzing reading data and providing the user with reminders, alerts, and other feedback to improve the user's health, the personal health organizer in an embodiment includes the electronic medical data record integration module 322 and/or the network computing support module 302 to assist in medical data synchronization. For example, the electronic medical data record integration module 322 can provide data backup and synchronization of medical results, contacts, and other user data (music, videos, etc.). The electronic medical data record integration module 322 can also be configured to enable synchronization of emails, text messages, and voice messages. The electronic medical data record integration module 322 and/or the network computing support module 302 can also be configured to synchronize patient data to centralized medical data servers such as Google Health, Microsoft Health Vault, etc. Poeze at [0068] Various embodiments of the personal health organizer also provide for exchange of medical data and related information via email. For example, while a caregiver is taking a reading or measurement of a patient with the personal health organizer, the caregiver can ask the patient whether or how the patient would like to receive information relating to the measurement, and if the patient prefers email or text messages, the email or text message format. The caregiver can input these communication preferences and send an email or text message to the patient at the point of measurement. In one embodiment, an email of the reading or measurement is automatically sent to the patient upon the completion of measurement process. In another embodiment, the email is sent later at the direction of the caregiver user or at a time configured by the caregiver user. The email or text message could also be routed to additional supervising caregivers, medical records personnel or files, others in the health providing mechanism for a particular patient, or the like. In some embodiments, federal, state, local, caregiver facility rulemaking bodies may place requirements on the distribution and/or content of the information, including, for example, the level of permission required for certain types of data based on, for example, the content thereof. In those instances, the personal health organizer may advantageously ask the caregiver at the point of measurement to acquire the appropriate permissions, or withhold sending the email or text message until such permissions are processed, authenticated, verified, or otherwise checked and approved or the like. In other embodiments, the personal health organizer may review the available permissions and appropriate rule authorities and determine the format and content of the email or text message that is available for sending. For example, the personal health organizer may include less information, less detailed information, different groupings of medical and/or personal information based

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	on a particular patient's permissions and/or applicable medical data disclosure rules. Other forms of electronic communications can also be used, for example, information can be posted to a website, such as a private blog. Information can also be sent through various other information posting websites such as, for example, Twitter™. Poeze at [0076] In another embodiment, if the device is used by a new user, based on the new user's reading (e.g. blood glucose reading), the device security module 342 can recognize that the user has changed. The device can then prompt the new user to enter a password. The device security module 342 can also utilize biometric identification, for example, through the built-in camera 214. The device security module 342 can recognize the face and expressions of the user from the camera. Another embodiment includes an additional rear sub CCD or CMOS camera placed behind an LCD or OLED screen so the user could be prompted for finger print or palm identification. In addition, a CCD or CMOS camera can be embedded in the sensor to take picture of the user's finger print. In addition to or in place of external biometric identification, a special near infrared emitter detector can absorb the unique vein pattern of the finger. The device security module 342 can also utilize the CCD or CMOS camera to distinguish among patients when the device is shared among multiple patients (e.g. in a hospital setting for where a healthcare personnel is using the device for multiple patients). Once a patient's finger print is recognized, the device automatically brings up the patient's file. Poeze at [0092] 2. The physiological data collection device of claim 1 wherein the data communication module is configured to cause the physiological reading data to be transmitted via email automatically upon the completion of a measurement taken of the patient. Poeze at Claim 2 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	

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6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	See claim 1 above. Poeze discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. In addition, in some embodiments, in order to assist in achieving a comparative balance of desired power output between the LEDs, some of the LEDs in the emitter 504 can have a filter or covering that reduces and/or cleans the optical radiation from particular LEDs or groups of LEDs. For example, since some wavelengths of light can penetrate through tissue relatively well, LEDs, such as some or all of the top-emitting LEDs can use a filter or covering, such as a cap or painted dye. This can be useful in allowing the emitter 504 to use LEDs with a higher output and/or to equalize intensity of LEDs. Poeze at [0115] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118] In addition, the detectors 506 can be arranged with a spatial configuration to provide a variation of path lengths among at least some of the detectors 506. That is, some of the detectors 506 can have the substantially, or from the perspective of the processing algorithm, effectively, the same path length from the emitter 504. However, according to an embodiment, at least some of the detectors 506 can have a different path length from the emitter 504 relative to other of the detectors 506. Variations in path lengths can be helpful in allowing the use of a bulk signal stream from the detectors 506. In some embodiments, the detectors 506 may employ a linear spacing, a logarithmic spacing, or a two or three dimensional matrix of spacing, or any other spacing scheme in order to provide an appropriate variation in path lengths. Poeze at [0119]

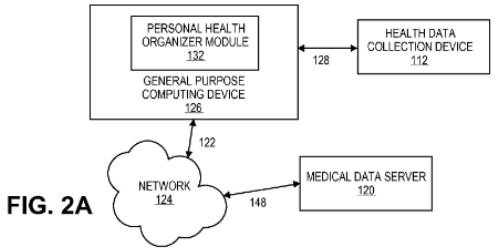
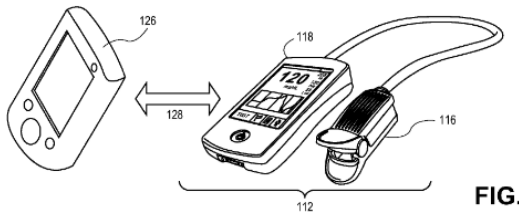
’475 Patent	Poeze
	 FIG. 8 Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless	See claim 6 above. Poeze discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.

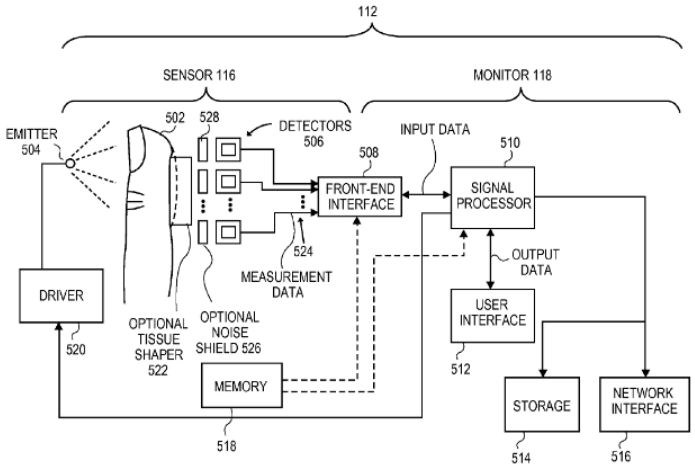
’475 Patent	Poeze
transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034]  FIG. 2A  FIG. 2B Poeze at Fig. 2A & 2B

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	As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the following components: one or more computer processor(s) 202, a storage 204, a display/touch panel 206, and an interface 208. One or more of these components can be connected together via a system bus 210. In an embodiment, the storage 204 includes (1) data storage such as a hard disk and/or removable media such as a flash drive, and/or (2) memory storage such as RAM or ROM. The processor(s) 202 can process signals received from a sensor such as the sensor 116 shown in FIGS. 1B, 2B, and 3B and derive physiological readings such as blood glucose level or other parameters from the signals. The storage 204 can include instructions or data for performing one or more methods disclosed herein. In one or more embodiments, the storage 204 includes a media card reader interface that accepts a media card such as an SD card, a microSD card, a memory stick, a CF card and the like. The portable media card can be used to store patient information and enable the personal health organizer device to be shared, with the settings and data for the individual user stored in the user's media card. The personal health organizer can also include a biometric identification module (such as a vein pattern or finger print scanner) 246 to distinguish one user from another or provide security for information stored. Poeze at [0040]  FIG. 4

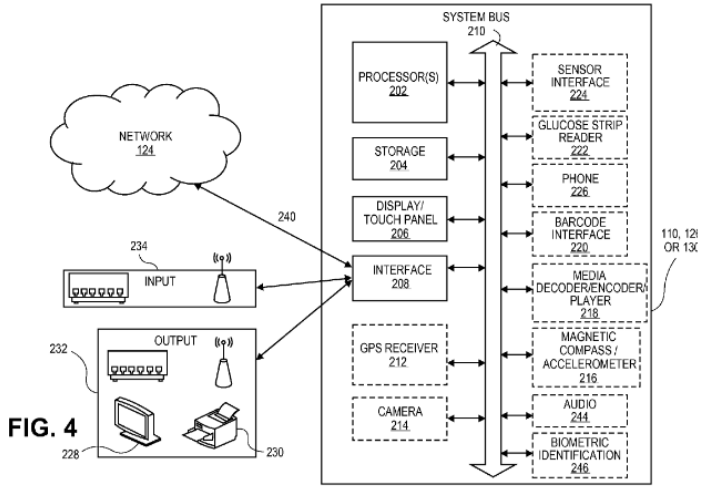
’475 Patent	Poeze
	Poeze at Fig. 4 In addition to analyzing reading data and providing the user with reminders, alerts, and other feedback to improve the user's health, the personal health organizer in an embodiment includes the electronic medical data record integration module 322 and/or the network computing support module 302 to assist in medical data synchronization. For example, the electronic medical data record integration module 322 can provide data backup and synchronization of medical results, contacts, and other user data (music, videos, etc.). The electronic medical data record integration module 322 can also be configured to enable synchronization of emails, text messages, and voice messages. The electronic medical data record integration module 322 and/or the network computing support module 302 can also be configured to synchronize patient data to centralized medical data servers such as Google Health, Microsoft Health Vault, etc. Poeze at [0068] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Poeze discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. See above at claim 1[pre] Embodiments of the present disclosure provide a portable health organizer that enables patients and healthcare personnel to manage health data, and in particular, physiological reading data from one or more health data collection devices such as a glucometer or pulse oximeter. In an embodiment, the personal health organizer is a dedicated portable device that is adapted to retrieve reading data from a health data collection device, which is a noninvasive device in an embodiment and an invasive device in another embodiment.

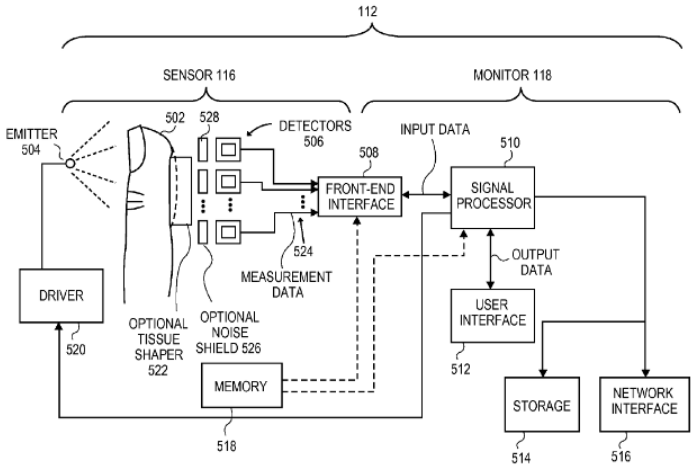
’475 Patent	Poeze
	Poeze at [0009] FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034]

’475 Patent	Poeze
	 FIG. 2A  FIG. 2B Poeze at Fig. 2A & 2B FIG. 8 is a block diagram that illustrates the components of an example of a health data collection device 112. In certain embodiments, the health data collection device 112 noninvasively measures a blood analyte, such as oxygen, carbon monoxide, methemoglobin, total hemoglobin, glucose, proteins, glucose, lipids, a percentage thereof (e.g., saturation) or for measuring many other physiologically relevant patient characteristics. The device 112 can also measure additional blood analytes and/or other physiological parameters useful in determining a state or trend of wellness of a patient. Poeze at [0098]

’475 Patent	Poeze
	 FIG. 8 Poeze at Fig. 8 The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

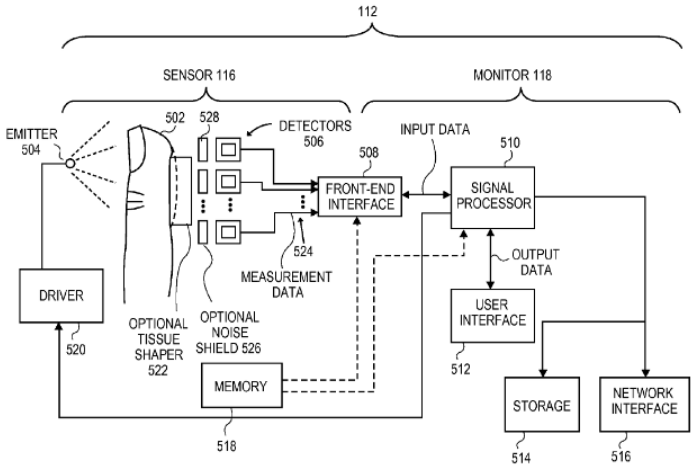
’475 Patent	Poeze
8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Poeze discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;. See above at claim 1[c], 1[j], 1[k] As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the following components: one or more computer processor(s) 202, a storage 204, a display/touch panel 206, and an interface 208. One or more of these components can be connected together via a system bus 210. In an embodiment, the storage 204 includes (1) data storage such as a hard disk and/or removable media such as a flash drive, and/or (2) memory storage such as RAM or ROM. The processor(s) 202 can process signals received from a sensor such as the sensor 116 shown in FIGS. 1B, 2B, and 3B and derive physiological readings such as blood glucose level or other parameters from the signals. The storage 204 can include instructions or data for performing one or more methods disclosed herein. In one or more embodiments, the storage 204 includes a media card reader interface that accepts a media card such as an SD card, a microSD card, a memory stick, a CF card and the like. The portable media card can be used to store patient information and enable the personal health organizer device to be shared, with the settings and data for the individual user stored in the user's media card. The personal health organizer can also include a biometric identification module (such as a vein pattern or finger print scanner) 246 to distinguish one user from another or provide security for information stored. Poeze at [0040]

’475 Patent	Poeze
	 FIG. 4 Poeze at Fig. 4 FIG. 8 is a block diagram that illustrates the components of an example of a health data collection device 112. In certain embodiments, the health data collection device 112 noninvasively measures a blood analyte, such as oxygen, carbon monoxide, methemoglobin, total hemoglobin, glucose, proteins, glucose, lipids, a percentage thereof (e.g., saturation) or for measuring many other physiologically relevant patient characteristics. The device 112 can also measure additional blood analytes and/or other physiological parameters useful in determining a state or trend of wellness of a patient. Poeze at [0098]

’475 Patent	Poeze
	 FIG. 8 Poeze at Fig. 8 The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver 520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million.

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	Poeze at [0117] The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Poeze discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. See above at claim 1[d] The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101]

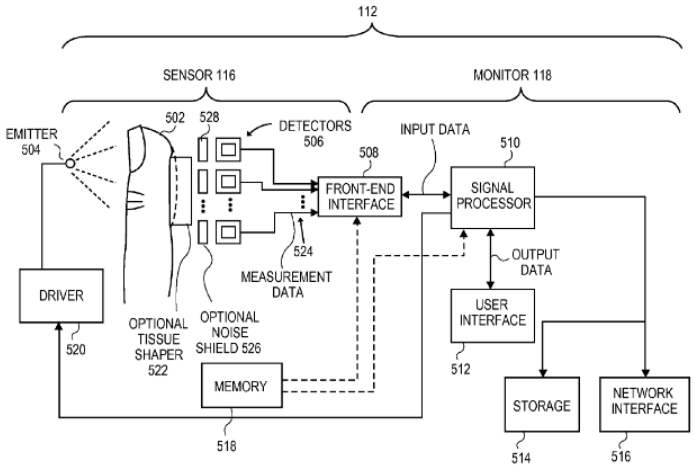
’475 Patent	Poeze
	In the depicted embodiment, the device 112 includes an optional tissue thickness adjuster or tissue shaper 522, which can include one or more protrusions, bumps, lenses, or other suitable tissue-shaping mechanisms. In certain embodiments, the tissue shaper 522 is a flat or substantially flat surface that can be positioned proximate the measurement site 502 and that can apply sufficient pressure to cause the tissue of the measurement site 502 to be flat or substantially flat. In other embodiments, the tissue shaper 522 is a convex or substantially convex surface with respect to the measurement site 502. Many other configurations of the tissue shaper 522 are possible. Advantageously, in certain embodiments, the tissue shaper 522 reduces thickness of the measurement site 502 while preventing or reducing occlusion at the measurement site 502. Reducing thickness of the site can advantageously reduce the amount of attenuation of the light because there is less tissue through which the light must travel. Shaping the tissue in to a convex (or alternatively concave) surface can also provide more surface area from which light can be detected. Poeze at [0102] In addition, in some embodiments, in order to assist in achieving a comparative balance of desired power output between the LEDs, some of the LEDs in the emitter 504 can have a filter or covering that reduces and/or cleans the optical radiation from particular LEDs or groups of LEDs. For example, since some wavelengths of light can penetrate through tissue relatively well, LEDs, such as some or all of the top-emitting LEDs can use a filter or covering, such as a cap or painted dye. This can be useful in allowing the emitter 504 to use LEDs with a higher output and/or to equalize intensity of LEDs. Poeze at [0115] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118]

’475 Patent	Poeze
	 FIG. 8 Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Poeze discloses or renders obvious a detector. See above at claim 1[e] The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB) or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose.

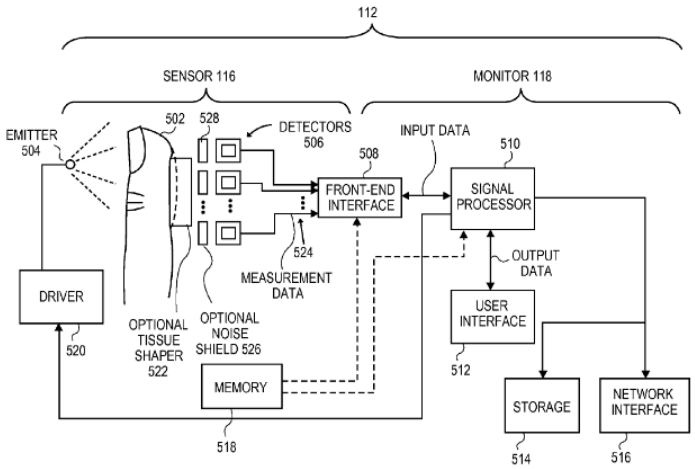
’475 Patent	Poeze
	Poeze at [0100] The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

’475 Patent	Poeze
	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Poeze discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. See above at claim 1[e], 1[k], [5] The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB) or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose. Poeze at [0100] The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments.

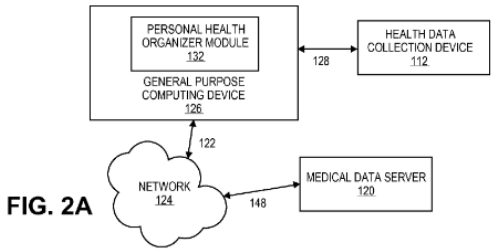
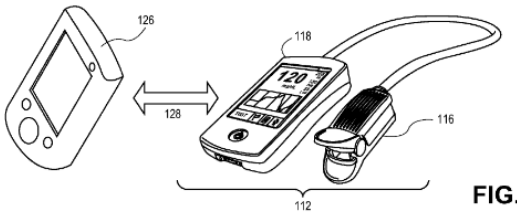
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	Poeze at [0116] The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver 520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million. Poeze at [0117] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118] The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127]

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	 FIG. 8 Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Poeze discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. See above at claim 1[e], 1[j], [5] The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB)

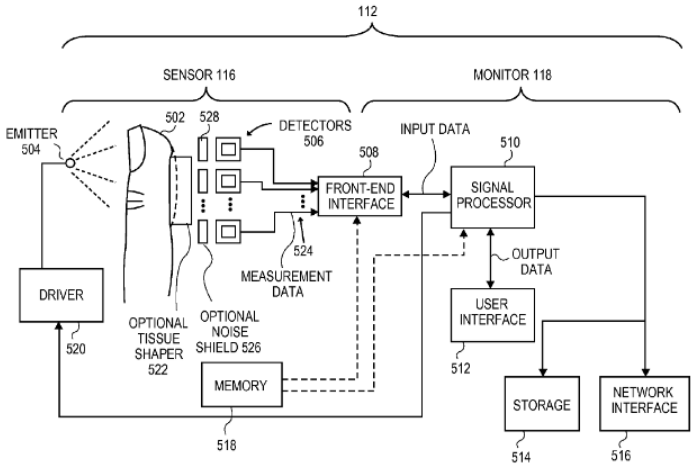
’475 Patent	Poeze
	or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose. Poeze at [0100] The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver 520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million. Poeze at [0117] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like.

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	Poeze at [0118] The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510 can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127]  FIG. 8 Poeze at Fig. 8

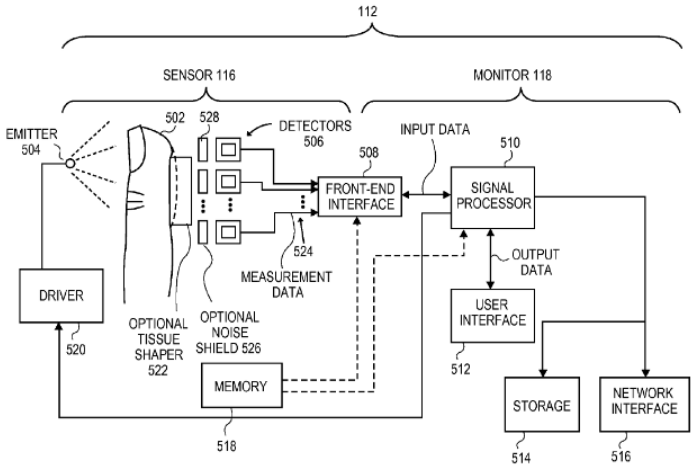
’475 Patent	Poeze
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	Poeze discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. Embodiments of the present disclosure provide a portable health organizer that enables patients and healthcare personnel to manage health data, and in particular, physiological reading data from one or more health data collection devices such as a glucometer or pulse oximeter. In an embodiment, the personal health organizer is a dedicated portable device that is adapted to retrieve reading data from a health data collection device, which is a noninvasive device in an embodiment and an invasive device in another embodiment. See above at claim 1[b], 1[e], 1[l], [5] Poeze at [0009] FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A.

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	In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034]  FIG. 2A  FIG. 2B Poeze at Fig. 2A & 2B The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB) or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose. Poeze at [0100] The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described

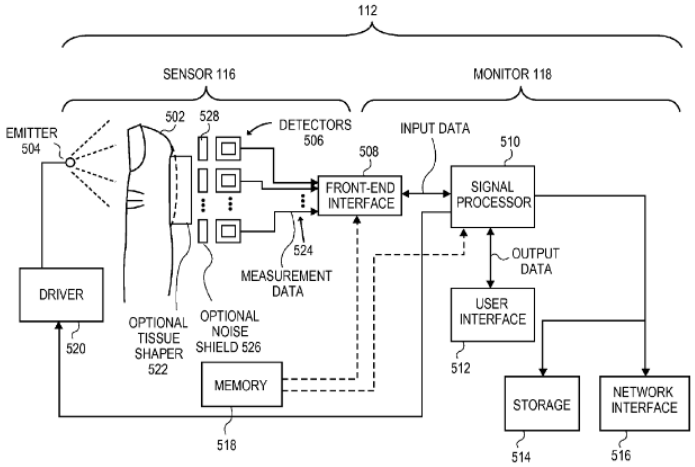
’475 Patent	Poeze
	primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] The data collection device 112 also includes a driver 520 that drives the emitter 504. The driver 520 can be a circuit or the like that is controlled by the monitor 118. For example, the driver 520 can provide pulses of current to the emitter 504. In an embodiment, the driver 520 drives the emitter 504 in a progressive fashion, such as in an alternating manner. The driver 520 can drive the emitter 504 with a series of pulses of about 1 milliwatt (mW) for some wavelengths that can penetrate tissue relatively well and from about 40 mW to about 100 mW for other wavelengths that tend to be significantly absorbed in tissue. A wide variety of other driving powers and driving methodologies can be used in various embodiments. Poeze at [0116] The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver 520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million. Poeze at [0117] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118] The signal processor 510 can provide various signals that control the operation of the sensor 116. For example, the signal processor 510 can provide an emitter control signal to the driver 520. This control signal can be useful in order to synchronize, minimize, or reduce jitter in the timing of pulses emitted from the emitter 504. Accordingly, this control signal can be useful in order to cause optical radiation pulses emitted from the emitter 504 to follow a precise timing and consistent pattern. For example, when a transimpedance-based front-end interface 508 is used, the control signal from the signal processor 510

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	can provide synchronization with the ADC in order to avoid aliasing, cross-talk, and the like. As also shown, an optional memory 518 can be included in the front-end interface 508 and/or in the signal processor 510. This memory 518 can serve as a buffer or storage location for the front-end interface 508 and/or the signal processor 510, among other uses. Poeze at [0127]  FIG. 8 Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the	Poeze discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.

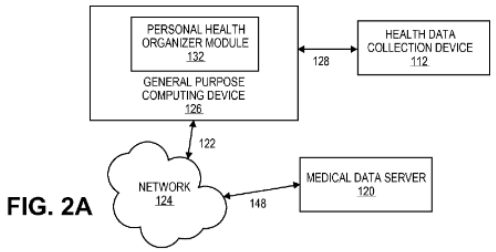
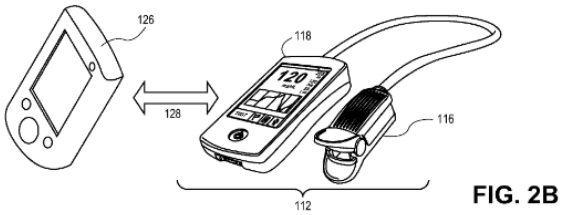
’475 Patent	Poeze
wearable device is being worn by the user.	The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB) or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose. Poeze at [0100] The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101] The detectors 506 capture and measure light from the measurement site 502. For example, the detectors 506 can capture and measure light transmitted from the emitter 504 that has been attenuated or reflected from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze at [0118]

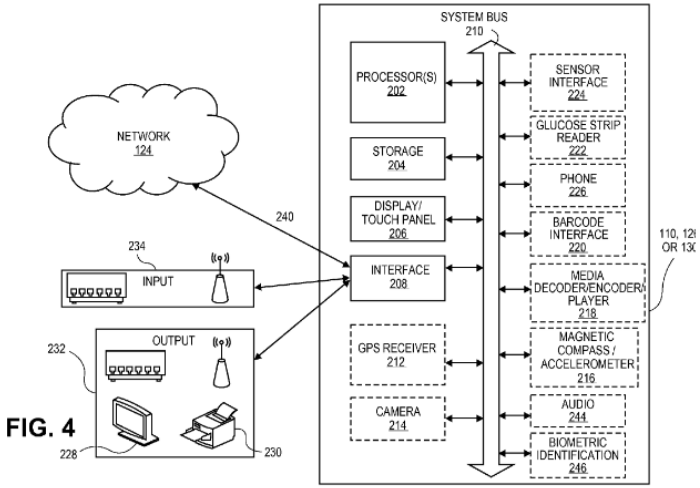
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	 FIG. 8 Poeze at Fig. 8 The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in

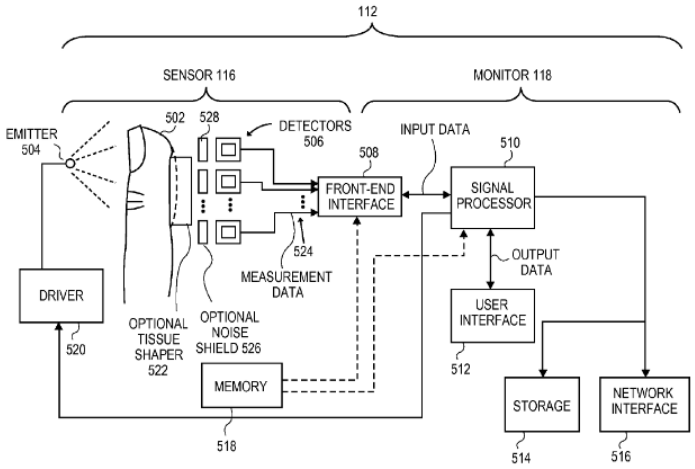
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	modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. Poeze discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. For example, the emitter 504 can emit optical radiation across other spectra for other analytes. In particular, the emitter 504 can employ light wavelengths to measure various blood analytes or percentages (e.g., saturation) thereof. For example, in an embodiment, the emitter 504 can emit optical radiation in the form of pulses at wavelengths about 905 nm, about 1050 nm, about 1200 nm, about 1300 nm, about 1330 nm, about 1610 nm, about 1640 nm, and about 1665 nm. In another embodiment, the emitter 504 can emit optical radiation ranging from about 860 nm to about 950 nm, about 950 nm to about 1100 nm, about 1100 nm to about 1270 nm, about 1250 nm to about 1350 nm, about 1300 nm to about 1360 nm, and about 1590 nm to about 1700 nm. Of course, the emitter 504 can transmit any of a variety of wavelengths of visible or near-infrared optical radiation. Poeze at [0111] The emitter 504 can also use super luminescent LEDs (SLEDs) or side-emitting LEDs. In some embodiments, the emitter 504 can employ SLEDs or side-emitting LEDs to emit optical radiation at about 1600 nm to about 1700 nm. Emitter 504 can use SLEDs or side-emitting LEDs to transmit near

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	infrared optical radiation because these types of sources can transmit at high power or relatively high power, e.g., about 40 mW to about 100 mW. This higher power capability can be useful to compensate or overcome the greater attenuation of these wavelengths of light in tissue and water. For example, the higher power emission can effectively compensate and/or normalize the absorption signal for light in the mentioned wavelengths to be similar in amplitude and/or effect as other wavelengths that can be detected by one or more photodetectors after absorption. However, the embodiments of the present disclosure do not necessarily require the use of high power optical sources. For example, some embodiments may be configured to measure analytes, such as total hemoglobin (tHb), oxygen saturation (SpO2), carboxyhemoglobin, methemoglobin, etc., without the use of high power optical sources like side emitting LEDs. Instead, such embodiments may employ other types of optical sources, such as top emitting LEDs. Alternatively, the emitter 504 can use other types of sources of optical radiation, such as a laser diode, to emit near-infrared light into the measurement site 502. Poeze at [0114]  FIG. 8 Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

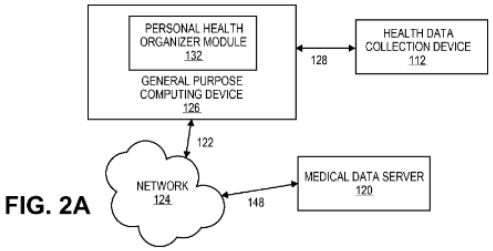
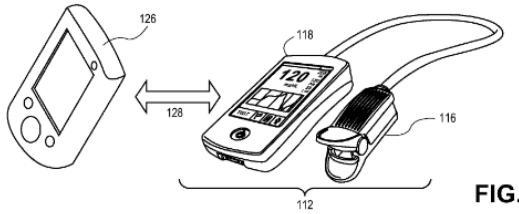
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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. Poeze discloses or renders obvious the physiological parameter of the user is associated with a blood constituent or a blood flow of the user. Embodiments of the present disclosure provide a portable health organizer that enables patients and healthcare personnel to manage health data, and in particular, physiological reading data from one or more health data collection devices such as a glucometer or pulse oximeter. In an embodiment, the personal health organizer is a dedicated portable device that is adapted to retrieve reading data from a health data collection device, which is a noninvasive device in an embodiment and an invasive device in another embodiment. Poeze at [0009] FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124.

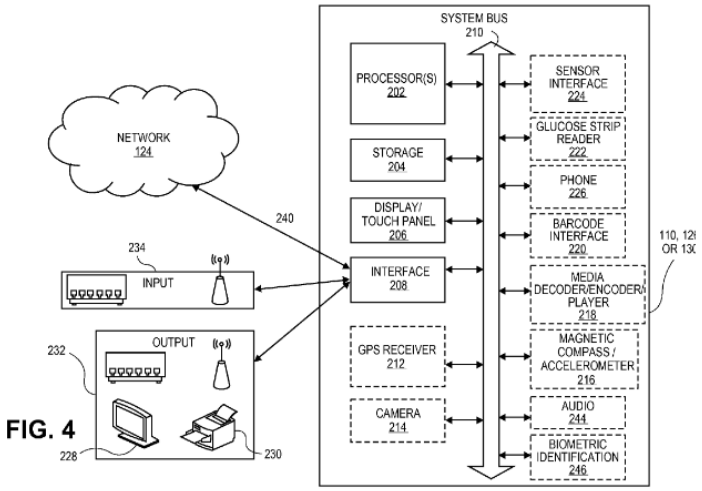
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	Poeze at [0034]  FIG. 2A  FIG. 2B Poeze at Fig. 2A & 2B As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the following components: one or more computer processor(s) 202, a storage 204, a display/touch panel 206, and an interface 208. One or more of these components can be connected together via a system bus 210. In an embodiment, the storage 204 includes (1) data storage such as a hard disk and/or removable media such as a flash drive, and/or (2) memory storage such as RAM or ROM. The processor(s) 202 can process signals received from a sensor such as the sensor 116 shown in FIGS. 1B, 2B, and 3B and derive physiological readings such as blood glucose level or other parameters from the signals. The storage 204 can include instructions or data for performing one or more methods disclosed herein. In one or more embodiments, the storage 204 includes a media card reader interface that accepts a media card such as an SD card, a microSD card, a memory stick, a CF card and the like. The portable media card can be used to store patient information and enable the personal health organizer device to be shared, with the settings and data for the individual user stored in the user's media card. The personal health organizer can also include a biometric identification module (such as a vein pattern or finger print scanner) 246 to distinguish one user from another or provide security for information stored.

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	Poeze at [0040]  FIG. 4 Poeze at Fig. 4 FIG. 8 is a block diagram that illustrates the components of an example of a health data collection device 112. In certain embodiments, the health data collection device 112 noninvasively measures a blood analyte, such as oxygen, carbon monoxide, methemoglobin, total hemoglobin, glucose, proteins, glucose, lipids, a percentage thereof (e.g., saturation) or for measuring many other physiologically relevant patient characteristics. The device 112 can also measure additional blood analytes and/or other physiological parameters useful in determining a state or trend of wellness of a patient. Poeze at [0098]

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	 FIG. 8 Poeze at Fig. 8 The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current from the detector(s) at signal-to-noise ratios (SNRs) of about 100 decibels (dB) or more, such as about 120 dB in order to measure various desired analytes. The data collection device 112 can operate with a lower SNR if less accuracy is needed for an analyte like glucose. Poeze at [0100] The data collection device 112 can measure analyte concentrations, including glucose, at least in part by detecting light attenuated by a measurement site 502. The measurement site 502 can be any location on a patient's body, such as a finger, foot, ear lobe, or the like. For convenience, this disclosure is described primarily in the context of a finger measurement site 502. However, the features of the embodiments disclosed herein can be used with other measurement sites 502. Poeze at [0101]

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	In the depicted embodiment shown in FIG. 8, the sensor 116 includes an emitter 504, a tissue shaper 522, a set of detectors 506, and a front-end interface 508. The emitter 504 can serve as the source of optical radiation transmitted towards measurement site 102. As will be described in further detail below, the emitter 504 can include one or more sources of optical radiation, such as LEDs, laser diodes, incandescent bulbs with appropriate frequency-selective filters, combinations of the same, or the like. In an embodiment, the emitter 504 includes sets of optical sources that are capable of emitting visible and near-infrared optical radiation. Poeze at [0106] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	See claim 8 above. Poeze discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency. FIG. 2A depicts another embodiment with a personal health organizer software module 132 executed on a general purpose computing device 126, with the computing device 126 coupled with the health data

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	collection device 112 via a communications link 128. The communications link 128 can be a wired or wireless connection adapted to transfer data between the two devices. The personal health organizer module 132 can be an executable program on an operating system of a device such as a mobile phone, a personal digital assistant, a portable music player, an electronic book reader, a netbook, a TV media center, and a laptop or desktop computer. For example, the personal health organizer module 132 can be an application that is executed on the operating system of a mobile phone such as the iPhone manufactured by Apple, Inc., a Blackberry device manufactured by Research In Motion, Inc., the Pre manufactured by Palm, Inc, or a mobile device manufactured by HTC, Nokia, or Motorola, etc. In an embodiment, the personal health organizer software module 132 is configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIG. 1A. In an embodiment, the computing device 126 is connected to the network 124 via a communications link 122, which can be a wired or wireless connection. As with FIG. 1A, the computing device 126 can be connected to the medical data server 120 via the network 124. Poeze at [0034]  FIG. 2A  FIG. 2B Poeze at Fig. 2A & 2B As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the following components: one or more computer processor(s) 202, a storage 204, a display/touch panel

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	206, and an interface 208. One or more of these components can be connected together via a system bus 210. In an embodiment, the storage 204 includes (1) data storage such as a hard disk and/or removable media such as a flash drive, and/or (2) memory storage such as RAM or ROM. The processor(s) 202 can process signals received from a sensor such as the sensor 116 shown in FIGS. 1B, 2B, and 3B and derive physiological readings such as blood glucose level or other parameters from the signals. The storage 204 can include instructions or data for performing one or more methods disclosed herein. In one or more embodiments, the storage 204 includes a media card reader interface that accepts a media card such as an SD card, a microSD card, a memory stick, a CF card and the like. The portable media card can be used to store patient information and enable the personal health organizer device to be shared, with the settings and data for the individual user stored in the user's media card. The personal health organizer can also include a biometric identification module (such as a vein pattern or finger print scanner) 246 to distinguish one user from another or provide security for information stored. Poeze at [0040]  FIG. 4 Poeze at Fig. 4

’475 Patent	Poeze
	In addition to analyzing reading data and providing the user with reminders, alerts, and other feedback to improve the user's health, the personal health organizer in an embodiment includes the electronic medical data record integration module 322 and/or the network computing support module 302 to assist in medical data synchronization. For example, the electronic medical data record integration module 322 can provide data backup and synchronization of medical results, contacts, and other user data (music, videos, etc.). The electronic medical data record integration module 322 can also be configured to enable synchronization of emails, text messages, and voice messages. The electronic medical data record integration module 322 and/or the network computing support module 302 can also be configured to synchronize patient data to centralized medical data servers such as Google Health, Microsoft Health Vault, etc. Poeze at [0068] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is responsive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal processor 510 in the monitor 118. The front-end interface 508 can have its components assembled in the sensor 116, in the monitor 118, in connecting cabling (if used), combinations of the same, or the like. The location of the front-end interface 508 can be chosen based on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120] The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance amplifiers, that are coupled to one or more analog to digital converters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end interface 508 can employ single-ended circuitry, differential circuitry, and/or a hybrid configuration. A transimpedance-based front-end interface 508 can be useful for its sampling rate capability and freedom in modulation/demodulation algorithms. For example, this type of front-end interface 508 can advantageously facilitate the sampling of the ADCs being synchronized with the pulses emitted from the emitter 504. Poeze at [0122]

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Poeze, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Poeze, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

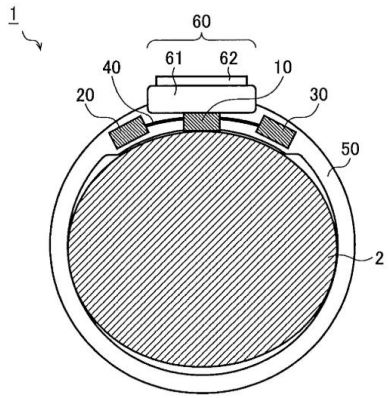
U.S. Pat. No. 12,268,475 in view of US Patent Publication No. 20120150047 to Koji Terumoto ("Terumoto")

As described in detail below, Terumoto (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Terumoto. The cited portions of Terumoto are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Terumoto. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Terumoto "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Terumoto does not expressly disclose certain limitations in the Asserted Claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Terumoto (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Terumoto anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

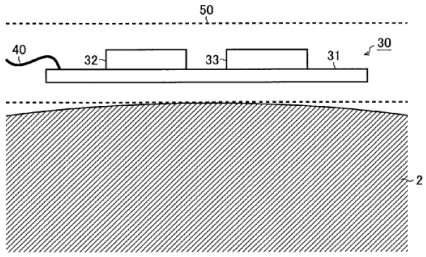
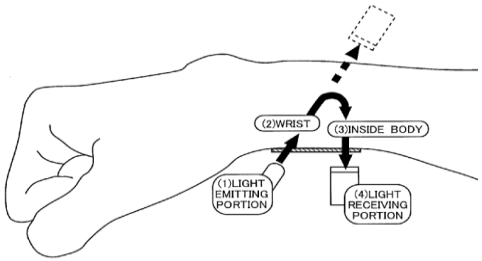
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 1	

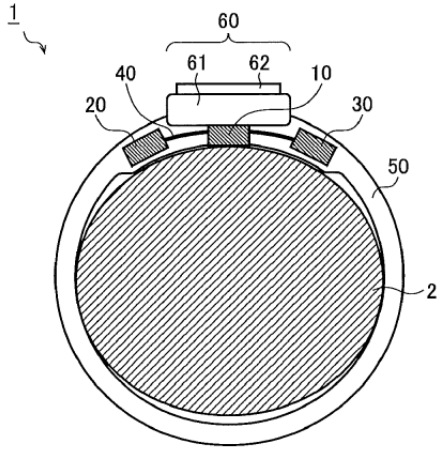
’475 Patent	Terumoto
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Terumoto discloses or renders obvious An apparatus adapted to be worn by a user comprising. In consideration of the aforementioned problems discovered by the inventers of this application, a purpose of this invention is to provide a pulse wave sensor which can measure the pulse wave without restricting a behavior of the examinee, or to provide a pulse wave sensor which can measure the pulse wave accurately by reducing an effect of the motion noise. Terumoto at [0009]  Terumoto at Fig. 3 FIG. 3 is a cross section diagram illustrating a first implementation of the pulse wave sensor schematically in accordance with the implementation example 1. The pulse wave sensor 1 of the first implementation has a construction to measure the pulse wave at the wrist 2, to be more concrete, which has an armlet construction (i.e., a wrist watch construction in the first implementation) to measure the pulse wave to be worn on the wrist 2. In addition, with respect to the construction elements, the pulse wave sensor 1 of the first implementation includes a measurement unit 10, a power source unit 20, a communication unit 30, a cable 40, an armlet type housing 50, and a display unit 60. Terumoto at [0103]

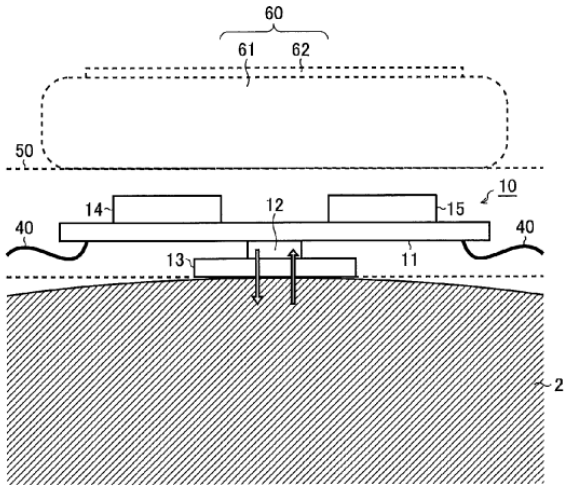
'475 Patent	Terumoto
	The measurement unit 10 is a unit to measure the pulse wave mainly, which is contained within the armlet type housing 50 to be located at the back side of the display unit 60. Owing to this construction, in a situation where the examinee turns the face to the display unit 60 to watch information (e.g., a result of the pulse wave measurement) displayed at the display unit 60, the measurement unit 10 is pressed to the wrist 2 according to the weight of the display unit 60, the pulse wave can be measured stably, furthermore, the accuracy for measuring the pulse wave can be improved. Moreover, with respect to the pulse wave measurement at the wrist, the inventors of this application confirmed it is possible to measure the pulse wave sufficiently, though the sensitivity is lower compared to the pulse wave measurement at the fingertip. In addition, the internal construction and the operation of the measurement unit 10 are explained in detail later. Terumoto at [0104] The power source unit 20 is a unit to supply power to the measurement unit 10 and the communication unit 30 mainly, the power source unit 20 is contained within the armlet type housing 50 to be located to the back side of the wrist 2 when the armlet type 50 is worn on the wrist 2. In this way, by means of locating the second unit 20 which can be a noise source for the first unit 10 separately from the first unit 10 as an another unit, the measurement accuracy of the pulse wave can be improved. In addition, an internal construction and an operation of the power source unit 20 is explained in detail later. Terumoto at [0105] The communication unit 30 is a unit to transfer the measurement data acquired at the measurement unit 10 to the outside mainly, the communication unit 30 is contained within the armlet type housing 50 to be located to the back side of the wrist 2 when the armlet type 50 is worn on the wrist 2. In this way, by means of locating the communication unit 30 which can be a noise source for the first unit 10 separately from the first unit 10 as an another unit, the measurement accuracy of the pulse wave can be improved. In addition, an internal construction and an operation of the communication unit 30 are explained in detail later. Terumoto at [0106] The armlet type housing 50 contains the measurement unit 10, the power source unit 20, the communication unit 30, and the cable 40. The armlet type housing 50 is worn on the wrist.

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	Terumoto at [0108] Especially, with respect to the first implementation which the display unit 60 is provided at the armlet type housing 50, because the pulse wave sensor 1 can be worn as wrist watch on a daily basis, resistance feeling against wearing the pulse wave sensor 1 can be eliminated, furthermore, a contribution to develop new users can be realized.\ Terumoto at [0112] The processing circuit 15 controls entire operation of the pulse wave sensor 1 generally, and also by means of performing a various signal process for the output signal of the amplifier circuit 14, it acquires various information about the pulse wave (i.e., the fluctuation of the pulse wave, the heart rate, the fluctuation of the heart rate, and the acceleration pulse wave). In addition, as the processing circuit 15, the CPU [Central Processing Unit] can be used appropriately. In this way, with respect to the construction both the light sensor 12 and the amplifier circuit 14 are located at the vicinity of the processing circuit 15, the output signal of the amplifier circuit 14 can be processed before the noise superimposes, therefore, it is possible to improve the analysis accuracy of the pulse wave. Terumoto at [0121] The battery 22 is a power supply source required to drive the pulse wave sensor 1, a lithium ion secondary battery or an electrical double layer capacitor can be used appropriately. In this way, with respect to the pulse wave sensor 1 of battery drive type, there is no need to connect a power supply cable from outside during the measurement of the pulse wave. Measurement of the pulse wave can be realized without restricting the behavior of the examinee. In addition, according to this construction, the battery 22 formed as highly flat is located right above the wrist 2, it is possible to improve an affinity of the pulse wave sensor 1 when the pulse sensor 1 is worn on the wrist 2, furthermore, the consciousness of the examinee for wearing the pulse wave sensor 1 can be reduced. Terumoto at [0124]

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	FIG. 6  Terumoto at Fig. 6 FIG. 1  Terumoto at Fig. 1 The wireless communication circuit 33 transmits the measurement data acquired at the measurement unit 10 (i.e., the raw data provided from the amplifier circuit 14, the processed data various processes has performed provided from the processing circuit 15, or the stored data provided from the memory 32) to the external personal computer or a cell phone. Because the wireless communication circuit 33 can be a noise source for the measurement unit 10 same as the power source circuit 23, it is desirable to embed the wireless communication circuit 33 to the communication unit 30 independent from the measurement

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	unit 10. In addition, with respect to the wireless communication circuit 33, the Bluetooth (the registered trademark) module IC can be used appropriately for example. With respect to a construction having such wireless communication circuit 33, the wired connection is not required to transmit the measurement data to the external apparatus, it makes possible to perform a real time transmission for the measurement data without restricting the behavior of the examinee. In addition, for designing the armlet type housing 50 as the water-proof construction, in terms of eliminating external terminals completely, it is desirable to adopt non-contact. Terumoto at [0130] FIG. 7 is a cross section diagram illustrating a second implementation of the pulse wave sensor schematically in accordance with the implementation example 1. With respect to the pulse wave sensor 1 in accordance with the second implementation, both the power source unit 20 and the communication 30 are contained to the armlet type housing 50 to be located at the inside of the wrist 2 when the armlet type housing 50 is worn on the wrist 2. In this way, by means of locating the power source unit 20 and the communication unit 30 which can be a noise source for the measurement unit 10 from the measurement unit 10 as far as possible, the measurement accuracy of the pulse wave can be improved. Terumoto at [0131] FIG. 9 is a schematic diagram to explain a first wearing state of the pulse sensor 1 (i.e., a state where the pulse wave sensor 1 is worn with the display unit 60 is located at the back side of the wrist 2). FIG. 10 is a schematic diagram to explain a second wearing state of the pulse sensor 1 (i.e., a state where the pulse wave sensor 1 is worn with the display unit 60 is located at the inside of the wrist 2). Terumoto at [0134] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..

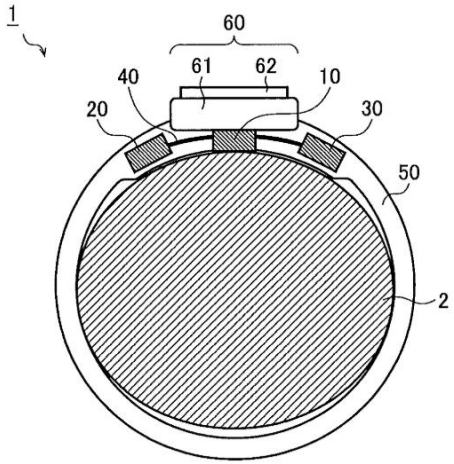
’475 Patent	Terumoto
1[a]. one or more biosensors adapted to be placed on the user,	Terumoto discloses or renders obvious one or more biosensors adapted to be placed on the user. FIG. 3  Terumoto at Fig. 3 FIG. 3 is a cross section diagram illustrating a first implementation of the pulse wave sensor schematically in accordance with the implementation example 1. The pulse wave sensor 1 of the first implementation has a construction to measure the pulse wave at the wrist 2, to be more concrete, which has an armlet construction (i.e., a wrist watch construction in the first implementation) to measure the pulse wave to be worn on the wrist 2. In addition, with respect to the construction elements, the pulse wave sensor 1 of the first implementation includes a measurement unit 10, a power source unit 20, a communication unit 30, a cable 40, an armlet type housing 50, and a display unit 60. Terumoto at [0103]

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	FIG. 4  Terumoto at Fig. 4 FIG. 4 is a cross section diagram illustrating a construction example of the measurement unit 10 schematically. The measurement unit 10 of this construction example includes a substrate 11, a light sensor 12, a measurement window 13, an amplifier circuit 14, and the processing circuit 15. Terumoto at [0116] The light sensor 12 is mounted to the surface of the substrate 11 directly, the amplifier circuit 14 and the processing circuit 15 are mounted to the back side of the substrate 11 directly. Moreover, the cable 40 to establish an electrical connection with the power source unit 20 and the communication unit 30 are connected to the substrate 11. In addition, the electrical connection is established between the surface and back side of the substrate 11 by means of a through hole and a via hole. In this way, with respect to a construction to directly mount the light sensor 12, the amplifier circuit 14, and the processing circuit 15, then the measurement unit 10 can be designed as thin, the wear feeling of the pulse wave sensor 1 can be improved. Furthermore, with respect to the construction to mount only the light sensor 12 to the

'475 Patent	Terumoto
	surface of the substrate 11, the light sensor 12 can be located at the vicinity of the wrist 2 as much as possible, then the measurement accuracy of the pulse wave can be improved. Terumoto at [0117] Owing to this construction, regardless of wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by at least one of the measurement unit 10 a to 10 c. The reason is explained concretely later in reference to FIG. 9 and FIG. 10. Terumoto at [0133] FIG. 9 is a schematic diagram to explain a first wearing state of the pulse sensor 1 (i.e., a state where the pulse wave sensor 1 is worn with the display unit 60 is located at the back side of the wrist 2). FIG. 10 is a schematic diagram to explain a second wearing state of the pulse sensor 1 (i.e., a state where the pulse wave sensor 1 is worn with the display unit 60 is located at the inside of the wrist 2). Terumoto at [0134] With respect to the inside of the wrist 2, though fit feeling of the pulse wave sensor 1 around the center portion is scanty because of the tendon located right beneath the skin, fit feeling of the pulse wave sensor 1 around the both ends is fine because of the thick flesh. Accordingly, with respect to the first wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement units 10 a and 10 c located at both ends of the measurement unit row. Terumoto at [0135] On the other hand, with respect to the back side of the wrist 2, though fit feeling of the pulse wave sensor 1 around both ends is scanty because of the born located right beneath the skin, fit feeling of the pulse wave sensor 1 around center portion is fine because of the thick flesh. Accordingly, with respect to the second wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement unit 10 b located at the center of the measurement unit row. Terumoto at [0136]

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	As mentioned above, with respect to the first wearing state of the pulse wave sensor 1, measurement units 10 a and 10 c located at both ends of the measurement unit row are able to measure the pulse wave accurately than the measurement unit 10 b located at the center of the measurement unit row. With respect to the second wearing state of the pulse wave sensor 2, measurement unit 10 b located at the center of the measurement unit row is able to measure the pulse wave accurately than the measurement units 10 a and 10 c located at both ends of the measurement units. Terumoto at [0137] To put it the other way around, the necessity of the operation of the measurement unit 10 b is scanty with respect to the first wearing state of the pulse wave sensor 1, the necessity of the operation of the measurement unit 10 a and 10 c is scanty with respect to the second wearing state of the pulse wave sensor 2. Terumoto at [0138] 31. A pulse wave sensor comprising: multiple light sensor portions to detect an intensity of the light emitted to an wrist and penetrates a living body, a controller to perform an addition or a subtraction for each output of the multiple light sensor portions, and an armlet type housing to contain the multiple light sensor portions and the controller. Terumoto at Claim 31 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are	Terumoto discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and

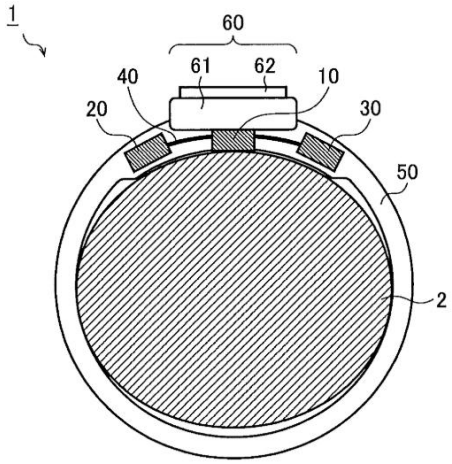
'475 Patent	Terumoto
measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. Moreover, with respect to the pulse wave sensor in accordance with the construction 1-3, the measurement unit includes a light sensor to detect an intensity of the light emitted to the wrist and penetrates a living body (i.e., construction 1-4). Terumoto at [0013] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. <What is Learned from the Pulse Wave> Terumoto at [0101]

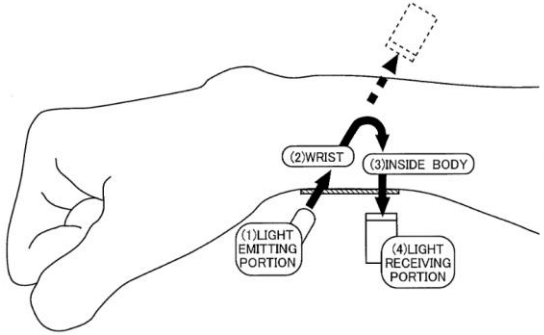
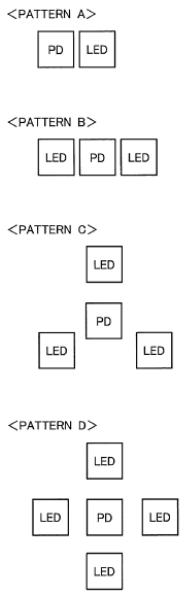
’475 Patent	Terumoto
	 Terumoto at Fig. 3 FIG. 3 is a cross section diagram illustrating a first implementation of the pulse wave sensor schematically in accordance with the implementation example 1. The pulse wave sensor 1 of the first implementation has a construction to measure the pulse wave at the wrist 2, to be more concrete, which has an armlet construction (i.e., a wrist watch construction in the first implementation) to measure the pulse wave to be worn on the wrist 2. In addition, with respect to the construction elements, the pulse wave sensor 1 of the first implementation includes a measurement unit 10, a power source unit 20, a communication unit 30, a cable 40, an armlet type housing 50, and a display unit 60. Terumoto at [0103] The measurement unit 10 is a unit to measure the pulse wave mainly, which is contained within the armlet type housing 50 to be located at the back side of the display unit 60. Owing to this construction, in a situation where the examinee turns the face to the display unit 60 to watch information (e.g., a result of the pulse wave measurement) displayed at the display unit 60, the measurement unit 10 is pressed to the wrist 2 according to the weight of the display unit 60, the pulse wave can be measured stably, furthermore, the accuracy for measuring the pulse wave can be improved. Moreover, with respect to the pulse wave measurement at the wrist, the inventors of this application confirmed it is possible to measure the pulse wave sufficiently, though the sensitivity is lower compared to the pulse wave measurement at

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	the fingertip. In addition, the internal construction and the operation of the measurement unit 10 are explained in detail later. Terumoto at [0104] The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] The amplifier circuit 14 amplifies the output signal (i.e., a detection signal of the light receiving portion) of the light sensor 12 and provides it to the processing circuit 15. In this way, with respect to a construction to equip the amplifier circuit 14 to the vicinity of the light sensor 12, the output signal of the light sensor 12 can be amplified before the noise is superimposed, then it makes possible to improve S/N [Signal/Noise Ratio] of the signal, furthermore, the measurement accuracy of the pulse wave can be improved. Terumoto at [0120] The processing circuit 15 controls entire operation of the pulse wave sensor 1 generally, and also by means of performing a various signal process for the output signal of the amplifier circuit 14, it acquires various information about the pulse wave (i.e., the fluctuation of the pulse wave, the heart rate, the fluctuation of the heart rate, and the acceleration pulse wave). In addition, as the processing circuit 15, the CPU [Central Processing Unit] can be used appropriately. In this way, with respect to the construction both the light sensor 12 and the amplifier circuit 14 are located at the vicinity of the processing circuit 15, the output signal of the amplifier circuit 14 can be processed before the noise superimposes, therefore, it is possible to improve the analysis accuracy of the pulse wave. Terumoto at [0121]

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	With respect to the inside of the wrist 2, though fit feeling of the pulse wave sensor 1 around the center portion is scanty because of the tendon located right beneath the skin, fit feeling of the pulse wave sensor 1 around the both ends is fine because of the thick flesh. Accordingly, with respect to the first wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement units 10 a and 10 c located at both ends of the measurement unit row Terumoto at [0135] As mentioned above, with respect to the first wearing state of the pulse wave sensor 1, measurement units 10 a and 10 c located at both ends of the measurement unit row are able to measure the pulse wave accurately than the measurement unit 10 b located at the center of the measurement unit row. With respect to the second wearing state of the pulse wave sensor 2, measurement unit 10 b located at the center of the measurement unit row is able to measure the pulse wave accurately than the measurement units 10 a and 10 c located at both ends of the measurement units. Terumoto at [0137] 1. A pulse wave sensor comprising: a construction to measure a pulse wave at a wrist. Terumoto at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having	Terumoto discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths.

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one or more optical wavelengths;	Moreover, with respect to the pulse wave sensor in accordance with the construction 1-4, wherein an output wavelength of the light sensor belongs to the visible light region and is smaller than or equal to 600 nm approximately (i.e., construction 1-5). Terumoto at [0014] Moreover, with respect to the pulse wave sensor in accordance with the construction 2-1 to 2-8, wherein output wavelengths of the multiple light sensor portions belong to the visible light region and are smaller than or equal to 600 nm approximately (i.e., construction 2-9). Terumoto at [0043] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount oflight attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhe-moglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorp-tion level of the peripheral arterial can be measured and plethysmogram can be measured. Terumoto at [0101]

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	 Terumoto at Fig. 3 FIG. 3 is a cross section diagram illustrating a first implementation of the pulse wave sensor schematically in accordance with the implementation example 1. The pulse wave sensor 1 of the first implementation has a construction to measure the pulse wave at the wrist 2, to be more concrete, which has an armlet construction (i.e., a wrist watch construc-tion in the first implementation) to measure the pulse wave to be worn on the wrist 2. In addition, with respect to the con-struction elements, the pulse wave sensor 1 of the first imple-mentation includes a measurement unit 10, a power source unit 20, a communication unit 30, a cable 40, an armlet type housing 50, and a display unit 60. Terumoto at [0103] The power source unit 20 is a unit to supply power to the measurement unit 10 and the communication unit 30 mainly, the power source unit 20 is contained within the armlet type housing 50 to be located to the back side of the wrist 2 when the armlet type 50 is worn on the wrist 2. In this way, by means oflocating the second unit 20 which can be a noise source for the first unit 10 separately from the first unit 10 as an another unit, the measurement accuracy of the pulse wave can be improved. In addition, an internal construction and an operation of the power source unit 20 is explained in detail later. Terumoto at [0105]

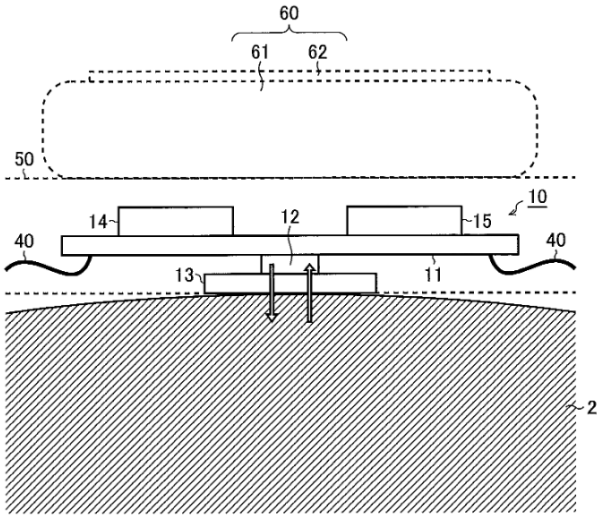
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	 Terumoto at Fig. 1 The armlet type housing 50 contains the measure-ment unit 10, the power source unit 20, the communication unit 30, and the cable 40. The armlet type housing 50 is worn on the wrist. Terumoto at [0108] FIG. 14 

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	Terumoto at Fig. 14 FIG. 14 is a cross section diagram illustrating a layout patterns A to D of a light emitting portion and a light receiving portion forming the light sensor 12 of the measurement unit 10. As illustrated in FIG. 14, for the light emitting portion LED and the light receiving portion PD, either layout patterns of 1 by 1 (i.e., layout patter A), 2 by 1 (i.e., layout pattern B), 3 by 1 (i.e., layout pattern C), and 4 by 1 (i.e., layout pattern D), and so on, can be adopted. In addition, in the case of adopting the layout patterns B to D, it is desirable to locate multiple light emitting portions (i.e., LED) to vertex of the regular polygon and to locate the light receiving portion to weighted center of the regular polygon. <Consideration about the Output Wave Length> Terumoto at [0148] In the experiment, by means of the pulse wave sen-sor 1 of so-called reflection type, each output wave length of the light emitting portions is set to Al (infrared: 940 mm), A2 (green: 630 nm), and A3 (blue: 468 nm), and each behavior is examined when the output intensity of the light emitting portions (i.e., driving current value) are varied to 1 mA, 5 mA, and 10 mA. As the result, with respect to the visible light region whose wave length is shorter than or equal to 600 nm, it is examined that the wave form of the pulse wave can be acquired relatively easy because the absorption coefficient of oxyhemoglobin HbO2 becomes larger and the peak intensity of the measured pulse wave becomes larger. Terumoto at [0149] Each of the light sensor portions 101-1 to 101-n detects an intensity of the light emitted to the wrist 200 and penetrates a living body. The light sensor portions 101-1 to 101-n are located equally spaced from one another and to go round the armlet type housing 107 same as the fourth to sixth implementations. In addition, because the construction and the output wave length of the light sensor portions 101-1 to 101-n are same as the aforementioned light sensor 12, a redundant explanation is omitted here. Terumoto at [0152] For example, as illustrated in FIG. 18, in the case of the shaft center of the armlet type housing 107 is facing to the horizontal direction or horizontal direction approximately, according to its own weight of the armlet type housing 107, among the light sensor portions 101-1 to 101-n, the light sensor portions

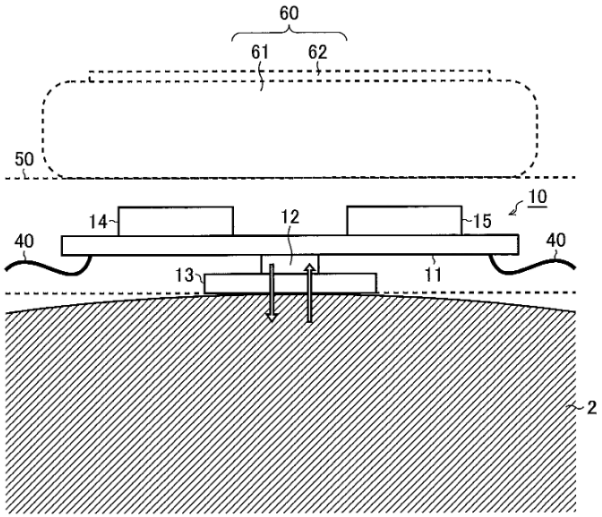
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	positioned above than the horizontal line which passes the center shaft are closely contacted to the wrist 200, and the sensors located beneath the horizontal line are apart from the wrist 200. Therefore, by turning ON the above positioned light sensor portions which are expected to perform normal pulse wave measurement, and turning OFF the beneath positioned light sensor portions which are not expected to perform normal pulse wave measurement in advance, the energy consumption can be reduced to ½ compared to all of the light sensor portions 101-1 to 101-n are turned ON without worsening the measurement accuracy of the pulse wave sensor 100. Terumoto at [0161] The first light sensor A10 is a light sensor to detect the pulse wave component mainly and includes the first light emitting portion A11, the first light receiving portion A12, and the measurement window A13. The first light emitting portion A11 emits a light of the first emission intensity P1 to the living body A2. As the first light emitting portion A11, a visible light LED or a near-infrared LED can be used. The first light receiving portion A12 receives a returned light emitted from the first light emitting portion A11 and penetrates the living body A2 and generates a first light receiving signal S1. As the first light receiving portion A12, a photo diode or a photo transistor can be used. The measurement window A13 is a translucency member (i.e., a glass plate or an acrylic plate) which is provided on the light emitting/receiving surface of the first light sensor A10. The first light sensor A10 performs the pulse wave measurement (i.e., light emission to the living body A2 and a detection of the returned light from the living body A2) via the measurement window A13. In addition, with respect to the thickness of the measurement window A13, it is desirable to design appropriately in view of the depth of focus of the first light sensor A10. Terumoto at [0190] The second light sensor A20 is a light sensor to detect the motion noise component mainly and includes the second light emitting portion A21, the second light receiving portion A22, and the measurement window A23. The second light emitting portion A21 emits a light of the second emission intensity P2 weaker than the first emission intensity P1 to the living body A2. As the second light emitting portion A21, same as the first light emitting portion A11, the visible light LED or the near-infrared LED can be used. The second light receiving portion A22 receives a returned light emitted from the second light emitting portion A21 and penetrates the living body A2 and generates a second light receiving signal S2. As the second light receiving portion A22, same as the first light receiving portion A12, a photo diode

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	or a photo transistor can be used. The measurement window A23 is a translucency member (i.e., a glass plate or an acrylic plate) which is provided on the light emitting/receiving surface of the second light sensor A20. The second light sensor A20 performs the pulse wave measurement (i.e., light emission to the living body A2 and a detection of the returned light from the living body A2) via the measurement window A23. In addition, with respect to the thickness of the measurement window A23, it is desirable to design appropriately in view of the depth of focus of the second light sensor A20. Terumoto at [0191] The pulse wave sensor according to claim 4, wherein an output wavelength of the light sensor belongs to the visible light region and is smaller than or equal to 600 nm approxi-mately. Terumoto at Claim 5 34. The pulse wave sensor according to claim 26, wherein output wavelengths of the multiple light sensor portions belong to the visible light region and are smaller than or equal to 600 nm approximately. Terumoto at Claim 34 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	Terumoto discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin. For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo

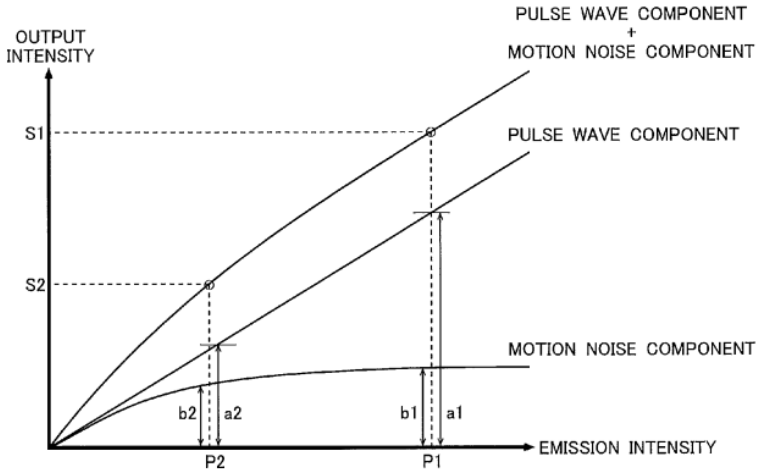
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	diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. <What is Learned from the Pulse Wave> Terumoto at [0101] FIG. 3 is a cross section diagram illustrating a first implementation of the pulse wave sensor schematically in accordance with the implementation example 1. The pulse wave sensor 1 of the first implementation has a construction to measure the pulse wave at the wrist 2, to be more concrete, which has an armlet construction (i.e., a wrist watch construction in the first implementation) to measure the pulse wave to be worn on the wrist 2. In addition, with respect to the construction elements, the pulse wave sensor 1 of the first implementation includes a measurement unit 10, a power source unit 20, a communication unit 30, a cable 40, an armlet type housing 50, and a display unit 60. Terumoto at [0103] The power source unit 20 is a unit to supply power to the measurement unit 10 and the communication unit 30 mainly, the power source unit 20 is contained within the armlet type housing 50 to be located to the back side of the wrist 2 when the armlet type 50 is worn on the wrist 2. In this way, by means oflocating the second unit 20 which can be a noise source for the first unit 10 separately from the first unit 10 as an another unit, the measurement accuracy of the pulse wave can be improved. In addition, an internal construction and an operation of the power source unit 20 is explained in detail later. Terumoto at [0105]

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	 Terumoto at Fig. 4 The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] With respect to the inside of the wrist 2, though fit feeling of the pulse wave sensor 1 around the center portion is scanty because of the tendon located right beneath the skin, fit feeling of the pulse wave sensor 1 around the both ends is fine because of the thick flesh. Accordingly, with respect to the first wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement units 10 a and 10 c located at both ends of the measurement unit row. Terumoto at [0135]

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	On the other hand, with respect to the back side of the wrist 2, though fit feeling of the pulse wave sensor 1 around both ends is scanty because of the born located right beneath the skin, fit feeling of the pulse wave sensor 1 around center portion is fine because of the thick flesh. Accordingly, with respect to the second wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement unit 10 b located at the center of the measurement unit row. Terumoto at [0136] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	Terumoto discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. By emitting the light from the light emitting portion to the wrist 2 and detect the intensity of the light which penetrates the living body by the light receiving portion, the light sensor 12 acquires the pulse wave data. In addition, the light sensor 12 in accordance with this construction example is not a construction both the light emitting portion and the light receiving portion are provided at opposite side against the wrist 2 each other (i.e., a so-called penetration type, in reference to a broken line arrow in FIG. 1). The light sensor 12 is a construction both the light emitting portion and the light receiving portion are provided at same side against the wrist 2 (i.e., a so-called reflection type, in reference to a full line arrow in FIG. 1). Terumoto at [0118]

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	 Terumoto at Fig. 4 The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] The amplifier circuit 14 amplifies the output signal (i.e., a detection signal of the light receiving portion) of the light sensor 12 and provides it to the processing circuit 15. In this way, with respect to a construction to equip the amplifier circuit 14 to the vicinity of the light sensor 12, the output signal of the light sensor 12 can be amplified before the noise is superimposed, then it makes possible to improve S/N [Signal/Noise Ratio] of the signal, furthermore, the measurement accuracy of the pulse wave can be improved. Terumoto at [0120]

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	The power source circuit 23 converts the input voltage from the battery 22 to an intended output voltage and supply it to each part of the pulse wave sensor 1. In this way, by means of embedding the power source circuit 23 which can be a noise source for the measurement unit 10 to the power source unit 20 which is independent from the measurement unit 10, the measurement accuracy of the pulse wave can be improved. Terumoto at [0125] In step S105, with respect to the measurement data measured by each of the light sensors portion which is turned ON in step S101 among the light sensor portions 101-1 to 101-*n*, a judgment whether or not the frequency of each output peak is within the predetermined range is performed, based on the judgment result, ON/OFF control of each of the light sensor portions 101-1 to 101-*n* is performed. To be more concrete, with respect to its frequency of output peak is not within the range of 60 bpm to 200 bpm [beats per minutes], the light sensor portion is turned OFF as interpreted frequency abnormality (e.g., noise superimpose, etc) is occurred. Terumoto at [0167] For example, among the light sensor portions X to Z in FIG. 20, with respect to the measurement data of the light sensor portions X and Y, though the frequencies FX and FY of output peak are within the predetermined range, with respect to the measurement data of the light sensor portion Z, the frequency FZ of output peak is not within the predetermined range because of the noise. Therefore, by turning OFF the light sensor portion Z which is not expected to measure the pulse wave normally in advance, further reduction of the energy consumption can be realized without worsening the measurement accuracy of the pulse wave Terumoto at [0168] Moreover, as illustrated in FIG. 22, a method can be considered to generate the subtracted output (i.e., A-B) by subtracting the output B including only the noise component (i.e., an output of the light sensor B which is provided additionally to detect only for the dark current) from the output A of the light sensor portion A which a noise component is superimposed. Owing to performing this operation process, the noise component can be removed and S/N ratio can be improved.

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	Terumoto at [0173] FIG. 27  Terumoto at Fig. 27 FIG. 27 is a correlation diagram illustrating a relationship between light emission intensity and output intensity. As illustrated in FIG. 27, the pulse wave component and the motion noise component are included to each of the first light receiving signal S1 and the second light receiving signal S2. Here, the inventor of this application gets new knowledge that there is a difference of sensitivity against the light emission alternation about the relationship between the pulse wave component and the motion noise component, based on the dedicated examination. To be more concrete, the sensitivity of the pulse wave component is high against the light emission intensity alternation, the higher the light emission intensity is enhanced, the larger the pulse wave component included in the light receiving signal becomes (in reference to a1 and a2 in FIG. 27). On the other hand, because the sensitivity of the motion noise component is low against the light emission intensity alternation, the motion noise component included

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	in the light receiving signal does not become so large even if the light emission intensity is enhanced (in reference to b1 and b2 in FIG. 27). Terumoto at [0200] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Terumoto discloses or renders obvious, the detection system is configured to be synchronized to the light source. For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount oflight attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhe-moglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorp-tion level of the peripheral arterial can be measured and plethysmogram can be measured. Terumoto at [0101] By emitting the light from the light emitting portion to the wrist 2 and detect the intensity of the light which penetrates the living body by the light receiving portion, the light sensor 12 acquires the pulse wave data. In addition, the light sensor 12 in accordance with this construction example is not a construction both the light emitting portion and the light receiving portion are provided at opposite side

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	against the wrist 2 each other (i.e., a so-called penetration type, in reference to a broken line arrow in FIG. 1). The light sensor 12 is a construction both the light emitting portion and the light receiving portion are provided at same side against the wrist 2 (i.e., a so-called reflection type, in reference to a full line arrow in FIG. 1). Terumoto at [0118] The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] FIG. 14 is a cross section diagram illustrating a layout patterns A to D of a light emitting portion and a light receiving portion forming the light sensor 12 of the measurement unit 10. As illustrated in FIG. 14, for the light emitting portion LED and the light receiving portion PD, either layout patterns of 1 by 1 (i.e., layout patter A), 2 by 1 (i.e., layout pattern B), 3 by 1 (i.e., layout pattern C), and 4 by 1 (i.e., layout pattern D), and so on, can be adopted. In addition, in the case of adopting the layout patterns B to D, it is desirable to locate multiple light emitting portions (i.e., LED) to vertex of the regular polygon and to locate the light receiving portion to weighted center of the regular polygon. Terumoto at [0148] In the experiment, by means of the pulse wave sen-sor 1 of so-called reflection type, each output wave length of the light emitting portions is set to Al (infrared: 940 mm), A2 (green: 630 nm), and A3 (blue: 468 nm), and each behavior is examined when the output intensity of the light emitting portions (i.e., driving current value) are varied to 1 mA, 5 mA, and 10 mA. As the result, with respect to the visible light region whose wave length is shorter than or equal to 600 nm, it is examined that the wave form of the pulse wave can be acquired relatively easy because the absorption coefficient of oxyhemoglobin HbO2 becomes larger and the peak intensity of the measured pulse wave becomes larger.

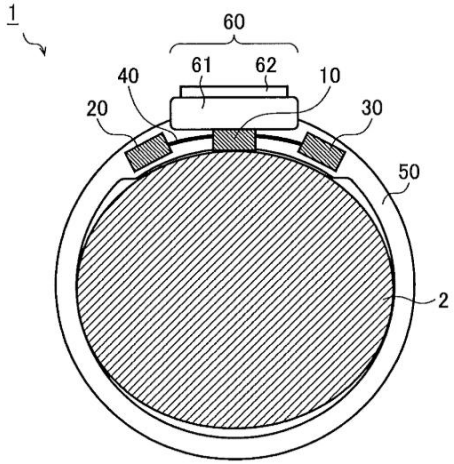
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	Terumoto at [0149] For example, among the light sensor portions X to Z in FIG. 20, with respect to the measurement data of the light sensor portions X and Y, though the frequencies FX and FY of output peak are within the predetermined range, with respect to the measurement data of the light sensor portion Z, the frequency FZ of output peak is not within the predetermined range because of the noise. Therefore, by turning OFF the light sensor portion Z which is not expected to measure the pulse wave normally in advance, further reduction of the energy consumption can be realized without worsening the measurement accuracy of the pulse wave Terumoto at [0168] The pulse wave sensor according to claim 4, wherein an output wavelength of the light sensor belongs to the visible light region and is smaller than or equal to 600 nm approxi-mately. Terumoto at Claim 5 26. A pulse wave sensor comprising: multiple light sensor portions to detect an intensity of the light emitted to a wrist and penetrates a living body, a controller to perform ON/OFF control of each of the multiple light sensor portions, and an armlet type housing to contain the multiple light sensor portions and the controller. Terumoto at Claim 26 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	Terumoto discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. Moreover, the pulse wave sensor disclosed in this specification includes multiple light sensor portions to detect an intensity of the light emitted to a wrist and penetrates a living body, a controller to perform ON/OFF control of each of the multiple light sensor portions, and an armlet type housing to contain the multiple light sensor portions and the controller (i.e., construction 2-1). Terumoto at [0035] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. <What is Learned from the Pulse Wave> Terumoto at [0101] By emitting the light from the light emitting portion to the wrist 2 and detect the intensity of the light which penetrates the living body by the light receiving portion, the light sensor 12 acquires the pulse wave data. In addition, the light sensor 12 in accordance with this construction example is not a construction both the light emitting portion and the light receiving portion are provided at opposite side against the wrist 2 each other (i.e., a so-called penetration type, in reference to a broken line arrow in FIG. 1). The light sensor 12 is a construction both the light emitting portion and the light receiving

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	portion are provided at same side against the wrist 2 (i.e., a so-called reflection type, in reference to a full line arrow in FIG. 1). Terumoto at [0118] The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] The amplifier circuit 14 amplifies the output signal (i.e., a detection signal of the light receiving portion) of the light sensor 12 and provides it to the processing circuit 15. In this way, with respect to a construction to equip the amplifier circuit 14 to the vicinity of the light sensor 12, the output signal of the light sensor 12 can be amplified before the noise is superimposed, then it makes possible to improve S/N [Signal/Noise Ratio] of the signal, furthermore, the measurement accuracy of the pulse wave can be improved. Terumoto at [0120] Each of the light sensor portions 101-1 to 101-n detects an intensity of the light emitted to the wrist 200 and penetrates a living body. The light sensor portions 101-1 to 101-n are located equally spaced from one another and to go round the armlet type housing 107 same as the fourth to sixth implementations. In addition, because the construction and the output wave length of the light sensor portions 101-1 to 101-n are same as the aforementioned light sensor 12, a redundant explanation is omitted here. Terumoto at [0152] For example, as illustrated in FIG. 18, in the case of the shaft center of the armlet type housing 107 is facing to the horizontal direction or horizontal direction approximately, according to its own weight of the armlet type housing 107, among the light sensor portions 101-1 to 101-n, the light sensor portions

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	positioned above than the horizontal line which passes the center shaft are closely contacted to the wrist 200, and the sensors located beneath the horizontal line are apart from the wrist 200. Therefore, by turning ON the above positioned light sensor portions which are expected to perform normal pulse wave measurement, and turning OFF the beneath positioned light sensor portions which are not expected to perform normal pulse wave measurement in advance, the energy consumption can be reduced to ½ compared to all of the light sensor portions 101-1 to 101-n are turned ON without worsening the measurement accuracy of the pulse wave sensor 100. Terumoto at [0161] In step S102, among the light sensor portions 101-1 to 101-n, by using the light sensor turned ON in step S101, a measurement is performed to detect the intensity and the frequency of the output peak. With respect to the pulse wave measurement in this step, it is performed to acquire information required to select the light sensor portion furthermore, and transmission of the measured date to the outside is not performed. Terumoto at [0163] In step S103, a judgment is performed whether or not a predetermined period T has passed since the pulse wave began in step S102. If judged as YES, the flow is proceeded to step S104, if judged as NO, the flow is returned to step S102. In addition, with respect to the aforementioned predetermined period T, it should be set long enough to detect the intensity and frequency of the output peak (in reference to FIG. 20). Terumoto at [0164] 4. The pulse wave sensor according to claim 3, wherein the measurement unit comprises a light sensor to detect an intensity of the light emitted to the wrist and penetrates a living body. Terumoto at Claim 4 The pulse wave sensor according to claim 4, wherein the multiple measurement units are located equally spaced from one another around the armlet type housing.

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	Terumoto at Claim 13 26. A pulse wave sensor comprising: multiple light sensor portions to detect an intensity of the light emitted to a wrist and penetrates a living body, a controller to perform ON/OFF control of each of the multiple light sensor portions, and an armlet type housing to contain the multiple light sensor portions and the controller. Terumoto at Claim 26 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	Terumoto discloses or renders obvious the output signal is indicative of the one or more physiological parameters. Moreover, with respect to the pulse wave sensor in accordance with the construction 1-3, the measurement unit includes a light sensor to detect an intensity of the light emitted to the wrist and penetrates a living body (i.e., construction 1-4). Terumoto at [0013] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e.,

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	oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. <What is Learned from the Pulse Wave> Terumoto at [0101]  Terumoto at Fig. 3 In addition, the pulse wave controlled by a heart or autonomic nerves does not always show a constant behavior, the pulse wave gives birth the changes (i.e., fluctuations) differently based on a state of the measured person. Accordingly, based on an analysis of the pulse wave of the changes (i.e., fluctuations), various body information of the measured person can be acquired. For example, an athletic ability or tension of the measured person can be learned from the heart rate. A fatigue level, a pleasant sleep level, and a stress level of the measured person can be learned from the fluctuation of the heart rate. Furthermore, based on an acceleration pulse wave acquired by differentiating the pulse wave two times by the time axis, the blood vessel age or arterial stiffness of the measured person can be learned. Terumoto at [0102]

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	FIG. 3 is a cross section diagram illustrating a first implementation of the pulse wave sensor schematically in accordance with the implementation example 1. The pulse wave sensor 1 of the first implementation has a construction to measure the pulse wave at the wrist 2, to be more concrete, which has an armlet construction (i.e., a wrist watch construction in the first implementation) to measure the pulse wave to be worn on the wrist 2. In addition, with respect to the construction elements, the pulse wave sensor 1 of the first implementation includes a measurement unit 10, a power source unit 20, a communication unit 30, a cable 40, an armlet type housing 50, and a display unit 60. Terumoto at [0103] The measurement unit 10 is a unit to measure the pulse wave mainly, which is contained within the armlet type housing 50 to be located at the back side of the display unit 60. Owing to this construction, in a situation where the examinee turns the face to the display unit 60 to watch information (e.g., a result of the pulse wave measurement) displayed at the display unit 60, the measurement unit 10 is pressed to the wrist 2 according to the weight of the display unit 60, the pulse wave can be measured stably, furthermore, the accuracy for measuring the pulse wave can be improved. Moreover, with respect to the pulse wave measurement at the wrist, the inventors of this application confirmed it is possible to measure the pulse wave sufficiently, though the sensitivity is lower compared to the pulse wave measurement at the fingertip. In addition, the internal construction and the operation of the measurement unit 10 are explained in detail later. Terumoto at [0104] The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] The amplifier circuit 14 amplifies the output signal (i.e., a detection signal of the light receiving portion) of the light sensor 12 and provides it to the processing circuit 15. In this way, with respect to a

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	construction to equip the amplifier circuit 14 to the vicinity of the light sensor 12, the output signal of the light sensor 12 can be amplified before the noise is superimposed, then it makes possible to improve S/N [Signal/Noise Ratio] of the signal, furthermore, the measurement accuracy of the pulse wave can be improved. Terumoto at [0120] The processing circuit 15 controls entire operation of the pulse wave sensor 1 generally, and also by means of performing a various signal process for the output signal of the amplifier circuit 14, it acquires various information about the pulse wave (i.e., the fluctuation of the pulse wave, the heart rate, the fluctuation of the heart rate, and the acceleration pulse wave). In addition, as the processing circuit 15, the CPU [Central Processing Unit] can be used appropriately. In this way, with respect to the construction both the light sensor 12 and the amplifier circuit 14 are located at the vicinity of the processing circuit 15, the output signal of the amplifier circuit 14 can be processed before the noise superimposes, therefore, it is possible to improve the analysis accuracy of the pulse wave. Terumoto at [0121] With respect to the inside of the wrist 2, though fit feeling of the pulse wave sensor 1 around the center portion is scanty because of the tendon located right beneath the skin, fit feeling of the pulse wave sensor 1 around the both ends is fine because of the thick flesh. Accordingly, with respect to the first wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement units 10 a and 10 c located at both ends of the measurement unit row Terumoto at [0135] As mentioned above, with respect to the first wearing state of the pulse wave sensor 1, measurement units 10 a and 10 c located at both ends of the measurement unit row are able to measure the pulse wave accurately than the measurement unit 10 b located at the center of the measurement unit row. With respect to the second wearing state of the pulse wave sensor 2, measurement unit 10 b located at the center of the measurement unit row is able to measure the pulse wave accurately than the measurement units 10 a and 10 c located at both ends of the measurement units. Terumoto at [0137]

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	1. A pulse wave sensor comprising: a construction to measure a pulse wave at a wrist. Terumoto at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Terumoto discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. Terumoto at [0101] By emitting the light from the light emitting portion to the wrist 2 and detect the intensity of the light which penetrates the living body by the light receiving portion, the light sensor 12 acquires the pulse

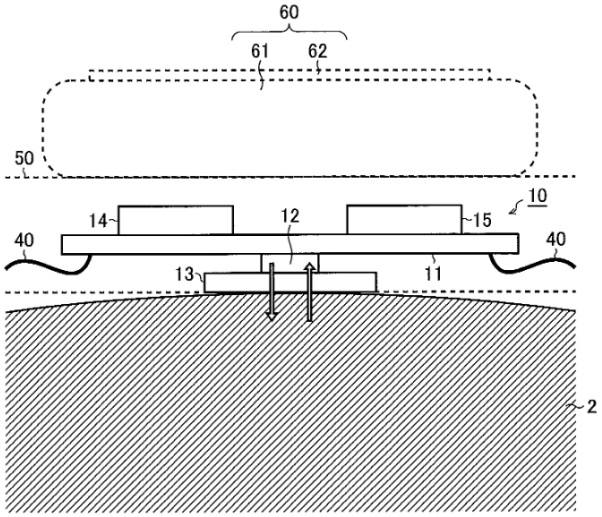
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	wave data. In addition, the light sensor 12 in accordance with this construction example is not a construction both the light emitting portion and the light receiving portion are provided at opposite side against the wrist 2 each other (i.e., a so-called penetration type, in reference to a broken line arrow in FIG. 1). The light sensor 12 is a construction both the light emitting portion and the light receiving portion are provided at same side against the wrist 2 (i.e., a so-called reflection type, in reference to a full line arrow in FIG. 1). Terumoto at [0118] The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] In step S108, a predetermined operation process is processed to the measurement data acquired in step S107. For example, as illustrated in FIG. 21, a method can be considered to generate an added output (i.e., A+B) by adding an output A of the light sensor portion A and an output B of the light sensor portion B. Owing to performing this operation process, S/N ratio can be improved by enhancing the intensity of the output peak. Terumoto at [0172] Moreover, as illustrated in FIG. 22, a method can be considered to generate the subtracted output (i.e., A-B) by subtracting the output B including only the noise component (i.e., an output of the light sensor B which is provided additionally to detect only for the dark current) from the output A of the light sensor portion A which a noise component is superimposed. Owing to performing this operation process, the noise component can be removed and S/N ratio can be improved. Terumoto at [0173]

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	The amplifier circuit 14 amplifies the output signal (i.e., a detection signal of the light receiving portion) of the light sensor 12 and provides it to the processing circuit 15. In this way, with respect to a construction to equip the amplifier circuit 14 to the vicinity of the light sensor 12, the output signal of the light sensor 12 can be amplified before the noise is superimposed, then it makes possible to improve S/N [Signal/Noise Ratio] of the signal, furthermore, the measurement accuracy of the pulse wave can be improved. Terumoto at [0120] Therefore, by subtracting second light receiving signal S2 acquired at the second light sensor A20 of relatively week second light emission intensity P2 from the first light receiving signal S1 acquired at the first light sensor A10 of the first light emission intensity P1, the motion noise included in respective signals can be counterbalanced, then pure pulse wave component can be acquired (in reference to FIG. 28). Thus, with respect to the pulse wave sensor A1 in accordance with this construction example, regardless of the movement or vibration of the examinee, the pulse wave can be measured with high accuracy, the pulse wave can be measured all day long in daily life. Terumoto at [0201] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Terumoto discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off. In step S104, with respect to the measurement data measured by each of the light sensors portion which is turned ON in step S101 among the light sensor portions 101-1 to 101-n, each output intensity and predetermined threshold value are compared, based on the comparison result, ON/OFF control of each of the light sensor portions 101-1 to 101-n is performed. To be more concrete, with respect to the data

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	whose output intensity is below than the predetermined threshold, the light sensor portion is turned OFF as interpreted output shortage is occurred. Terumoto at [0165] In step S105, with respect to the measurement data measured by each of the light sensors portion which is turned ON in step S101 among the light sensor portions 101-1 to 101-n, a judgment whether or not the frequency of each output peak is within the predetermined range is performed, based on the judgment result, ON/OFF control of each of the light sensor portions 101-1 to 101-n is performed. To be more concrete, with respect to its frequency of output peak is not within the range of 60 bpm to 200 bpm [beats per minutes], the light sensor portion is turned OFF as interpreted frequency abnormality (e.g., noise superimpose, etc) is occurred. Terumoto at [0167] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Terumoto discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. In step S102, among the light sensor portions 101-1 to 101-n, by using the light sensor turned ON in step S101, a measurement is performed to detect the intensity and the frequency of the output peak. With respect to the pulse wave measurement in this step, it is performed to acquire information required to select the light sensor portion furthermore, and transmission of the measured date to the outside is not performed. Terumoto at [0163]

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	In step S105, with respect to the measurement data measured by each of the light sensors portion which is turned ON in step S101 among the light sensor portions 101-1 to 101-n, a judgment whether or not the frequency of each output peak is within the predetermined range is performed, based on the judgment result, ON/OFF control of each of the light sensor portions 101-1 to 101-n is performed. To be more concrete, with respect to its frequency of output peak is not within the range of 60 bpm to 200 bpm [beats per minutes], the light sensor portion is turned OFF as interpreted frequency abnormality (e.g., noise superimpose, etc) is occurred. Terumoto at [0167] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Terumoto discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. In step S108, a predetermined operation process is processed to the measurement data acquired in step S107. For example, as illustrated in FIG. 21, a method can be considered to generate an added output (i.e., A+B) by adding an output A of the light sensor portion A and an output B of the light sensor portion B. Owing to performing this operation process, S/N ratio can be improved by enhancing the intensity of the output peak. Terumoto at [0172] Moreover, as illustrated in FIG. 22, a method can be considered to generate the subtracted output (i.e., A-B) by subtracting the output B including only the noise component (i.e., an output of the light sensor B which is provided additionally to detect only for the dark current) from the output A of the light sensor portion A which a noise component is superimposed. Owing to performing this operation process, the noise component can be removed and S/N ratio can be improved.

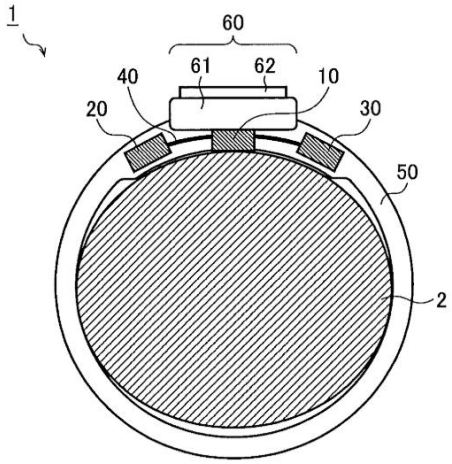
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	Terumoto at [0173] Therefore, by subtracting second light receiving signal S2 acquired at the second light sensor A20 of relatively week second light emission intensity P2 from the first light receiving signal S1 acquired at the first light sensor A10 of the first light emission intensity P1, the motion noise included in respective signals can be counterbalanced, then pure pulse wave component can be acquired (in reference to FIG. 28). Thus, with respect to the pulse wave sensor A1 in accordance with this construction example, regardless of the movement or vibration of the examinee, the pulse wave can be measured with high accuracy, the pulse wave can be measured all day long in daily life. Terumoto at [0201] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Terumoto discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured.

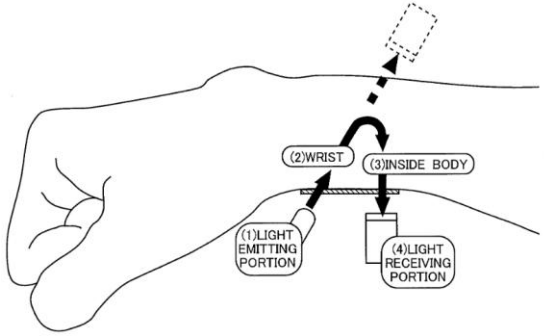
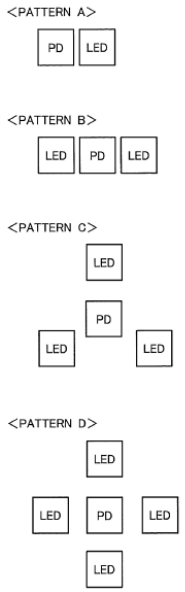
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	<What is Learned from the Pulse Wave> Terumoto at [0101]  Terumoto at Fig. 4 The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] With respect to the inside of the wrist 2, though fit feeling of the pulse wave sensor 1 around the center portion is scanty because of the tendon located right beneath the skin, fit feeling of the pulse wave sensor 1 around the both ends is fine because of the thick flesh. Accordingly, with respect to the first wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement units 10 a and 10 c located at both ends of the measurement unit row.

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	Terumoto at [0135] On the other hand, with respect to the back side of the wrist 2, though fit feeling of the pulse wave sensor 1 around both ends is scanty because of the born located right beneath the skin, fit feeling of the pulse wave sensor 1 around center portion is fine because of the thick flesh. Accordingly, with respect to the second wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement unit 10 b located at the center of the measurement unit row. Terumoto at [0136] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.	See claim 1 above. Terumoto discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.. 16. The pulse wave sensor according to claim 4 wherein the measurement unit comprises: an amplifier circuit to amplify an output signal of the light sensor, and a processing circuit to acquire information related to the pulse wave based on the output signal of the amplifier circuit. Terumoto at Claim 16 In step S103, a judgment is performed whether or not a predetermined period T has passed since the pulse wave began in step S102. If judged as YES, the flow is proceeded to step S104, if judged as NO,

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	the flow is returned to step S102. In addition, with respect to the aforementioned predetermined period T, it should be set long enough to detect the intensity and frequency of the output peak (in reference to FIG. 20). Terumoto at [0164] In step S104, with respect to the measurement data measured by each of the light sensors portion which is turned ON in step S101 among the light sensor portions 101-1 to 101-n, each output intensity and predetermined threshold value are compared, based on the comparison result, ON/OFF control of each of the light sensor portions 101-1 to 101-n is performed. To be more concrete, with respect to the data whose output intensity is below than the predetermined threshold, the light sensor portion is turned OFF as interpreted output shortage is occurred. Terumoto at [0165] In step S108, a predetermined operation process is processed to the measurement data acquired in step S107. For example, as illustrated in FIG. 21, a method can be considered to generate an added output (i.e., A+B) by adding an output A of the light sensor portion A and an output B of the light sensor portion B. Owing to performing this operation process, S/N ratio can be improved by enhancing the intensity of the output peak. Terumoto at [0172] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	
6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises	See claim 1 above.

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six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	Terumoto discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. Moreover, with respect to the pulse wave sensor in accordance with the construction 1-4, wherein an output wavelength of the light sensor belongs to the visible light region and is smaller than or equal to 600 nm approximately (i.e., construction 1-5). Terumoto at [0014] Moreover, with respect to the pulse wave sensor in accordance with the construction 2-1 to 2-8, wherein output wavelengths of the multiple light sensor portions belong to the visible light region and are smaller than or equal to 600 nm approximately (i.e., construction 2-9). Terumoto at [0043] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount oflight attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhe-moglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorp-tion level of the peripheral arterial can be measured and plethysmogram can be measured. Terumoto at [0101]

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	 Terumoto at Fig. 3 FIG. 3 is a cross section diagram illustrating a first implementation of the pulse wave sensor schematically in accordance with the implementation example 1. The pulse wave sensor 1 of the first implementation has a construction to measure the pulse wave at the wrist 2, to be more concrete, which has an armlet construction (i.e., a wrist watch construc-tion in the first implementation) to measure the pulse wave to be worn on the wrist 2. In addition, with respect to the con-struction elements, the pulse wave sensor 1 of the first imple-mentation includes a measurement unit 10, a power source unit 20, a communication unit 30, a cable 40, an armlet type housing 50, and a display unit 60. Terumoto at [0103] The power source unit 20 is a unit to supply power to the measurement unit 10 and the communication unit 30 mainly, the power source unit 20 is contained within the armlet type housing 50 to be located to the back side of the wrist 2 when the armlet type 50 is worn on the wrist 2. In this way, by means oflocating the second unit 20 which can be a noise source for the first unit 10 separately from the first unit 10 as an another unit, the measurement accuracy of the pulse wave can be improved. In addition, an internal construction and an operation of the power source unit 20 is explained in detail later. Terumoto at [0105]

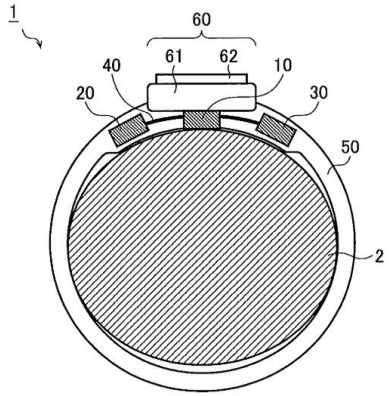
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	 Terumoto at Fig. 1 The armlet type housing 50 contains the measure-ment unit 10, the power source unit 20, the communication unit 30, and the cable 40. The armlet type housing 50 is worn on the wrist. Terumoto at [0108] FIG. 14 

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	Terumoto at Fig. 14 FIG. 14 is a cross section diagram illustrating a layout patterns A to D of a light emitting portion and a light receiving portion forming the light sensor 12 of the measurement unit 10. As illustrated in FIG. 14, for the light emitting portion LED and the light receiving portion PD, either layout patterns of 1 by 1 (i.e., layout patter A), 2 by 1 (i.e., layout pattern B), 3 by 1 (i.e., layout pattern C), and 4 by 1 (i.e., layout pattern D), and so on, can be adopted. In addition, in the case of adopting the layout patterns B to D, it is desirable to locate multiple light emitting portions (i.e., LED) to vertex of the regular polygon and to locate the light receiving portion to weighted center of the regular polygon. <Consideration about the Output Wave Length> Terumoto at [0148] In the experiment, by means of the pulse wave sen-sor 1 of so-called reflection type, each output wave length of the light emitting portions is set to Al (infrared: 940 mm), A2 (green: 630 nm), and A3 (blue: 468 nm), and each behavior is examined when the output intensity of the light emitting portions (i.e., driving current value) are varied to 1 mA, 5 mA, and 10 mA. As the result, with respect to the visible light region whose wave length is shorter than or equal to 600 nm, it is examined that the wave form of the pulse wave can be acquired relatively easy because the absorption coefficient of oxyhemoglobin HbO2 becomes larger and the peak intensity of the measured pulse wave becomes larger. Terumoto at [0149] Each of the light sensor portions 101-1 to 101-n detects an intensity of the light emitted to the wrist 200 and penetrates a living body. The light sensor portions 101-1 to 101-n are located equally spaced from one another and to go round the armlet type housing 107 same as the fourth to sixth implementations. In addition, because the construction and the output wave length of the light sensor portions 101-1 to 101-n are same as the aforementioned light sensor 12, a redundant explanation is omitted here. Terumoto at [0152] For example, as illustrated in FIG. 18, in the case of the shaft center of the armlet type housing 107 is facing to the horizontal direction or horizontal direction approximately, according to its own weight of the armlet type housing 107, among the light sensor portions 101-1 to 101-n, the light sensor portions

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	positioned above than the horizontal line which passes the center shaft are closely contacted to the wrist 200, and the sensors located beneath the horizontal line are apart from the wrist 200. Therefore, by turning ON the above positioned light sensor portions which are expected to perform normal pulse wave measurement, and turning OFF the beneath positioned light sensor portions which are not expected to perform normal pulse wave measurement in advance, the energy consumption can be reduced to ½ compared to all of the light sensor portions 101-1 to 101-n are turned ON without worsening the measurement accuracy of the pulse wave sensor 100. Terumoto at [0161] The first light sensor A10 is a light sensor to detect the pulse wave component mainly and includes the first light emitting portion A11, the first light receiving portion A12, and the measurement window A13. The first light emitting portion A11 emits a light of the first emission intensity P1 to the living body A2. As the first light emitting portion A11, a visible light LED or a near-infrared LED can be used. The first light receiving portion A12 receives a returned light emitted from the first light emitting portion A11 and penetrates the living body A2 and generates a first light receiving signal S1. As the first light receiving portion A12, a photo diode or a photo transistor can be used. The measurement window A13 is a translucency member (i.e., a glass plate or an acrylic plate) which is provided on the light emitting/receiving surface of the first light sensor A10. The first light sensor A10 performs the pulse wave measurement (i.e., light emission to the living body A2 and a detection of the returned light from the living body A2) via the measurement window A13. In addition, with respect to the thickness of the measurement window A13, it is desirable to design appropriately in view of the depth of focus of the first light sensor A10. Terumoto at [0190] The second light sensor A20 is a light sensor to detect the motion noise component mainly and includes the second light emitting portion A21, the second light receiving portion A22, and the measurement window A23. The second light emitting portion A21 emits a light of the second emission intensity P2 weaker than the first emission intensity P1 to the living body A2. As the second light emitting portion A21, same as the first light emitting portion A11, the visible light LED or the near-infrared LED can be used. The second light receiving portion A22 receives a returned light emitted from the second light emitting portion A21 and penetrates the living body A2 and generates a second light receiving signal S2. As the second light receiving portion A22, same as the first light receiving portion A12, a photo diode

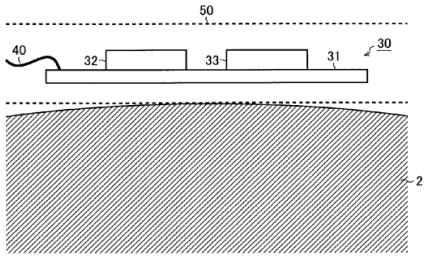
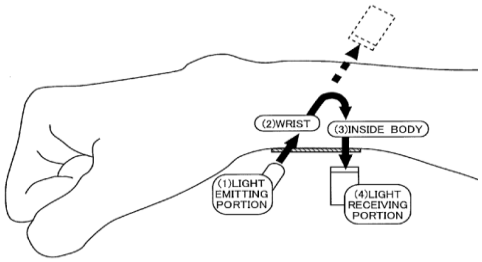
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	or a photo transistor can be used. The measurement window A23 is a translucency member (i.e., a glass plate or an acrylic plate) which is provided on the light emitting/receiving surface of the second light sensor A20. The second light sensor A20 performs the pulse wave measurement (i.e., light emission to the living body A2 and a detection of the returned light from the living body A2) via the measurement window A23. In addition, with respect to the thickness of the measurement window A23, it is desirable to design appropriately in view of the depth of focus of the second light sensor A20. Terumoto at [0191] The pulse wave sensor according to claim 4, wherein an output wavelength of the light sensor belongs to the visible light region and is smaller than or equal to 600 nm approxi-mately. Terumoto at Claim 5 34. The pulse wave sensor according to claim 26, wherein output wavelengths of the multiple light sensor portions belong to the visible light region and are smaller than or equal to 600 nm approximately. Terumoto at Claim 34 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless	See claim 6 above. Terumoto discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.

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receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	The wireless communication circuit 33 transmits the measurement data acquired at the measurement unit 10 (i.e., the raw data provided from the amplifier circuit 14, the processed data various processes has performed provided from the processing circuit 15, or the stored data provided from the memory 32) to the external personal computer or a cell phone. Because the wireless communication circuit 33 can be a noise source for the measurement unit 10 same as the power source circuit 23, it is desirable to embed the wireless communication circuit 33 to the communication unit 30 independent from the measurement unit 10. In addition, with respect to the wireless communication circuit 33, the Bluetooth (the registered trademark) module IC can be used appropriately for example. With respect to a construction having such wireless communication circuit 33, the wired connection is not required to transmit the measurement data to the external apparatus, it makes possible to perform a real time transmission for the measurement data without restricting the behavior of the examinee. In addition, for designing the armlet type housing 50 as the water-proof construction, in terms of eliminating external terminals completely, it is desirable to adopt non-contact method as a method to transmit the measurement data to the outside. Terumoto at [0130] The wireless communication portion A60 transmits the pulse wave data S3 acquired at the controller A30 (i.e., the raw data, the processed data various processes are performed, or the stored data at memory portion A50) to the external personal computer or a cell phone. In addition, with respect to the wireless communication portion A60, the Bluetooth (the registered trademark) module IC can be used appropriately for example. Owing to such a construction, the wired connection is not required to transmit the pulse wave data S3 to the external apparatus, it makes possible to perform a real time transmission for the pulse wave data S3 without restricting the behavior of the examinee. Terumoto at [0198] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	

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8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Terumoto discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. See above at claim 1[pre] In consideration of the aforementioned problems discovered by the inventers of this application, a purpose of this invention is to provide a pulse wave sensor which can measure the pulse wave without restricting a behavior of the examinee, or to provide a pulse wave sensor which can measure the pulse wave accurately by reducing an effect of the motion noise. Terumoto at [0009]  Terumoto at Fig. 3 FIG. 3 is a cross section diagram illustrating a first implementation of the pulse wave sensor schematically in accordance with the implementation example 1. The pulse wave sensor 1 of the first implementation has a construction to measure the pulse wave at the wrist 2, to be more concrete, which has an armlet construction (i.e., a wrist watch construction in the first implementation) to measure the pulse wave to be worn on the wrist 2. In addition, with respect to the construction elements, the pulse wave sensor 1 of the first implementation includes a measurement unit 10, a power source unit 20, a communication unit 30, a cable 40, an armlet type housing 50, and a display unit 60.

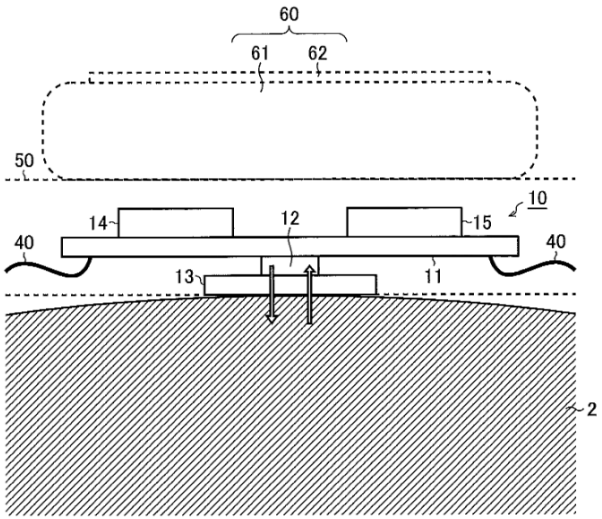
’475 Patent	Terumoto
	Terumoto at [0103] The measurement unit 10 is a unit to measure the pulse wave mainly, which is contained within the armlet type housing 50 to be located at the back side of the display unit 60. Owing to this construction, in a situation where the examinee turns the face to the display unit 60 to watch information (e.g., a result of the pulse wave measurement) displayed at the display unit 60, the measurement unit 10 is pressed to the wrist 2 according to the weight of the display unit 60, the pulse wave can be measured stably, furthermore, the accuracy for measuring the pulse wave can be improved. Moreover, with respect to the pulse wave measurement at the wrist, the inventors of this application confirmed it is possible to measure the pulse wave sufficiently, though the sensitivity is lower compared to the pulse wave measurement at the fingertip. In addition, the internal construction and the operation of the measurement unit 10 are explained in detail later. Terumoto at [0104] The power source unit 20 is a unit to supply power to the measurement unit 10 and the communication unit 30 mainly, the power source unit 20 is contained within the armlet type housing 50 to be located to the back side of the wrist 2 when the armlet type 50 is worn on the wrist 2. In this way, by means of locating the second unit 20 which can be a noise source for the first unit 10 separately from the first unit 10 as an another unit, the measurement accuracy of the pulse wave can be improved. In addition, an internal construction and an operation of the power source unit 20 is explained in detail later. Terumoto at [0105] The communication unit 30 is a unit to transfer the measurement data acquired at the measurement unit 10 to the outside mainly, the communication unit 30 is contained within the armlet type housing 50 to be located to the back side of the wrist 2 when the armlet type 50 is worn on the wrist 2. In this way, by means of locating the communication unit 30 which can be a noise source for the first unit 10 separately from the first unit 10 as an another unit, the measurement accuracy of the pulse wave can be improved. In addition, an internal construction and an operation of the communication unit 30 are explained in detail later. Terumoto at [0106]

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	The armlet type housing 50 contains the measurement unit 10, the power source unit 20, the communication unit 30, and the cable 40. The armlet type housing 50 is worn on the wrist. Terumoto at [0108] Especially, with respect to the first implementation which the display unit 60 is provided at the armlet type housing 50, because the pulse wave sensor 1 can be worn as wrist watch on a daily basis, resistance feeling against wearing the pulse wave sensor 1 can be eliminated, furthermore, a contribution to develop new users can be realized.\ Terumoto at [0112] The processing circuit 15 controls entire operation of the pulse wave sensor 1 generally, and also by means of performing a various signal process for the output signal of the amplifier circuit 14, it acquires various information about the pulse wave (i.e., the fluctuation of the pulse wave, the heart rate, the fluctuation of the heart rate, and the acceleration pulse wave). In addition, as the processing circuit 15, the CPU [Central Processing Unit] can be used appropriately. In this way, with respect to the construction both the light sensor 12 and the amplifier circuit 14 are located at the vicinity of the processing circuit 15, the output signal of the amplifier circuit 14 can be processed before the noise superimposes, therefore, it is possible to improve the analysis accuracy of the pulse wave. Terumoto at [0121] The battery 22 is a power supply source required to drive the pulse wave sensor 1, a lithium ion secondary battery or an electrical double layer capacitor can be used appropriately. In this way, with respect to the pulse wave sensor 1 of battery drive type, there is no need to connect a power supply cable from outside during the measurement of the pulse wave. Measurement of the pulse wave can be realized without restricting the behavior of the examinee. In addition, according to this construction, the battery 22 formed as highly flat is located right above the wrist 2, it is possible to improve an affinity of the pulse wave sensor 1 when the pulse sensor 1 is worn on the wrist 2, furthermore, the consciousness of the examinee for wearing the pulse wave sensor 1 can be reduced. Terumoto at [0124]

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	FIG. 6  Terumoto at Fig. 6 FIG. 1  Terumoto at Fig. 1 The wireless communication circuit 33 transmits the measurement data acquired at the measurement unit 10 (i.e., the raw data provided from the amplifier circuit 14, the processed data various processes has performed provided from the processing circuit 15, or the stored data provided from the memory 32) to the external personal computer or a cell phone. Because the wireless communication circuit 33 can be a noise source for the measurement unit 10 same as the power source circuit 23, it is desirable to embed

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	the wireless communication circuit 33 to the communication unit 30 independent from the measurement unit 10. In addition, with respect to the wireless communication circuit 33, the Bluetooth (the registered trademark) module IC can be used appropriately for example. With respect to a construction having such wireless communication circuit 33, the wired connection is not required to transmit the measurement data to the external apparatus, it makes possible to perform a real time transmission for the measurement data without restricting the behavior of the examinee. In addition, for designing the armlet type housing 50 as the water-proof construction, in terms of eliminating external terminals completely, it is desirable to adopt non-contact. Terumoto at [0130] FIG. 7 is a cross section diagram illustrating a second implementation of the pulse wave sensor schematically in accordance with the implementation example 1. With respect to the pulse wave sensor 1 in accordance with the second implementation, both the power source unit 20 and the communication 30 are contained to the armlet type housing 50 to be located at the inside of the wrist 2 when the armlet type housing 50 is worn on the wrist 2. In this way, by means of locating the power source unit 20 and the communication unit 30 which can be a noise source for the measurement unit 10 from the measurement unit 10 as far as possible, the measurement accuracy of the pulse wave can be improved. Terumoto at [0131] FIG. 9 is a schematic diagram to explain a first wearing state of the pulse sensor 1 (i.e., a state where the pulse wave sensor 1 is worn with the display unit 60 is located at the back side of the wrist 2). FIG. 10 is a schematic diagram to explain a second wearing state of the pulse sensor 1 (i.e., a state where the pulse wave sensor 1 is worn with the display unit 60 is located at the inside of the wrist 2). Terumoto at [0134] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Terumoto discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;. In step S104, with respect to the measurement data measured by each of the light sensors portion which is turned ON in step S101 among the light sensor portions 101-1 to 101-n, each output intensity and predetermined threshold value are compared, based on the comparison result, ON/OFF control of each of the light sensor portions 101-1 to 101-n is performed. To be more concrete, with respect to the data whose output intensity is below than the predetermined threshold, the light sensor portion is turned OFF as interpreted output shortage is occurred. Terumoto at [0165] In step S105, with respect to the measurement data measured by each of the light sensors portion which is turned ON in step S101 among the light sensor portions 101-1 to 101-n, a judgment whether or not the frequency of each output peak is within the predetermined range is performed, based on the judgment result, ON/OFF control of each of the light sensor portions 101-1 to 101-n is performed. To be more concrete, with respect to its frequency of output peak is not within the range of 60 bpm to 200 bpm [beats per minutes], the light sensor portion is turned OFF as interpreted frequency abnormality (e.g., noise superimpose, etc) is occurred. Terumoto at [0167] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the	Terumoto discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user.

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output light towards a bodily tissue of the user;	See above at claim 1[c], 1[j], 1[k] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. <What is Learned from the Pulse Wave> Terumoto at [0101]  Terumoto at Fig. 4

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	The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] With respect to the inside of the wrist 2, though fit feeling of the pulse wave sensor 1 around the center portion is scanty because of the tendon located right beneath the skin, fit feeling of the pulse wave sensor 1 around the both ends is fine because of the thick flesh. Accordingly, with respect to the first wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement units 10 a and 10 c located at both ends of the measurement unit row. Terumoto at [0135] On the other hand, with respect to the back side of the wrist 2, though fit feeling of the pulse wave sensor 1 around both ends is scanty because of the born located right beneath the skin, fit feeling of the pulse wave sensor 1 around center portion is fine because of the thick flesh. Accordingly, with respect to the second wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement unit 10 b located at the center of the measurement unit row. Terumoto at [0136] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Terumoto discloses or renders obvious a detector.

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	See above at claim 1[d] Moreover, the pulse wave sensor disclosed in this specification includes multiple light sensor portions to detect an intensity of the light emitted to a wrist and penetrates a living body, a controller to perform ON/OFF control of each of the multiple light sensor portions, and an armlet type housing to contain the multiple light sensor portions and the controller (i.e., construction 2-1). Terumoto at [0035] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. <What is Learned from the Pulse Wave> Terumoto at [0101] By emitting the light from the light emitting portion to the wrist 2 and detect the intensity of the light which penetrates the living body by the light receiving portion, the light sensor 12 acquires the pulse wave data. In addition, the light sensor 12 in accordance with this construction example is not a construction both the light emitting portion and the light receiving portion are provided at opposite side against the wrist 2 each other (i.e., a so-called penetration type, in reference to a broken line arrow in FIG. 1). The light sensor 12 is a construction both the light emitting portion and the light receiving portion are provided at same side against the wrist 2 (i.e., a so-called reflection type, in reference to a full line arrow in FIG. 1).

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	Terumoto at [0118] The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] The amplifier circuit 14 amplifies the output signal (i.e., a detection signal of the light receiving portion) of the light sensor 12 and provides it to the processing circuit 15. In this way, with respect to a construction to equip the amplifier circuit 14 to the vicinity of the light sensor 12, the output signal of the light sensor 12 can be amplified before the noise is superimposed, then it makes possible to improve S/N [Signal/Noise Ratio] of the signal, furthermore, the measurement accuracy of the pulse wave can be improved. Terumoto at [0120] Each of the light sensor portions 101-1 to 101-n detects an intensity of the light emitted to the wrist 200 and penetrates a living body. The light sensor portions 101-1 to 101-n are located equally spaced from one another and to go round the armlet type housing 107 same as the fourth to sixth implementations. In addition, because the construction and the output wave length of the light sensor portions 101-1 to 101-n are same as the aforementioned light sensor 12, a redundant explanation is omitted here. Terumoto at [0152] For example, as illustrated in FIG. 18, in the case of the shaft center of the armlet type housing 107 is facing to the horizontal direction or horizontal direction approximately, according to its own weight of the armlet type housing 107, among the light sensor portions 101-1 to 101-n, the light sensor portions positioned above than the horizontal line which passes the center shaft are closely contacted to the wrist 200, and the sensors located beneath the horizontal line are apart from the wrist 200. Therefore, by turning ON the above positioned light sensor portions which are expected to perform normal pulse wave

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	measurement, and turning OFF the beneath positioned light sensor portions which are not expected to perform normal pulse wave measurement in advance, the energy consumption can be reduced to ½ compared to all of the light sensor portions 101-1 to 101-n are turned ON without worsening the measurement accuracy of the pulse wave sensor 100. Terumoto at [0161] In step S102, among the light sensor portions 101-1 to 101-n, by using the light sensor turned ON in step S101, a measurement is performed to detect the intensity and the frequency of the output peak. With respect to the pulse wave measurement in this step, it is performed to acquire information required to select the light sensor portion furthermore, and transmission of the measured date to the outside is not performed. Terumoto at [0163] In step S103, a judgment is performed whether or not a predetermined period T has passed since the pulse wave began in step S102. If judged as YES, the flow is proceeded to step S104, if judged as NO, the flow is returned to step S102. In addition, with respect to the aforementioned predetermined period T, it should be set long enough to detect the intensity and frequency of the output peak (in reference to FIG. 20). Terumoto at [0164] **4**. The pulse wave sensor according to claim 3, wherein the measurement unit comprises a light sensor to detect an intensity of the light emitted to the wrist and penetrates a living body. Terumoto at Claim 4 26. A pulse wave sensor comprising: multiple light sensor portions to detect an intensity of the light emitted to a wrist and penetrates a living body, a controller to perform ON/OFF control of each of the multiple light sensor portions, and an armlet type housing to contain the multiple light sensor portions and the controller.

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	Terumoto at Claim 26 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Terumoto discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. See above at claim 1[e] Moreover, with respect to the pulse wave sensor in accordance with the construction 1-4 to 1-15, wherein the measurement unit includes an amplifier circuit to amplify an output signal of the light sensor, and a processing circuit to acquire information related to the pulse wave based on the output signal of the amplifier circuit (i.e., construction 1-16). Terumoto at [0025] Moreover, with respect to the pulse wave sensor in accordance with the construction 1-16, wherein the measurement unit comprises a substrate having a surface on which the light sensor is mounted and having a rear face on which the amplifier circuit and the processing circuit are mounted. (i.e., construction 1-17). Terumoto at [0026] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo

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	diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. Terumoto at [0101] FIG. 4 is a cross section diagram illustrating a construction example of the measurement unit 10 schematically. The measurement unit 10 of this construction example includes a substrate 11, a light sensor 12, a measurement window 13, an amplifier circuit 14, and the processing circuit 15. Terumoto at [0116] The light sensor 12 is mounted to the surface of the substrate 11 directly, the amplifier circuit 14 and the processing circuit 15 are mounted to the back side of the substrate 11 directly. Moreover, the cable 40 to establish an electrical connection with the power source unit 20 and the communication unit 30 are connected to the substrate 11. In addition, the electrical connection is established between the surface and back side of the substrate 11 by means of a through hole and a via hole. In this way, with respect to a construction to directly mount the light sensor 12, the amplifier circuit 14, and the processing circuit 15, then the measurement unit 10 can be designed as thin, the wear feeling of the pulse wave sensor 1 can be improved. Furthermore, with respect to the construction to mount only the light sensor 12 to the surface of the substrate 11, the light sensor 12 can be located at the vicinity of the wrist 2 as much as possible, then the measurement accuracy of the pulse wave can be improved. Terumoto at [0117] By emitting the light from the light emitting portion to the wrist 2 and detect the intensity of the light which penetrates the living body by the light receiving portion, the light sensor 12 acquires the pulse wave data. In addition, the light sensor 12 in accordance with this construction example is not a construction both the light emitting portion and the light receiving portion are provided at opposite side against the wrist 2 each other (i.e., a so-called penetration type, in reference to a broken line arrow in

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	FIG. 1). The light sensor 12 is a construction both the light emitting portion and the light receiving portion are provided at same side against the wrist 2 (i.e., a so-called reflection type, in reference to a full line arrow in FIG. 1). Terumoto at [0118] The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] In step S108, a predetermined operation process is processed to the measurement data acquired in step S107. For example, as illustrated in FIG. 21, a method can be considered to generate an added output (i.e., A+B) by adding an output A of the light sensor portion A and an output B of the light sensor portion B. Owing to performing this operation process, S/N ratio can be improved by enhancing the intensity of the output peak. Terumoto at [0172] Moreover, as illustrated in FIG. 22, a method can be considered to generate the subtracted output (i.e., A-B) by subtracting the output B including only the noise component (i.e., an output of the light sensor B which is provided additionally to detect only for the dark current) from the output A of the light sensor portion A which a noise component is superimposed. Owing to performing this operation process, the noise component can be removed and S/N ratio can be improved. Terumoto at [0173] The amplifier circuit 14 amplifies the output signal (i.e., a detection signal of the light receiving portion) of the light sensor 12 and provides it to the processing circuit 15. In this way, with respect to a construction to equip the amplifier circuit 14 to the vicinity of the light sensor 12, the output signal of

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	the light sensor 12 can be amplified before the noise is superimposed, then it makes possible to improve S/N [Signal/Noise Ratio] of the signal, furthermore, the measurement accuracy of the pulse wave can be improved. Terumoto at [0120] Therefore, by subtracting second light receiving signal S2 acquired at the second light sensor A20 of relatively week second light emission intensity P2 from the first light receiving signal S1 acquired at the first light sensor A10 of the first light emission intensity P1, the motion noise included in respective signals can be counterbalanced, then pure pulse wave component can be acquired (in reference to FIG. 28). Thus, with respect to the pulse wave sensor A1 in accordance with this construction example, regardless of the movement or vibration of the examinee, the pulse wave can be measured with high accuracy, the pulse wave can be measured all day long in daily life. Terumoto at [0201] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Terumoto discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. See above at claim 1[e], 1[k], [5] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo

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	diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. Terumoto at [0101] By emitting the light from the light emitting portion to the wrist 2 and detect the intensity of the light which penetrates the living body by the light receiving portion, the light sensor 12 acquires the pulse wave data. In addition, the light sensor 12 in accordance with this construction example is not a construction both the light emitting portion and the light receiving portion are provided at opposite side against the wrist 2 each other (i.e., a so-called penetration type, in reference to a broken line arrow in FIG. 1). The light sensor 12 is a construction both the light emitting portion and the light receiving portion are provided at same side against the wrist 2 (i.e., a so-called reflection type, in reference to a full line arrow in FIG. 1). Terumoto at [0118] The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] In step S108, a predetermined operation process is processed to the measurement data acquired in step S107. For example, as illustrated in FIG. 21, a method can be considered to generate an added output (i.e., A+B) by adding an output A of the light sensor portion A and an output B of the light sensor portion

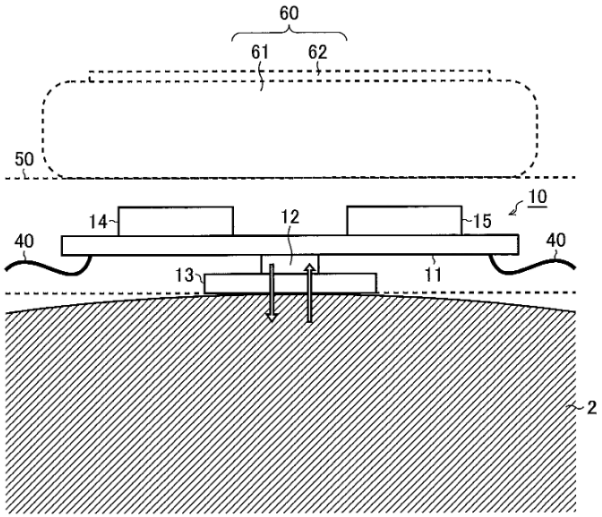
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	B. Owing to performing this operation process, S/N ratio can be improved by enhancing the intensity of the output peak. Terumoto at [0172] Moreover, as illustrated in FIG. 22, a method can be considered to generate the subtracted output (i.e., A-B) by subtracting the output B including only the noise component (i.e., an output of the light sensor B which is provided additionally to detect only for the dark current) from the output A of the light sensor portion A which a noise component is superimposed. Owing to performing this operation process, the noise component can be removed and S/N ratio can be improved. Terumoto at [0173] The amplifier circuit 14 amplifies the output signal (i.e., a detection signal of the light receiving portion) of the light sensor 12 and provides it to the processing circuit 15. In this way, with respect to a construction to equip the amplifier circuit 14 to the vicinity of the light sensor 12, the output signal of the light sensor 12 can be amplified before the noise is superimposed, then it makes possible to improve S/N [Signal/Noise Ratio] of the signal, furthermore, the measurement accuracy of the pulse wave can be improved. Terumoto at [0120] Therefore, by subtracting second light receiving signal S2 acquired at the second light sensor A20 of relatively week second light emission intensity P2 from the first light receiving signal S1 acquired at the first light sensor A10 of the first light emission intensity P1, the motion noise included in respective signals can be counterbalanced, then pure pulse wave component can be acquired (in reference to FIG. 28). Thus, with respect to the pulse wave sensor A1 in accordance with this construction example, regardless of the movement or vibration of the examinee, the pulse wave can be measured with high accuracy, the pulse wave can be measured all day long in daily life. Terumoto at [0201] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	Terumoto discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. See above at claim 1[e], 1[j], [5] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. Terumoto at [0101] By emitting the light from the light emitting portion to the wrist 2 and detect the intensity of the light which penetrates the living body by the light receiving portion, the light sensor 12 acquires the pulse wave data. In addition, the light sensor 12 in accordance with this construction example is not a construction both the light emitting portion and the light receiving portion are provided at opposite side against the wrist 2 each other (i.e., a so-called penetration type, in reference to a broken line arrow in FIG. 1). The light sensor 12 is a construction both the light emitting portion and the light receiving

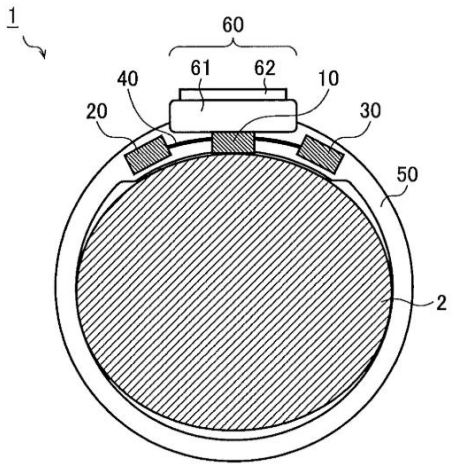
’475 Patent	Terumoto
	portion are provided at same side against the wrist 2 (i.e., a so-called reflection type, in reference to a full line arrow in FIG. 1). Terumoto at [0118] The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] The amplifier circuit 14 amplifies the output signal (i.e., a detection signal of the light receiving portion) of the light sensor 12 and provides it to the processing circuit 15. In this way, with respect to a construction to equip the amplifier circuit 14 to the vicinity of the light sensor 12, the output signal of the light sensor 12 can be amplified before the noise is superimposed, then it makes possible to improve S/N [Signal/Noise Ratio] of the signal, furthermore, the measurement accuracy of the pulse wave can be improved. Terumoto at [0120] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in With respect to the inside of the wrist 2, though fit feeling of the pulse wave sensor 1 around the center portion is scanty because of the tendon located right beneath the skin, fit feeling of the pulse wave sensor 1 around the both ends is fine because of the thick flesh. Accordingly, with respect to the first wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement units 10 a and 10 c located at both ends of the measurement unit row. Terumoto at [0135]

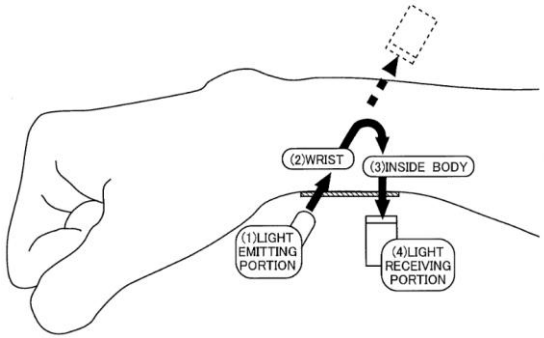
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	On the other hand, with respect to the back side of the wrist 2, though fit feeling of the pulse wave sensor 1 around both ends is scanty because of the born located right beneath the skin, fit feeling of the pulse wave sensor 1 around center portion is fine because of the thick flesh. Accordingly, with respect to the second wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement unit 10 b located at the center of the measurement unit row. Terumoto at [0136] In step S108, a predetermined operation process is processed to the measurement data acquired in step S107. For example, as illustrated in FIG. 21, a method can be considered to generate an added output (i.e., A+B) by adding an output A of the light sensor portion A and an output B of the light sensor portion B. Owing to performing this operation process, S/N ratio can be improved by enhancing the intensity of the output peak. Terumoto at [0172] Moreover, as illustrated in FIG. 22, a method can be considered to generate the subtracted output (i.e., A-B) by subtracting the output B including only the noise component (i.e., an output of the light sensor B which is provided additionally to detect only for the dark current) from the output A of the light sensor portion A which a noise component is superimposed. Owing to performing this operation process, the noise component can be removed and S/N ratio can be improved. Terumoto at [0173] Therefore, by subtracting second light receiving signal S2 acquired at the second light sensor A20 of relatively week second light emission intensity P2 from the first light receiving signal S1 acquired at the first light sensor A10 of the first light emission intensity P1, the motion noise included in respective signals can be counterbalanced, then pure pulse wave component can be acquired (in reference to FIG. 28). Thus, with respect to the pulse wave sensor A1 in accordance with this construction example, regardless of the movement or vibration of the examinee, the pulse wave can be measured with high accuracy, the pulse wave can be measured all day long in daily life. Terumoto at [0201]

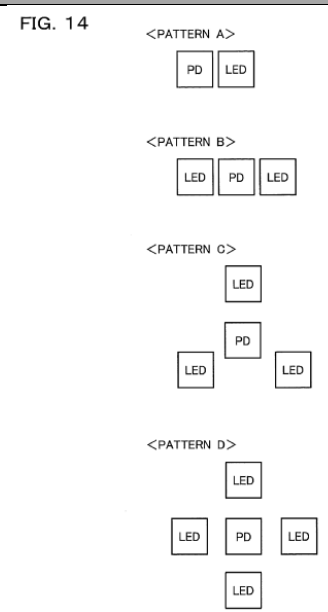
’475 Patent	Terumoto
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.	Terumoto discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user. See above at claim 1[b], 1[e], 1[l], [5] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. <What is Learned from the Pulse Wave> Terumoto at [0101]

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	 Terumoto at Fig. 4 The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] With respect to the inside of the wrist 2, though fit feeling of the pulse wave sensor 1 around the center portion is scanty because of the tendon located right beneath the skin, fit feeling of the pulse wave sensor 1 around the both ends is fine because of the thick flesh. Accordingly, with respect to the first wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement units 10 a and 10 c located at both ends of the measurement unit row. Terumoto at [0135]

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	On the other hand, with respect to the back side of the wrist 2, though fit feeling of the pulse wave sensor 1 around both ends is scanty because of the born located right beneath the skin, fit feeling of the pulse wave sensor 1 around center portion is fine because of the thick flesh. Accordingly, with respect to the second wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement unit 10 b located at the center of the measurement unit row. Terumoto at [0136] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. Terumoto discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. Moreover, with respect to the pulse wave sensor in accordance with the construction 1-4, wherein an output wavelength of the light sensor belongs to the visible light region and is smaller than or equal to 600 nm approximately (i.e., construction 1-5). Terumoto at [0014] Moreover, with respect to the pulse wave sensor in accordance with the construction 2-1 to 2-8, wherein output wavelengths of the multiple light sensor portions belong to the visible light region and are smaller than or equal to 600 nm approximately (i.e., construction 2-9). Terumoto at [0043]

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	For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount oflight attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhe-moglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorp-tion level of the peripheral arterial can be measured and plethysmogram can be measured. Terumoto at [0101]  Terumoto at Fig. 3 FIG. 3 is a cross section diagram illustrating a first implementation of the pulse wave sensor schematically in accordance with the implementation example 1. The pulse wave sensor 1 of the first

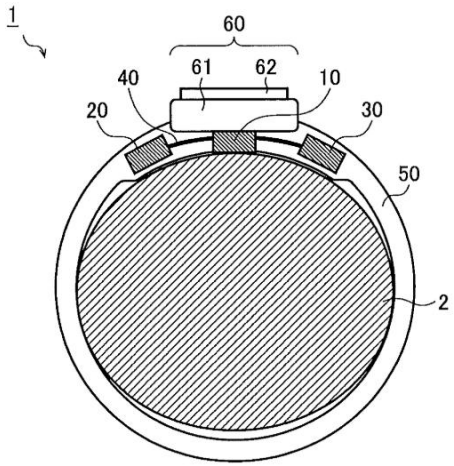
’475 Patent	Terumoto
	implementation has a construction to measure the pulse wave at the wrist 2, to be more concrete, which has an armlet construction (i.e., a wrist watch construc-tion in the first implementation) to measure the pulse wave to be worn on the wrist 2. In addition, with respect to the con-struction elements, the pulse wave sensor 1 of the first imple-mentation includes a measurement unit 10, a power source unit 20, a communication unit 30, a cable 40, an armlet type housing 50, and a display unit 60. Terumoto at [0103] The power source unit 20 is a unit to supply power to the measurement unit 10 and the communication unit 30 mainly, the power source unit 20 is contained within the armlet type housing 50 to be located to the back side of the wrist 2 when the armlet type 50 is worn on the wrist 2. In this way, by means oflocating the second unit 20 which can be a noise source for the first unit 10 separately from the first unit 10 as an another unit, the measurement accuracy of the pulse wave can be improved. In addition, an internal construction and an operation of the power source unit 20 is explained in detail later. Terumoto at [0105]  Terumoto at Fig. 1 The armlet type housing 50 contains the measure-ment unit 10, the power source unit 20, the communication unit 30, and the cable 40. The armlet type housing 50 is worn on the wrist. Terumoto at [0108]

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	 Terumoto at Fig. 14 FIG. 14 is a cross section diagram illustrating a layout patterns A to D of a light emitting portion and a light receiving portion forming the light sensor 12 of the measurement unit 10. As illustrated in FIG. 14, for the light emitting portion LED and the light receiving portion PD, either layout patterns of 1 by 1 (i.e., layout patter A), 2 by 1 (i.e., layout pattern B), 3 by 1 (i.e., layout pattern C), and 4 by 1 (i.e., layout pattern D), and so on, can be adopted. In addition, in the case of adopting the layout patterns B to D, it is desirable to locate multiple light emitting portions (i.e., LED) to vertex of the regular polygon and to locate the light receiving portion to weighted center of the regular polygon. <Consideration about the Output Wave Length> Terumoto at [0148] In the experiment, by means of the pulse wave sen-sor 1 of so-called reflection type, each output wave length of the light emitting portions is set to Al (infrared: 940 mm), A2 (green: 630 nm), and A3 (blue: 468 nm), and each behavior is examined when the output intensity of the light emitting portions (i.e., driving current value) are varied to 1 mA, 5 mA, and 10 mA. As the result, with respect to the visible

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	light region whose wave length is shorter than or equal to 600 nm, it is examined that the wave form of the pulse wave can be acquired relatively easy because the absorption coefficient of oxyhemoglobin HbO2 becomes larger and the peak intensity of the measured pulse wave becomes larger. Terumoto at [0149] Each of the light sensor portions 101-1 to 101-n detects an intensity of the light emitted to the wrist 200 and penetrates a living body. The light sensor portions 101-1 to 101-n are located equally spaced from one another and to go round the armlet type housing 107 same as the fourth to sixth implementations. In addition, because the construction and the output wave length of the light sensor portions 101-1 to 101-n are same as the aforementioned light sensor 12, a redundant explanation is omitted here. Terumoto at [0152] For example, as illustrated in FIG. 18, in the case of the shaft center of the armlet type housing 107 is facing to the horizontal direction or horizontal direction approximately, according to its own weight of the armlet type housing 107, among the light sensor portions 101-1 to 101-n, the light sensor portions positioned above than the horizontal line which passes the center shaft are closely contacted to the wrist 200, and the sensors located beneath the horizontal line are apart from the wrist 200. Therefore, by turning ON the above positioned light sensor portions which are expected to perform normal pulse wave measurement, and turning OFF the beneath positioned light sensor portions which are not expected to perform normal pulse wave measurement in advance, the energy consumption can be reduced to ½ compared to all of the light sensor portions 101-1 to 101-n are turned ON without worsening the measurement accuracy of the pulse wave sensor 100. Terumoto at [0161] The first light sensor A10 is a light sensor to detect the pulse wave component mainly and includes the first light emitting portion A11, the first light receiving portion A12, and the measurement window A13. The first light emitting portion A11 emits a light of the first emission intensity P1 to the living body A2. As the first light emitting portion A11, a visible light LED or a near-infrared LED can be used. The first light receiving portion A12 receives a returned light emitted from the first light emitting portion A11 and penetrates the living body A2 and generates a first light receiving signal S1. As the first light receiving portion A12, a photo diode or a photo transistor can be used. The measurement window A13 is a

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	translucency member (i.e., a glass plate or an acrylic plate) which is provided on the light emitting/receiving surface of the first light sensor A10. The first light sensor A10 performs the pulse wave measurement (i.e., light emission to the living body A2 and a detection of the returned light from the living body A2) via the measurement window A13. In addition, with respect to the thickness of the measurement window A13, it is desirable to design appropriately in view of the depth of focus of the first light sensor A10. Terumoto at [0190] The second light sensor A20 is a light sensor to detect the motion noise component mainly and includes the second light emitting portion A21, the second light receiving portion A22, and the measurement window A23. The second light emitting portion A21 emits a light of the second emission intensity P2 weaker than the first emission intensity P1 to the living body A2. As the second light emitting portion A21, same as the first light emitting portion A11, the visible light LED or the near-infrared LED can be used. The second light receiving portion A22 receives a returned light emitted from the second light emitting portion A21 and penetrates the living body A2 and generates a second light receiving signal S2. As the second light receiving portion A22, same as the first light receiving portion A12, a photo diode or a photo transistor can be used. The measurement window A23 is a translucency member (i.e., a glass plate or an acrylic plate) which is provided on the light emitting/receiving surface of the second light sensor A20. The second light sensor A20 performs the pulse wave measurement (i.e., light emission to the living body A2 and a detection of the returned light from the living body A2) via the measurement window A23. In addition, with respect to the thickness of the measurement window A23, it is desirable to design appropriately in view of the depth of focus of the second light sensor A20. Terumoto at [0191] The pulse wave sensor according to claim 4, wherein an output wavelength of the light sensor belongs to the visible light region and is smaller than or equal to 600 nm approxi-mately. Terumoto at Claim 5 34. The pulse wave sensor according to claim 26, wherein output wavelengths of the multiple light sensor portions belong to the visible light region and are smaller than or equal to 600 nm approximately.

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	Terumoto at Claim 34 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. Terumoto discloses or renders obvious the physiological parameter of the user is associated with a blood constituent or a blood flow of the user. Moreover, with respect to the pulse wave sensor in accordance with the construction 1-3, the measurement unit includes a light sensor to detect an intensity of the light emitted to the wrist and penetrates a living body (i.e., construction 1-4). Terumoto at [0013] For example, with respect to a pulse measurement by means of plethysmography, as illustrated in FIG. 1, the light is emitted from the light emitting portion (e.g., LED [light Emitting Diode], etc) to part of the living body (i.e., other portions work well, the wrist shown in FIG. 1 or the fingertip illustrated in FIG. 24, for example) pressed to the measurement window. Then an intensity of the light which penetrates through the body and go out of the body is detected at the light receiving portion (e.g., a photo diode or a photo transistor). Here, as illustrated in FIG. 2, although the amount of light attenuation (i.e., the light absorption level) absorbed in biological tissue or venous blood (i.e., deoxyhemoglobin Hb) is constant, the amount of light attenuation (i.e., light absorption level) absorbed by the arterial blood (i.e., oxyhemoglobin HbO2) fluctuates based on the person's beat (i.e., pulse) according to the time lapse. Therefore, by using the living body window (i.e., a wave length region where the light is easy to penetrate the living body), a transition of the absorption level of the peripheral arterial can be measured and plethysmogram can be measured. <What is Learned from the Pulse Wave>

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	Terumoto at [0101]  Terumoto at Fig. 3 FIG. 3 is a cross section diagram illustrating a first implementation of the pulse wave sensor schematically in accordance with the implementation example 1. The pulse wave sensor 1 of the first implementation has a construction to measure the pulse wave at the wrist 2, to be more concrete, which has an armlet construction (i.e., a wrist watch construction in the first implementation) to measure the pulse wave to be worn on the wrist 2. In addition, with respect to the construction elements, the pulse wave sensor 1 of the first implementation includes a measurement unit 10, a power source unit 20, a communication unit 30, a cable 40, an armlet type housing 50, and a display unit 60. Terumoto at [0103] The measurement unit 10 is a unit to measure the pulse wave mainly, which is contained within the armlet type housing 50 to be located at the back side of the display unit 60. Owing to this construction, in a situation where the examinee turns the face to the display unit 60 to watch information (e.g., a result of the pulse wave measurement) displayed at the display unit 60, the measurement unit 10 is pressed to the wrist 2 according to the weight of the display unit 60, the pulse wave can be measured stably, furthermore, the accuracy for measuring the pulse wave can be improved. Moreover, with respect to the pulse wave measurement at the wrist, the inventors of this application confirmed it is possible to measure

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	the pulse wave sufficiently, though the sensitivity is lower compared to the pulse wave measurement at the fingertip. In addition, the internal construction and the operation of the measurement unit 10 are explained in detail later. Terumoto at [0104] The measurement window 13 is constructed with the translucency member (i.e., a glass plate or an acrylic plate, and so on) which is provided at the light emitting/receiving surface of the light sensor 12. The light sensor 12 performs the measurement of the pulse wave (i.e., detection for the emitted light to the wrist 2 and a reflected light go back from the wrist 2) via this measurement window 13. In addition, with respect to the thickness of the measurement window 13, it is desirable to design appropriately in view of the depth of focus of the light sensor 12. Terumoto at [0119] The amplifier circuit 14 amplifies the output signal (i.e., a detection signal of the light receiving portion) of the light sensor 12 and provides it to the processing circuit 15. In this way, with respect to a construction to equip the amplifier circuit 14 to the vicinity of the light sensor 12, the output signal of the light sensor 12 can be amplified before the noise is superimposed, then it makes possible to improve S/N [Signal/Noise Ratio] of the signal, furthermore, the measurement accuracy of the pulse wave can be improved. Terumoto at [0120] The processing circuit 15 controls entire operation of the pulse wave sensor 1 generally, and also by means of performing a various signal process for the output signal of the amplifier circuit 14, it acquires various information about the pulse wave (i.e., the fluctuation of the pulse wave, the heart rate, the fluctuation of the heart rate, and the acceleration pulse wave). In addition, as the processing circuit 15, the CPU [Central Processing Unit] can be used appropriately. In this way, with respect to the construction both the light sensor 12 and the amplifier circuit 14 are located at the vicinity of the processing circuit 15, the output signal of the amplifier circuit 14 can be processed before the noise superimposes, therefore, it is possible to improve the analysis accuracy of the pulse wave. Terumoto at [0121]

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	With respect to the inside of the wrist 2, though fit feeling of the pulse wave sensor 1 around the center portion is scanty because of the tendon located right beneath the skin, fit feeling of the pulse wave sensor 1 around the both ends is fine because of the thick flesh. Accordingly, with respect to the first wearing state of the pulse wave sensor 1, the pulse wave can be measured appropriately by the measurement units 10 a and 10 c located at both ends of the measurement unit row Terumoto at [0135] As mentioned above, with respect to the first wearing state of the pulse wave sensor 1, measurement units 10 a and 10 c located at both ends of the measurement unit row are able to measure the pulse wave accurately than the measurement unit 10 b located at the center of the measurement unit row. With respect to the second wearing state of the pulse wave sensor 2, measurement unit 10 b located at the center of the measurement unit row is able to measure the pulse wave accurately than the measurement units 10 a and 10 c located at both ends of the measurement units. Terumoto at [0137] 1. A pulse wave sensor comprising: a construction to measure a pulse wave at a wrist. Terumoto at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further	See claim 8 above.

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configured to modulate the light source with a modulation frequency.	Terumoto discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency.. In step S102, among the light sensor portions 101-1 to 101-n, by using the light sensor turned ON in step S101, a measurement is performed to detect the intensity and the frequency of the output peak. With respect to the pulse wave measurement in this step, it is performed to acquire information required to select the light sensor portion furthermore, and transmission of the measured date to the outside is not performed. Terumoto at [0163] In step S103, a judgment is performed whether or not a predetermined period T has passed since the pulse wave began in step S102. If judged as YES, the flow is proceeded to step S104, if judged as NO, the flow is returned to step S102. In addition, with respect to the aforementioned predetermined period T, it should be set long enough to detect the intensity and frequency of the output peak (in reference to FIG. 20). Terumoto at [0164] For example, among the light sensor portions X to Z in FIG. 20, with respect to the measurement data of the light sensor portions X and Y, though the frequencies FX and FY of output peak are within the predetermined range, with respect to the measurement data of the light sensor portion Z, the frequency FZ of output peak is not within the predetermined range because of the noise. Therefore, by turning OFF the light sensor portion Z which is not expected to measure the pulse wave normally in advance, further reduction of the energy consumption can be realized without worsening the measurement accuracy of the pulse wave. Terumoto at [0168] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Terumoto, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Terumoto, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

U.S. Pat. No. 12,268,475 in view of US Patent No. 8,172,761 to Nikolai Rulkov ("Rulkov")

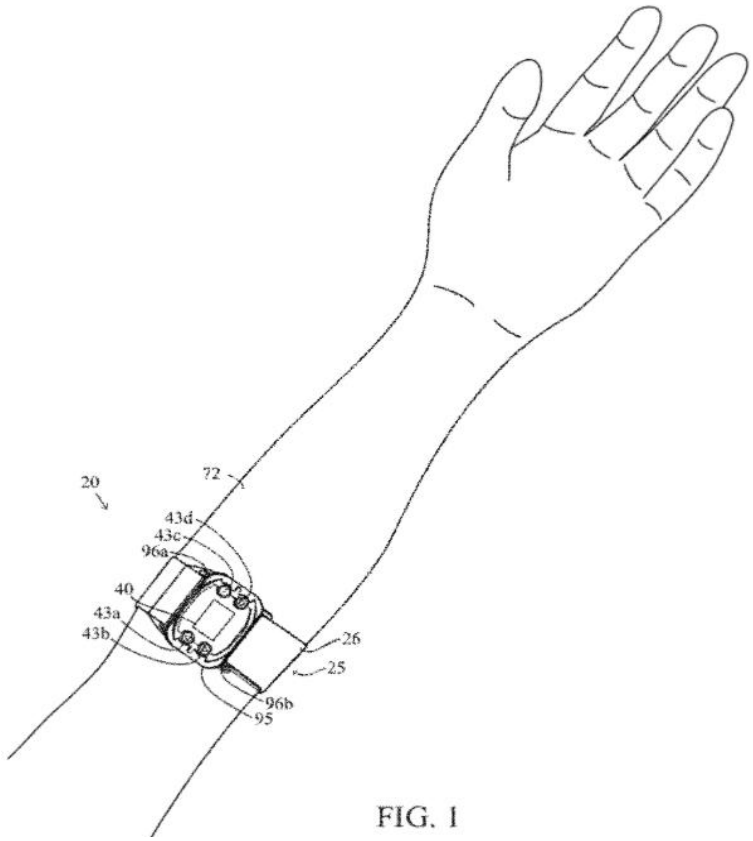
As described in detail below, Rulkov (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Rulkov. The cited portions of Rulkov are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Rulkov. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Rulkov "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Rulkov does not expressly disclose certain limitations in the Asserted Claims, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Rulkov (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Rulkov anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plainitff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

'475 Patent	Rulkov
Claim 1	

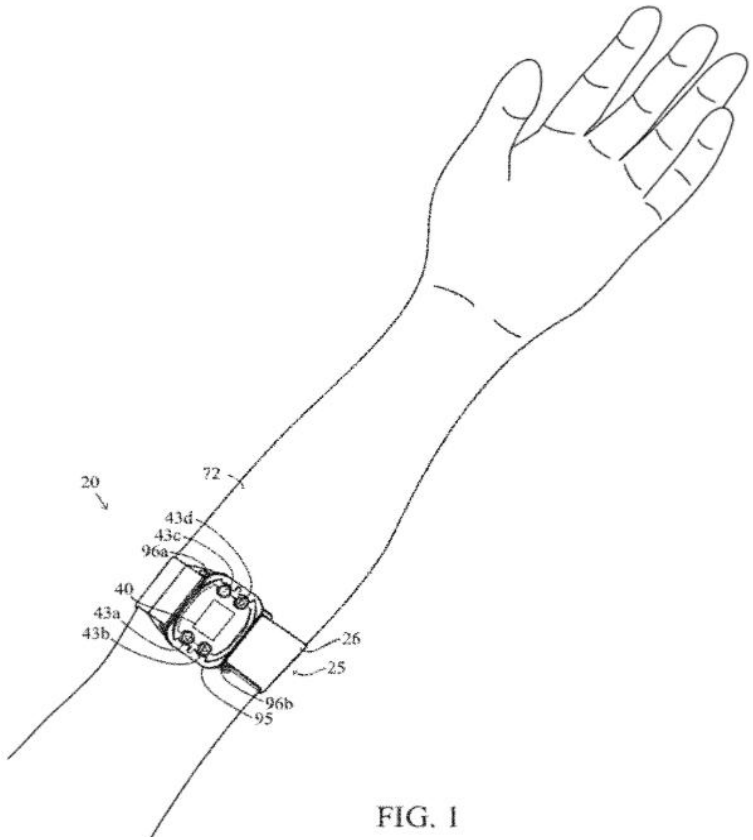
’475 Patent	Rulkov
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Rulkov discloses or renders obvious An apparatus adapted to be worn by a user comprising. The present invention provides a solution to the shortcomings of the prior art. The present invention is accurate, comfortable to wear by a user for extended time periods, allows for input and controlled output by the user, is light weight, and provides sufficient real-time information to the user about the user's health. Rulkov at 2:57-62 Another aspect of the present invention is of the present invention is a system for monitoring a real-time vital sign of a user. The system for monitoring a real-time vital sign of a user comprises a monitoring device comprising an optical sensor for generating a real-time digitized optical signal corresponding to a flow of blood through an artery of the user and an accelerometer for generating real-time accelerometer data comprising a X-axis signal, a Y-axis signal and a Z-axis signal based on a movement of the user. The system further comprises a first transceiver for transmitting the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a mobile communication device comprising a second transceiver for receiving the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a processor in electrical communication with the second transceiver, the processor configured to receive the real-time digitized signal and the real-time accelerometer data, the processor configured to calculate a period of motion related harmonics from the real-time accelerometer data utilizing a repetitive motion pattern analyzer, the processor configured to modify the real-time digitized optical signal by suppressing the motion related harmonics calculated by the motion pattern analyzer to generate a modified optical signal, the processor configured to generate a real-time heart rate for the user from the modified optical signal, Rulkov at 3:1-27 Optionally, the modified optical signal is filtered with a narrow band filter adaptively tuned to a heart rate frequency calculated by a heart rate evaluator to generate the real-time heart rate for the user. Preferably, the repetitive motion pattern analyzer comprises an array of Comb filters. Preferably, the optical sensor comprises two green LEDs and a photodetector

’475 Patent	Rulkov
	Rulkov at 3:28-34  FIG. 1 Rulkov at Fig. 1 As shown in FIGS. 1-5, a monitoring device is generally designated 20. The monitoring device 20 preferably includes an article 25 and an attachment band 26 having an exterior surface 26 a and interior surface 26 b. The monitoring device 20 is preferably secured with VELCRO® hook and loop material 31 a and 31 b. The article 25 preferably includes an optical sensor 30, control components 43 a-43 c and optionally a display member 40. The monitoring device 20 is preferably worn on a user's wrist, arm or ankle.

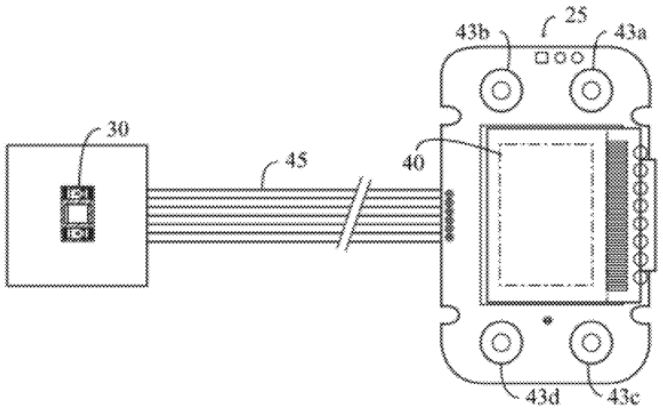
’475 Patent	Rulkov
	Rulkov at 4:36-44 Although the monitoring device 20 is described in reference to an article worn on a user's arm, wrist or ankle, those skilled in the pertinent art will recognize that the monitoring device 20 may take other forms such as eyewear disclosed in Brady et al, U.S. Pat. No. 7,648,463, for a Monitoring Device, Method And System, which is hereby incorporated by reference in its entirety or a glove such as disclosed in Rulkov et al., U.S. Pat. No. 7,887,492, for a Monitoring Device, Method And System, which is hereby incorporated by reference in its entirety. Rulkov at 4:61-5:3 The optical sensor 30 of the monitoring device 20 is preferably positioned over the radial artery or ulnar artery if the article 25 is worn on the user's arm. The optical sensor 30 of the monitoring device 20 is preferably positioned over the posterior tibial artery of a user if the article 25 is worn on the user's ankle. However, those skilled in the pertinent art will recognize that the optical sensor may be placed over other arteries of the user without departing from the scope and spirit of the present invention. Further, the optical sensor 30 need only be in proximity to an artery of the user in order to obtain a reading or signal. Rulkov at 5:4-14 In one embodiment, discussed below, the display member40 is removed and the signal is sent to a device such as a personal digital assistant, laptop computer, mobile telephone, exercise equipment, or the like for display and even processing of the user's real-time vital signs information. Alternatively, the circuitry assembly includes a flexible microprocessor board which is a low power, micro-size easily integrated board which provides blood oxygenation level, pulse rate (heart rate), signal strength bargraph, plethysmogram and status bits data. The microprocessor can also store data. The microprocessor can process the data to display pulse rate, blood oxygenation levels, calories expended by the user of a pre-set time period, target zone activity, time and dynamic blood pressure. Further, microprocessor preferably includes an automatic gain control for preventing saturation of the photodetector, which allows for the device to be used on different portions of the human body. Rulkov at 5:48-64

’475 Patent	Rulkov
	A smartphone 1501 receives signals from a heart rate monitor (“HRM”) and the display of the smartphone is used to view a user's heart rate (“HR”) and to work out to apps and to store data. The HRM simply outputs HR and accelerometer data to the smartphone where a mobile application software (“HRM SW”) is processed by the powerful processor of the smartphone. All “heavy” processing and memory is conducted on the smartphone. This reduces the cost, size and power requirements of monitoring device and allows for the more powerful offboard processing, display and storage of HR data by the smartphone. The software application might be a pure fitness app, might be provided by WEIGHT WATCHERS to their clients as an app or could be a game or even medical application for in home use. The game might also require that heart rate reach a certain high or low target before being able to conduct a specified in-game action. For example, a user might have to restore heart rate to their resting baseline before being able to do a high jump. Similarly, they might have to enter a higher target heart zone to “power up” for an attack. HRM application for video game overview: A heart rate monitor would be used as an integral, interactive element of video games to add a degree of realism. A basic example would be in a game that required shooting skills or skills that could be enhanced or degraded by a physical state as indicated by heart rate level. A player's normal heart rate would be measured and entered into a game data base. This average would be used as a baseline to provide more accurate shooting or combat skills if the heart rate was at a lower level during the activity and accuracy would be degraded if the HR was at a certain level above the average. This is reflective of the real world where actual snipers use heart rate as a means to achieve better accuracy. It also is reflective of the real world where a person has to physically move and evade and then fire accurately or engage in other physical combat using manual weapons or personal combat skills. This technique could also be used in sports games such as golf games where shot accuracy could be improved by a lower heart rate or conversely adversely affected by an elevate HR reflecting a nervous or agitated state. The game could encourage and promote the use of interactive biofeedback to control the heart rate and improve performance. In this case the biofeedback training could translate into real world applications for sports or other activities. This application of HR monitoring technology requires a real time heart rate monitor. Such a device may detect the electrical pulses from the heart such as the chest belt monitors, however a preferred application would be a more convenient monitor that would be worn on the arm of the game player, but would be motion resistant as well as continuous. Rulkov at 14:15-63 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

’475 Patent	Rulkov
	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	Rulkov discloses or renders obvious one or more biosensors adapted to be placed on the user. Another aspect of the present invention is of the present invention is a system for monitoring a real-time vital sign of a user. The system for monitoring a real-time vital sign of a user comprises a monitoring device comprising an optical sensor for generating a real-time digitized optical signal corresponding to a flow of blood through an artery of the user and an accelerometer for generating real-time accelerometer data comprising a X-axis signal, a Y-axis signal and a Z-axis signal based on a movement of the user. The system further comprises a first transceiver for transmitting the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a mobile communication device comprising a second transceiver for receiving the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a processor in electrical communication with the second transceiver, the processor configured to receive the real-time digitized signal and the real-time accelerometer data, the processor configured to calculate a period of motion related harmonics from the real-time accelerometer data utilizing a repetitive motion pattern analyzer, the processor configured to modify the real-time digitized optical signal by suppressing the motion related harmonics calculated by the motion pattern analyzer to generate a modified optical signal, the processor configured to generate a real-time heart rate for the user from the modified optical signal, Rulkov at 3:1-27

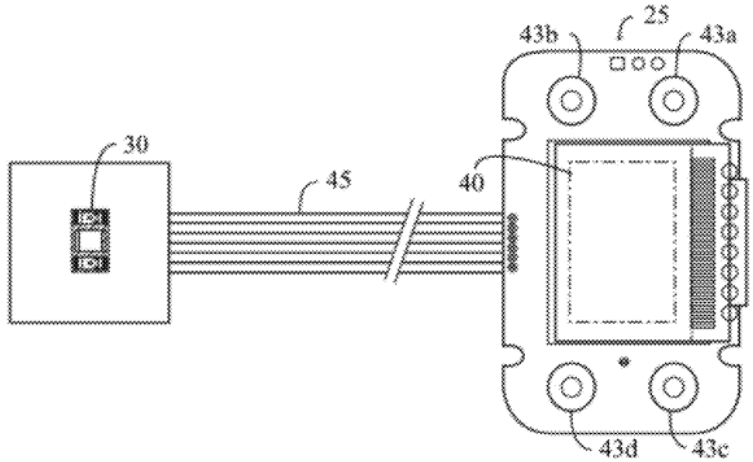
’475 Patent	Rulkov
	 FIG. 1 Rulkov at Fig. 1 As shown in FIGS. 1-5, a monitoring device is generally designated 20. The monitoring device 20 preferably includes an article 25 and an attachment band 26 having an exterior surface 26 a and interior surface 26 b. The monitoring device 20 is preferably secured with VELCRO® hook and loop material 31 a and 31 b. The article 25 preferably includes an optical sensor 30, control components 43 a-43 c and optionally a display member 40. The monitoring device 20 is preferably worn on a user's wrist, arm or ankle. Rulkov at 4:36-44

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	The optical sensor 30 of the monitoring device 20 is preferably positioned over the radial artery or ulnar artery if the article 25 is worn on the user's arm. The optical sensor 30 of the monitoring device 20 is preferably positioned over the posterior tibial artery of a user if the article 25 is worn on the user's ankle. However, those skilled in the pertinent art will recognize that the optical sensor may be placed over other arteries of the user without departing from the scope and spirit of the present invention. Further, the optical sensor 30 need only be in proximity to an artery of the user in order to obtain a reading or signal. Rulkov at 5:4-14 In a preferred embodiment, the optical sensor 30 is a plurality of light emitting diodes (“LED”) 35 based on green light wherein the LEDs 35 generate green light (wavelength of 500-570 nm), and a photodetector 36 detects the green light. Yet in an alternative embodiment, the optical sensor 30 is a photodetector 36 and a single LED 35 transmitting light at a wavelength of approximately 900 nanometers as a pulsed infrared LED. Yet further, the optical sensor is a combination of a green light LED and a pulsed infrared LED to offset noise affects of ambient light and sunlight. As the heart pumps blood through the arteries in the user's arm, ankle or wrist, the photodetector 36, which is typically a photodiode, detects reflectance/transmission at the wavelengths (green, red or infrared), and in response generates a radiation-induced signal. Rulkov at 5:15-29 A preferred optical sensor 30 utilizing green light is a TRS1755 sensor from TAOS, Inc of Plano Tex. The TRS1755 comprises a green LED light source (567 nm wavelength) and a light-to-voltage converter. The output voltage is directly proportional to the reflected light intensity. Another preferred photodetector 36 is a light-to-voltage photodetector such as the TSL260R and TSL261, TSL261R photodetectors available from TAOS, Inc of Plano Tex. Alternatively, the photodetector 130 is a light-to-frequency photodetector such as the TSL245R, which is also available from TAOS, Inc. The light-to-voltage photodetectors have an integrated transimpedance amplifier on a single monolithic integrated circuit, which reduces the need for ambient light filtering. The TSL261 photodetector preferably operates at a wavelength greater than 750 nanometers, and optimally at 940 nanometers, which would preferably have a LED that radiates light at those wavelengths.

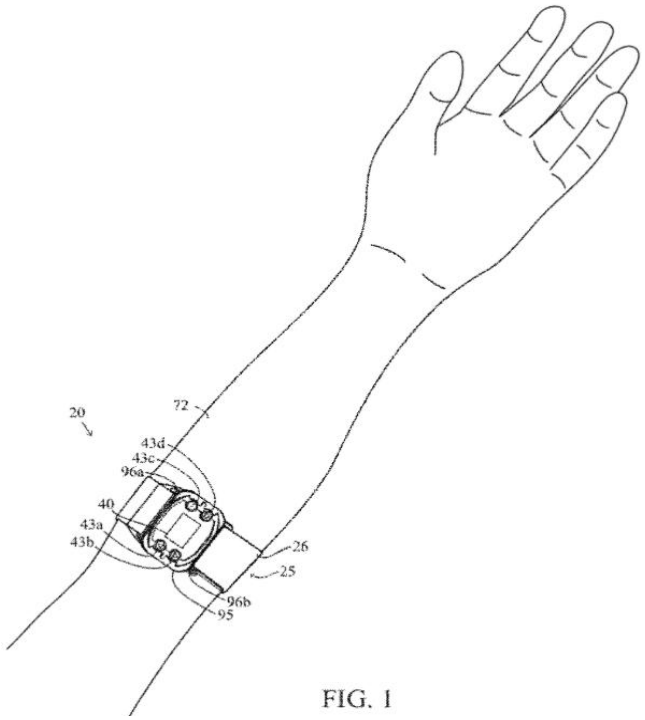
’475 Patent	Rulkov
	Rulkov at 5:30-46  FIG. 6 Rulkov at Fig. 6 A connection wire arrangement 45 is shown in FIGS. 6 and 8, wherein the connection 45 between the microprocessor and the optical sensor 30 is preferably non-planar or non-straight in order to reduce noise in the signal. The optical sensor 30 preferably comprises a photodetector 36, and first and second LEDs 35 which transmit light. Using two LEDs on each side of a photodetector creates a more mechanically stable optical sensor 30. Rulkov at 6:18-25 1. A system for monitoring a real-time vital sign of a user, the system comprising: an monitoring device comprising an optical sensor for generating a real-time digitized optical signal corresponding to a flow of blood through an artery of the user, an accelerometer for generating a real-time accelerometer data comprising a X-axis signal, a Y-axis signal and a Z-axis signal based on a movement of the user, and

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	a first transceiver for transmitting the real-time digitized optical signal and the real-time accelerometer data from the monitoring device; a mobile communication device comprising a second transceiver for receiving the real-time digitized optical signal and the real-time accelerometer data from the monitoring device, a processor in electrical communication with the second transceiver, the processor configured to receive the real-time digitized signal and the real-time accelerometer data, the processor configured to calculate a period of motion related harmonics from the real-time accelerometer data utilizing a repetitive motion pattern analyzer, the processor configured to modify the real-time digitized optical signal by suppressing the motion related harmonics calculated by the motion pattern analyzer to generate a modified optical signal, the processor configured to generate a real-time heart rate for the user from the modified optical signal, and a display for displaying the real-time heart rate value for the user received from the processor. Rulkov at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate	Rulkov discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. In monitoring one's health there is a constant need to know how many calories have been expended whether exercising or going about one's daily routine. A calorie is a measure of heat, generated when energy is produced in our bodies. The amount of calories burned during exercise is a measure of the total amount of energy used during a workout. This can be important, since increased energy usage through exercise helps reduce body fat. There are several means to measure this expenditure of energy. To calculate the calories burned during exercise one multiplies the intensity level of the exercise by one's

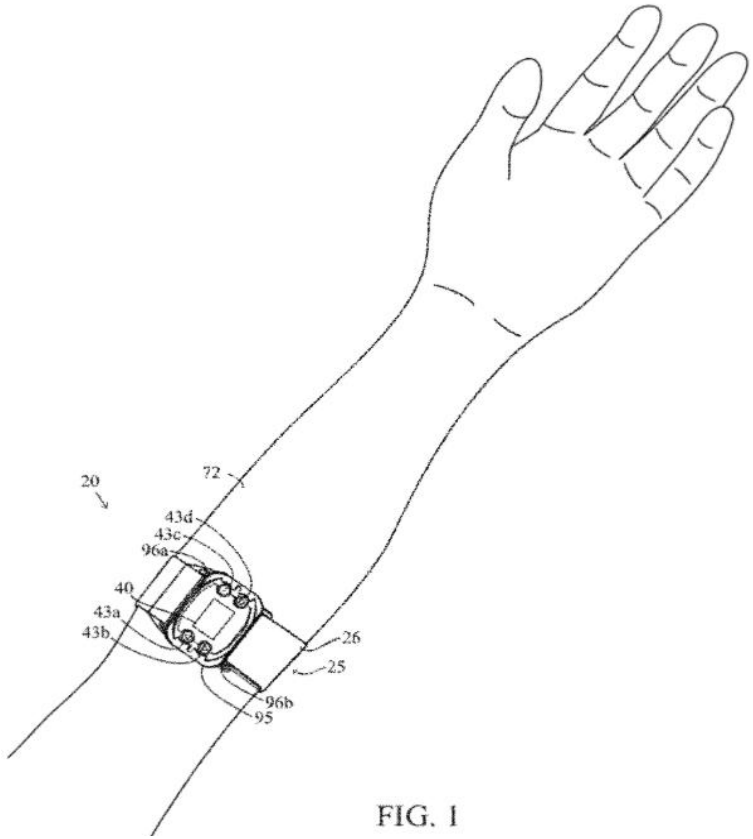
’475 Patent	Rulkov
monitoring and a blood flow measurement;	body weight (in kilograms). This provides the amount of calories burned in an hour. A unit of measurement called a MET is used to rate the intensity of an exercise. One MET is equal to the amount of energy expended at rest. Rulkov at 2:9-23 Another aspect of the present invention is of the present invention is a system for monitoring a real-time vital sign of a user. The system for monitoring a real-time vital sign of a user comprises a monitoring device comprising an optical sensor for generating a real-time digitized optical signal corresponding to a flow of blood through an artery of the user and an accelerometer for generating real-time accelerometer data comprising a X-axis signal, a Y-axis signal and a Z-axis signal based on a movement of the user. The system further comprises a first transceiver for transmitting the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a mobile communication device comprising a second transceiver for receiving the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a processor in electrical communication with the second transceiver, the processor configured to receive the real-time digitized signal and the real-time accelerometer data, the processor configured to calculate a period of motion related harmonics from the real-time accelerometer data utilizing a repetitive motion pattern analyzer, the processor configured to modify the real-time digitized optical signal by suppressing the motion related harmonics calculated by the motion pattern analyzer to generate a modified optical signal, the processor configured to generate a real-time heart rate for the user from the modified optical signal, Rulkov at 3:1-27 Optionally, the modified optical signal is filtered with a narrow band filter adaptively tuned to a heart rate frequency calculated by a heart rate evaluator to generate the real-time heart rate for the user. Preferably, the repetitive motion pattern analyzer comprises an array of Comb filters. Preferably, the optical sensor comprises two green LEDs and a photodetector Rulkov at 3:28-34

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	 FIG. 6 Rulkov at Fig. 6 The right button 43 *c* is pushed to scroll through the choices of other output values, which comprises: basal metabolic rate; average heart rate; minimum heart rate; maximum heart rate; fat burn heart rate exercise target zone; cardio burn heart rate exercise target zone; and, summary of daily calories burned. The basal metabolic rate (displayed as “BMR”) is an estimate of the total calories burned by the user in one day without exercise, and is based on the user inputted personal data. The average heart rate (displayed as “avHR”) is the average heart rate of the user between resets, and is an overall indicator of fitness. The lower the average heart rate, the healthier the heart. The average heart rate is also a measure of the effectiveness of the exercise program employed by the user since a decrease in the average heart rate of the user will indicate the user's fitness has improved. The minimum heart rate (displayed as “mnHR”) of the user is typically measured during sleep and periods of relaxation. The maximum heart rate (displayed as “mxHR”) is typically measured during intense workouts. The fat burn heart rate exercise target zone (displayed as “fatB”) displays a low and high range for the heart rate of the user to optimize fat burning during exercise. The cardio burn heart rate exercise target zone provides a high and low range for the heart rate of the user to optimize cardio conditioning during exercise. The summary of daily calories burned (displayed as “cal”) displays the daily calories burned by the user.

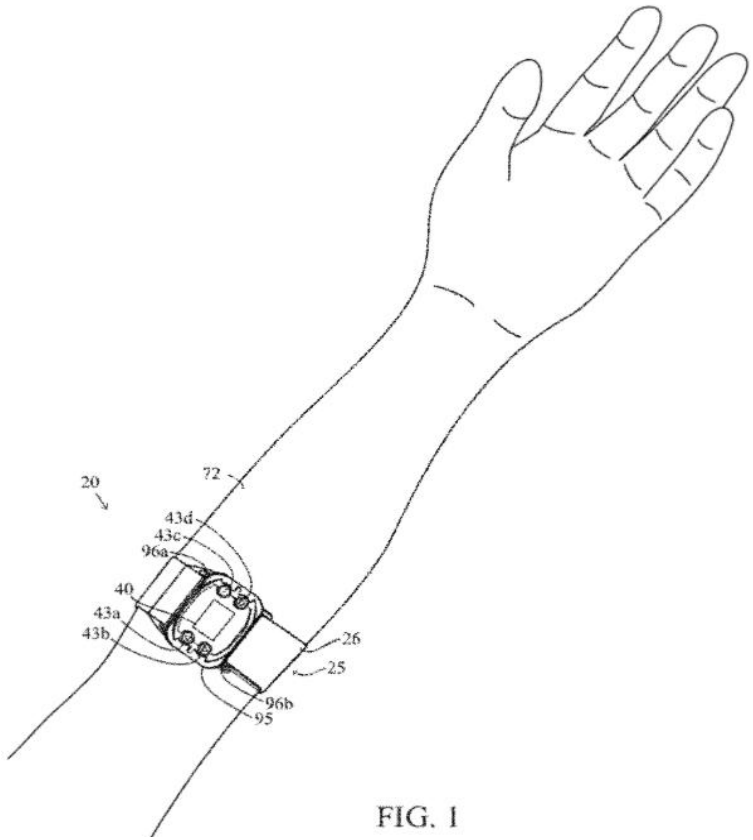
’475 Patent	Rulkov
	Rulkov at 7:39-64 One aspect of the present invention is a system for monitoring at least one vital sign of a user. The system comprises a smartphone and a monitoring device. The smartphone comprises a short range wireless transceiver, a processor and a display screen. The monitoring device comprises a housing, an optical sensor for measuring blood flow through an artery of a wrist, arm or ankle of the user, a processor, a short range wireless transceiver, and a power source. The short range wireless transceiver operates on a communication protocol using a 9 kHz communication format, a 125 kHz RFID communication format, a 13.56 MHz communication format, a 433 MHz communication format, a 433 MHz RFID communication format, or a 900 MHz RFID communication format. Rulkov at 13:55-67 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	Rulkov discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. Although the monitoring device20 is described in reference to an article worn on a user's arm, wrist or ankle, those skilled in the pertinent art will recognize that the monitoring device20may take other forms such as eyewear disclosed in Brady et al, U.S. Pat. No. 7,648,463, for a Monitoring Device, Method And System, which is hereby incorporated by reference in its entirety or a glove such as disclosed in Rulkov et al., U.S. Pat. No. 7,887,492, for a Monitoring Device, Method And System, which is hereby incorporated by reference in its entirety. Rulkov at 4:61-5:3

’475 Patent	Rulkov
	 FIG. 1 Rulkov at Fig. 1 The optical sensor 30 of the monitoring device 20 is preferably positioned over the radial artery or ulnar artery if the article 25 is worn on the user's arm. The optical sensor 30 of the monitoring device 20 is preferably positioned over the posterior tibial artery of a user if the article 25 is worn on the user's ankle. However, those skilled in the pertinent art will recognize that the optical sensor may be placed over other arteries of the user without departing from the scope and spirit of the present invention. Further, the optical sensor 30 need only be in proximity to an artery of the user in order to obtain a reading or signal. Rulkov at 5:6-15 In a preferred embodiment, the optical sensor30 is a plurality of light emitting diodes (“LED”) 35 based on green light wherein the LEDs35 generate green light (wavelength of 500-570 nm), and a photodetector36 detects the green light. Yet in an alternative embodiment, the optical sensor30 is a photodetector36 and a single LED35 transmitting light at a wavelength of approximately 900 nanometers

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	as a pulsed infrared LED. Yet further, the optical sensor is a combination of a green light LED and a pulsed infrared LED to offset noise affects of ambient light and sunlight. As the heart pumps blood through the arteries in the user's arm, ankle or wrist, the photodetector36, which is typically a photodiode, detects reflectance/transmission at the wavelengths (green, red or infrared), and in response generates a radiation-induced signal. Rulkov at 5:16-30 A preferred optical sensor30 utilizing green light is a TRS1755 sensor from TAOS, Inc of Plano Tex. The TRS1755 comprises a green LED light source (567 nm wavelength) and a light-to-voltage converter. The output voltage is directly proportional to the reflected light intensity. Another preferred photodetector36 is a light-to-voltage photodetector such as the TSL260R and TSL261, TSL261R photodetectors available from TAOS, Inc of Plano Tex. Alternatively, the photodetector130 is a light-to-frequency photodetector such as the TSL245R, which is also available from TAOS, Inc. The light-to-voltage photodetectors have an integrated transimpedance amplifier on a single monolithic integrated circuit, which reduces the need for ambient light filtering. The TSL261 photodetector preferably operates at a wavelength greater than 750 nanometers, and optimally at 940 nanometers, which would preferably have a LED that radiates light at those wavelengths. Rulkov at 5:31-47 One aspect of the present invention is a system for monitoring at least one vital sign of a user. The system comprises a smartphone and a monitoring device. The smartphone comprises a short range wireless transceiver, a processor and a display screen. The monitoring device comprises a housing, an optical sensor for measuring blood flow through an artery of a wrist, arm or ankle of the user, a processor, a short range wireless transceiver, and a power source. The short range wireless transceiver operates on a communication protocol using a 9 kHz communication format, a 125 kHz RFID communication format, a 13.56 MHz communication format, a 433 MHz communication format, a 433 MHz RFID communication format, or a 900 MHz RFID communication format. Rulkov at 13:55-67 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

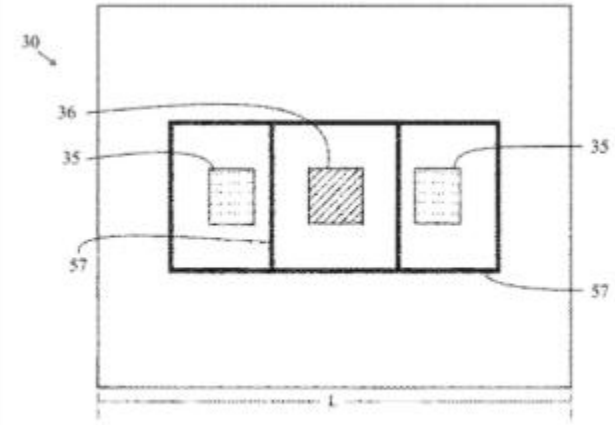
’475 Patent	Rulkov
	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	Rulkov discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin.  FIG. 1 Rulkov at Fig. 1

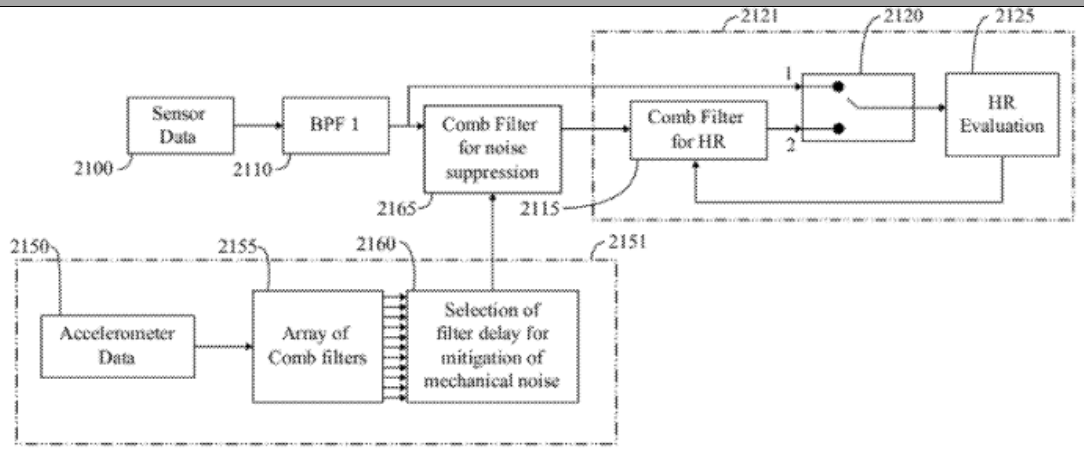
’475 Patent	Rulkov
	As shown in FIGS. 1-5, a monitoring device is generally designated 20. The monitoring device 20 preferably includes an article 25 and an attachment band 26 having an exterior surface 26 a and interior surface 26 b. The monitoring device 20 is preferably secured with VELCRO® hook and loop material 31 a and 31 b. The article 25 preferably includes an optical sensor 30, control components 43 a-43 c and optionally a display member 40. The monitoring device 20 is preferably worn on a user's wrist, arm or ankle. Rulkov at 4:36-47 It is desirous to adapt the monitoring device 20 to the anatomy of the user's arm or even the user's ankle. The band 26 is preferably composed of neoprene, leather, synthetic leather, LYCRA, another similar material, or a combination thereof. The article 25 is preferably composed of a semi-rigid or rigid plastic with a rubber-like or semi-flex plastic bottom layer for contact with the user's body. The bottom layer of the article 25 may have a curve surface for contact with a user's body. The article 25 preferably has a mass ranging from 5 grams to 50 grams. Preferably, the lower the mass of the article 25, the more comfort to the user. The article 25 preferably has a thickness ranging from 5 mm to 10 mm, and is most preferably 6.5 mm. Rulkov at 4:48-60 Although the monitoring device 20 is described in reference to an article worn on a user's arm, wrist or ankle, those skilled in the pertinent art will recognize that the monitoring device 20 may take other forms such as eyewear disclosed in Brady et al, U.S. Pat. No. 7,648,463, for a Monitoring Device, Method And System, which is hereby incorporated by reference in its entirety or a glove such as disclosed in Rulkov et al., U.S. Pat. No. 7,887,492, for a Monitoring Device, Method And System, which is hereby incorporated by reference in its entirety. Rulkov at 4:61-5:3

’475 Patent	Rulkov
	 FIG. 1 Rulkov at Fig. 1 The optical sensor 30 of the monitoring device 20 is preferably positioned over the radial artery or ulnar artery if the article 25 is worn on the user's arm. The optical sensor 30 of the monitoring device 20 is preferably positioned over the posterior tibial artery of a user if the article 25 is worn on the user's ankle. However, those skilled in the pertinent art will recognize that the optical sensor may be placed over other arteries of the user without departing from the scope and spirit of the present invention. Further, the optical sensor 30 need only be in proximity to an artery of the user in order to obtain a reading or signal. Rulkov at 5:4-15

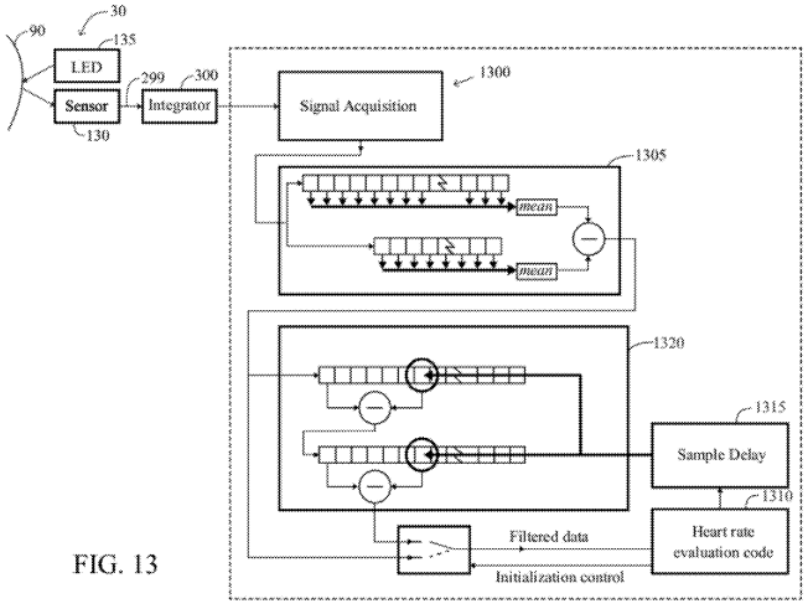
’475 Patent	Rulkov
	The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). Rulkov at 12:65-13:5 One aspect of the present invention is a system for monitoring at least one vital sign of a user. The system comprises a smartphone and a monitoring device. The smartphone comprises a short range wireless transceiver, a processor and a display screen. The monitoring device comprises a housing, an optical sensor for measuring blood flow through an artery of a wrist, arm or ankle of the user, a processor, a short range wireless transceiver, and a power source. The short range wireless transceiver operates on a communication protocol using a 9 kHz communication format, a 125 kHz RFID communication format, a 13.56 MHz communication format, a 433 MHz communication format, a 433 MHz RFID communication format, or a 900 MHz RFID communication format. Rulkov at 13:55-67 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	Rulkov discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. A preferred optical sensor 30 utilizing green light is a TRS1755 sensor from TAOS, Inc of Plano Tex. The TRS1755 comprises a green LED light source (567 nm wavelength) and a light-to-voltage converter. The output voltage is directly proportional to the reflected light intensity. Another preferred photodetector 36 is a light-to-voltage photodetector such as the TSL260R and TSL261, TSL261R

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	photodetectors available from TAOS, Inc of Plano Tex. Alternatively, the photodetector 130 is a light-to-frequency photodetector such as the TSL245R, which is also available from TAOS, Inc. The light-to-voltage photodetectors have an integrated transimpedance amplifier on a single monolithic integrated circuit, which reduces the need for ambient light filtering. The TSL261 photodetector preferably operates at a wavelength greater than 750 nanometers, and optimally at 940 nanometers, which would preferably have a LED that radiates light at those wavelengths. Rulkov at 5:31-47 In a preferred embodiment, the optical sensor 30 is a plurality of light emitting diodes (“LED”) 35 based on green light wherein the LEDs 35 generate green light (wavelength of 500-570 nm), and a photodetector 36 detects the green light. Yet in an alternative embodiment, the optical sensor 30 is a photodetector 36 and a single LED 35 transmitting light at a wavelength of approximately 900 nanometers as a pulsed infrared LED. Yet further, the optical sensor is a combination of a green light LED and a pulsed infrared LED to offset noise affects of ambient light and sunlight. As the heart pumps blood through the arteries in the user's arm, ankle or wrist, the photodetector 36, which is typically a photodiode, detects reflectance/transmission at the wavelengths (green, red or infrared), and in response generates a radiation-induced signal. Rulkov at 5:16-30 A connection wire arrangement 45 is shown in FIGS. 6 and 8, wherein the connection 45 between the microprocessor and the optical sensor 30 is preferably non-planar or non-straight in order to reduce noise in the signal. The optical sensor 30 preferably comprises a photodetector 36, and first and second LEDs 35 which transmit light. Using two LEDs on each side of a photodetector creates a more mechanically stable optical sensor 30. Rulkov at 6:18-25 A motion sensor 1100 is included to assist in identifying motion noise and filtering the noise from the signal sent by the sensor 30. The motion sensor 1100, such as an accelerometer, is integrated into the circuitry and software of the monitoring device 20. As the motion sensor detects an arm swinging, the noise component is utilized with the signal processing noise filtering techniques to provide additional filtering to remove the noise element and improve the accuracy of the monitoring device 20. More

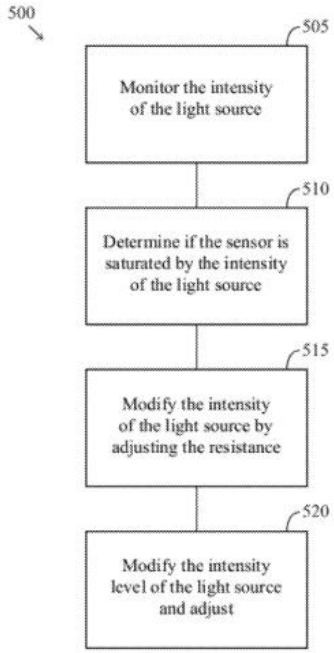
’475 Patent	Rulkov
	specifically, the signal from the optical sensor 30 is transmitted to the processor where a custom blood pressure filter 41 w processes the signal which is further processed at by custom adaptive filter 41 x before being sent to a heart beat tracking system 41 y and then transmitted to a heart rate beat output 41 z. The heart rate beat output 41 z provides feedback to the custom adaptive filter 41 x which also receives input from the motion sensor 1100. Rulkov at 11:4-19  FIG. 9 Rulkov at Fig. 9

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	 FIG. 20 Rulkov at Fig. 20 FIG. 20 illustrates signal processing of a vital sign with the use of an accelerometer to filter the signal. As shown in FIG. 20, sensor data at block 2100 is sent to a band pass filter 2110 and then to a comb filter 2165 for noise suppression, then to a Comb filter for a heart rate 2215 and to a heart rate evaluator 2125 through a switch 2120. Feedback from the heart rate evaluator 2125 is sent to comb filter 2115. However, accelerometer data from block 2150 is sent to an array of Comb filters 2155, then to a selection of a filter delay for mitigation of mechanical noise at 2160 and then to comb filter 2165 for noise suppression in the vital sign signal from the vital sign sensor. Rulkov at 12:3-14 In a preferred design of the sensor 30, the distance between the centers of active areas of LEDs 35 is preferably 5-6 mm. The active area (photodetector 36) of a sensor 30 is placed in the middle of that distance. In the custom sensor, the distance of a custom sensor is preferably in the range of 3-4 mm (which means the spacing between the centers of photodetector 36 and LEDs 35 is about 1.5-2 mm). The distance is preferably sufficient for the placement of an opaque barrier between them. To control the amplitude of the LED intensity pulse a sufficient current (voltage) range of intensity ramp is used to control the LEDs 35 and to achieve the same levels of intensity in both LEDs 35 within a given range. The electrical characteristics of 520 nm SunLED in terms of voltage range for intensity ramp is sufficient.

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	The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). LGA enables an easy way to seal the contact area from moisture. The preferred embodiment uses 250 microsecond LED pulses and a 12T photodetector 36 with second order active high pass filter (100 Hz cutoff). The DC output of the sensor 30 is monitored to ensure that it is not saturated by the effects of ambient light. The use of short-term pulses reduces ambient light. In the preferred embodiment, voltage is collected at the sensor output every 2 msec. Inside the microprocessor 741, an average 8 consecutive samples improve the SNR (signal to noise ratio) and then work with the averaged numbers. Therefore the sampling rate for raw data is preferably 2 msec, however if 8-samples averaging is utilized in the integrated sensor the data output rate is reduced to sending a new averaged value every 16 msec. An ADC is used with a 12-bit resolution. The response of TSL 12T is acceptable. 100 Hz is the low limit for LPF cutoff. The selection of pulse duration is preferably based on the speed of the LED drivers, sensor electronics and output pick detection. The higher the low frequency cutoff that is implemented for the selected pulse duration, the better SNR. Rulkov at 12:52-13:25 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Rulkov discloses or renders obvious, the detection system is configured to be synchronized to the light source. A preferred optical sensor 30 utilizing green light is a TRS1755 sensor from TAOS, Inc of Plano Tex. The TRS1755 comprises a green LED light source (567 nm wavelength) and a light-to-voltage converter. The output voltage is directly proportional to the reflected light intensity. Another preferred photodetector 36 is a light-to-voltage photodetector such as the TSL260R and TSL261, TSL261R photodetectors available from TAOS, Inc of Plano Tex. Alternatively, the photodetector 130 is a light-

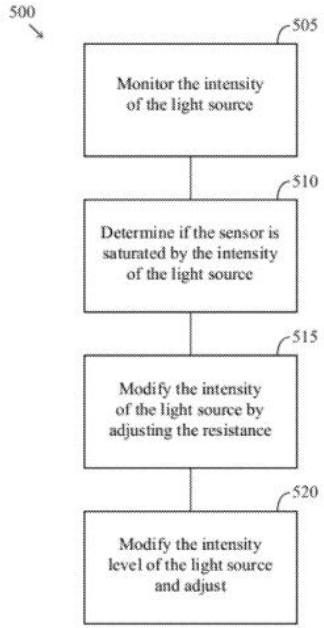
’475 Patent	Rulkov
	to-frequency photodetector such as the TSL245R, which is also available from TAOS, Inc. The light-to-voltage photodetectors have an integrated transimpedance amplifier on a single monolithic integrated circuit, which reduces the need for ambient light filtering. The TSL261 photodetector preferably operates at a wavelength greater than 750 nanometers, and optimally at 940 nanometers, which would preferably have a LED that radiates light at those wavelengths. Rulkov at 5:31-47 A general method is as follows. The light source 35 transmits light through at least one artery of the user. The photo-detector 36 detects the light. The pulse rate is determined by the signals received by the photo-detector 36. Rulkov at 6:52-55  FIG. 13 Rulkov at Fig. 13

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	FIG. 13 illustrates a block diagram of a flow chart of a signal processing method of the present invention. As shown in FIG. 10, the photodetector 36 of the optical sensor 30 receives light from the light source 35 while in proximity to the user's artery. The light source 35 is preferably a plurality of LEDs 35. The intensity of the light is preferably controlled by an integrator 300. In a preferred embodiment, the optical sensor 30 is a TRS1755 which includes a green LED light source (567 nm wavelength) and a light-to-voltage converter. The output voltage is directly proportional to the reflected light intensity. The signal 299 is sent to the microprocessor. At block 1300, the signal acquisition is performed. In reference to FIGS. 14 and 15, in the pulse mode the LED 35 is periodically activated for short intervals of time by a signal from the microcontroller. The reflected pulse of light is received by the sensor, with the generation of a voltage pulse having an amplitude proportional to the intensity of the reflected light. When the LED is activated, the switch, SW, is open by the action of the control signal from the microcontroller, and the capacitor, C, integrates the pulse generated from the sensor by charging through the resistor R. Immediately prior to deactivation of the LED, the analog-to-digital converter acquires the value of the voltage integrated across the capacitor, C. The analog-to-digital converter generates a data sample in digital form which is utilized by the microcontroller for evaluation of the heart rate the wearer. Subsequent to the sample being acquired by the analog-to-digital converter, the LED is deactivated and the capacitor, C, is shortcut by switch, SW, to reset the integrator, RC. A signal indicating sensor saturation is also sent to the microcontroller for light control of the LEDs. This states remains unchanged for a given time interval after which the process is repeated, which is illustrated in FIG. 15. The signals are shown in FIG. 15, with the raw sensor signal received from the sensor amplifier shown as varying between reflected light when the LEDs are on and an ambient light level when the LEDs are off. The filtered signal from the high pass filter (“HPF”) is shown as the filtered sensor signal in FIG. 14. The integrator reset signal is shown as integrator out signal in FIG. 15, and the integrator reset signal in FIG. 14. Rulkov at 9:60-10:31

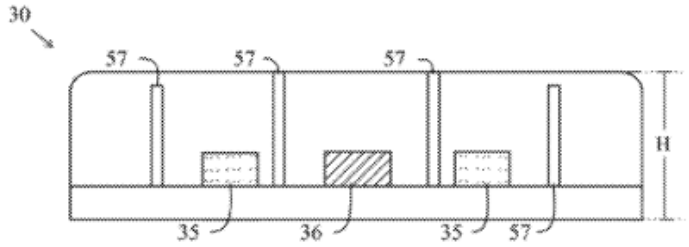
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	 FIG. 17 Rulkov at Fig. 17 FIG. 17 is a preferred method 500 for controlling the light intensity of the optical sensor 30. At block 505, the light intensity of the light source 35 is monitored. At block 510, the sensor/photodetector is determined to be saturated by the light source. At block 515, the intensity of the light source is modified by adjusting the resistance and the flow of current to the light source 35. At block 520, the light intensity is again monitored and adjusted if necessary. In a preferred embodiment, this automatic gain mechanism prevents the green light from overwhelming the photodetector 36 thereby maintaining an accurate reading no matter where the optical sensor is placed on the user. Rulkov at 11:20-31

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	Rulkov discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. In a preferred embodiment, the optical sensor30 is a plurality of light emitting diodes ("LED") 35 based on green light wherein the LEDs35 generate green light (wavelength of 500-570 nm), and a photodetector36 detects the green light. Yet in an alternative embodiment, the optical sensor30 is a photodetector36 and a single LED35 transmitting light at a wavelength of approximately 900 nanometers as a pulsed infrared LED. Yet further, the optical sensor is a combination of a green light LED and a pulsed infrared LED to offset noise affects of ambient light and sunlight. As the heart pumps blood through the arteries in the user's arm, ankle or wrist, the photodetector36, which is typically a photodiode, detects reflectance/transmission at the wavelengths (green, red or infrared), and in response generates a radiation-induced signal. Rulkov at 5:16-30 A preferred optical sensor30 utilizing green light is a TRS1755 sensor from TAOS, Inc of Plano Tex. The TRS1755 comprises a green LED light source (567 nm wavelength) and a light-to-voltage converter. The output voltage is directly proportional to the reflected light intensity. Another preferred photodetector36 is a light-to-voltage photodetector such as the TSL260R and TSL261, TSL261R photodetectors available from TAOS, Inc of Plano Tex. Alternatively, the photodetector130 is a light-to-frequency photodetector such as the TSL245R, which is also available from TAOS, Inc. The light-to-voltage photodetectors have an integrated transimpedance amplifier on a single monolithic integrated circuit, which reduces the need for ambient light filtering. The TSL261 photodetector preferably operates at a wavelength greater than 750 nanometers, and optimally at 940 nanometers, which would preferably have a LED that radiates light at those wavelengths.

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	Rulkov at 5:31-47 A connection wire arrangement 45 is shown in FIGS. 6 and 8, wherein the connection 45 between the microprocessor and the optical sensor 30 is preferably non-planar or non-straight in order to reduce noise in the signal. The optical sensor 30 preferably comprises a photodetector 36, and first and second LEDs 35 which transmit light. Using two LEDs on each side of a photodetector creates a more mechanically stable optical sensor 30. Rulkov at 6:18-25 FIG. 13 illustrates a block diagram of a flow chart of a signal processing method of the present invention. As shown in FIG. 10, the photodetector 36 of the optical sensor 30 receives light from the light source 35 while in proximity to the user's artery. The light source 35 is preferably a plurality of LEDs 35. The intensity of the light is preferably controlled by an integrator 300. In a preferred embodiment, the optical sensor 30 is a TRS1755 which includes a green LED light source (567 nm wavelength) and a light-to-voltage converter. The output voltage is directly proportional to the reflected light intensity. The signal 299 is sent to the microprocessor. At block 1300, the signal acquisition is performed. In reference to FIGS. 14 and 15, in the pulse mode the LED 35 is periodically activated for short intervals of time by a signal from the microcontroller. The reflected pulse of light is received by the sensor, with the generation of a voltage pulse having an amplitude proportional to the intensity of the reflected light. When the LED is activated, the switch, SW, is open by the action of the control signal from the microcontroller, and the capacitor, C, integrates the pulse generated from the sensor by charging through the resistor R. Immediately prior to deactivation of the LED, the analog-to-digital converter acquires the value of the voltage integrated across the capacitor, C. The analog-to-digital converter generates a data sample in digital form which is utilized by the microcontroller for evaluation of the heart rate the wearer. Subsequent to the sample being acquired by the analog-to-digital converter, the LED is deactivated and the capacitor, C, is shortcut by switch, SW, to reset the integrator, RC. A signal indicating sensor saturation is also sent to the microcontroller for light control of the LEDs. This states remains unchanged for a given time interval after which the process is repeated, which is illustrated in FIG. 15. The signals are shown in FIG. 15, with the raw sensor signal received from the sensor amplifier shown as varying between reflected light when the LEDs are on and an ambient light level when the LEDs are off. The filtered signal from the high pass filter (“HPF”) is shown as the filtered sensor signal in FIG. 14. The integrator reset signal is shown as integrator out signal in FIG. 15, and the integrator reset signal in FIG. 14.

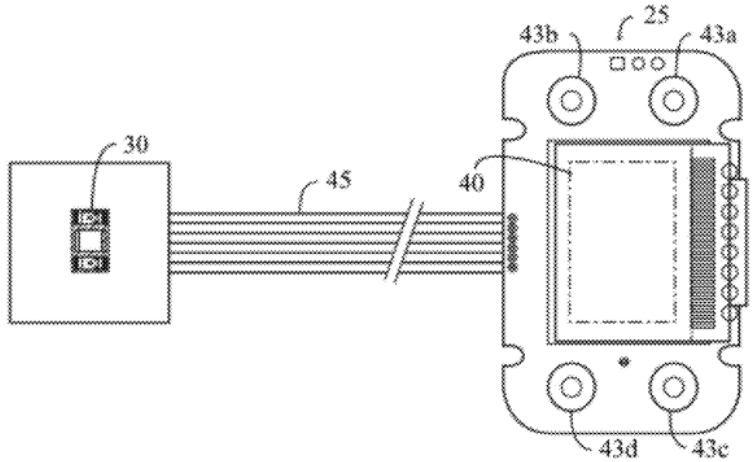
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	Rulkov at 9:60-10:31  FIG. 17 Rulkov at Fig. 17 FIG. 17 is a preferred method 500 for controlling the light intensity of the optical sensor 30. At block 505, the light intensity of the light source 35 is monitored. At block 510, the sensor/photodetector is determined to be saturated by the light source. At block 515, the intensity of the light source is modified by adjusting the resistance and the flow of current to the light source 35. At block 520, the light intensity is again monitored and adjusted if necessary. In a preferred embodiment, this automatic gain mechanism prevents the green light from overwhelming the photodetector 36 thereby maintaining an accurate reading no matter where the optical sensor is placed on the user.

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	Rulkov at 11:20-31 FIG. 16 illustrates how the control mechanism operates to maintain a proper light intensity. As the signal reaches the upper limit, the photodetector becomes saturated and the processor lowers the current flow, which results in a break in the signal. Then as the signal is lowered it becomes too low and the processor increases the light intensity resulting in a break in the signal. Rulkov at 11:32-38 A block diagram for vital sign signal processing is shown in FIG. 18. The optical sensor730 is placed on or near an artery90 of a user of the monitoring device20. The optical sensor730 has a pair of LEDs735 and a photodetector736, which receives reflected light 737 from the LEDs735. The microprocessor741 has a LED control715 connected to DAC702 for controlling the intensity of the LEDs737. The signal from the photodetector736 is transmitted to a high pass filter (HPF) 703 which sends it to an analog to digital converter704, and the signal from the photodetector737 is also sent directly to a second analog to digital converter704. The real-time signal is then sent to a sensor data evaluation714 to provide feedback to the LED control715, and then is also sent to the filter of the signal processing for mitigations of noise and heart rate evaluations712. Simultaneously, the accelerometer710 transmits X-axis, Y-axis and Z-axis signals for the motion of the monitoring device20 to an accelerometer data evaluation711 of the microprocessor741. This signal is then sent to the signal processing for mitigations of noise and heart rate evaluations712. The output for the heart rate and/or calories is generated at block713 of the microprocessor741, which then sends the results to the display740. Rulkov at 11:39-60

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	 FIG. 10 Rulkov at Fig. 10 FIGS. 9-11 illustrate the sensor 30. The sensor 30 has a photodetector 36, at least two LEDs 35 and an opaque light shield 57. The LEDs 35 are preferably green light LEDs. The sensor 30 preferably has a length, L, of 7-10 mm on each side, as shown in FIG. 9. The sensor 30 preferably has a height, H, of 1-1.5 mm, as shown in FIG. 10. The opaque light shield 57 blocks the direct light from the LEDs 35 to the photodetector 36. Only the green light diffused and translucent through the media (skin of the user) 61, as shown in FIG. 11, is allowed to enter the chamber of the photodetector 36. This provides for a more accurate heart rate or vital sign signal. Rulkov at 12:41-51 In a preferred design of the sensor 30, the distance between the centers of active areas of LEDs 35 is preferably 5-6 mm. The active area (photodetector 36) of a sensor 30 is placed in the middle of that distance. In the custom sensor, the distance of a custom sensor is preferably in the range of 3-4 mm (which means the spacing between the centers of photodetector 36 and LEDs 35 is about 1.5-2 mm). The distance is preferably sufficient for the placement of an opaque barrier between them. To control the amplitude of the LED intensity pulse a sufficient current (voltage) range of intensity ramp is used to control the LEDs 35 and to achieve the same levels of intensity in both LEDs 35 within a given range. The electrical characteristics of 520 nm SunLED in terms of voltage range for intensity ramp is sufficient. The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is

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	acceptable). LGA enables an easy way to seal the contact area from moisture. The preferred embodiment uses 250 microsecond LED pulses and a 12T photodetector 36 with second order active high pass filter (100 Hz cutoff). The DC output of the sensor 30 is monitored to ensure that it is not saturated by the effects of ambient light. The use of short-term pulses reduces ambient light. In the preferred embodiment, voltage is collected at the sensor output every 2 msec. Inside the microprocessor 741, an average 8 consecutive samples improve the SNR (signal to noise ratio) and then work with the averaged numbers. Therefore the sampling rate for raw data is preferably 2 msec, however if 8-samples averaging is utilized in the integrated sensor the data output rate is reduced to sending a new averaged value every 16 msec. An ADC is used with a 12-bit resolution. The response of TSL 12T is acceptable. 100 Hz is the low limit for LPF cutoff. The selection of pulse duration is preferably based on the speed of the LED drivers, sensor electronics and output pick detection. The higher the low frequency cutoff that is implemented for the selected pulse duration, the better SNR. Rulkov at 12:52-13:25 4. The system according to claim 1 wherein the optical sensor comprises two green LEDs and a photodetector. Rulkov at Claim 4 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	Rulkov discloses or renders obvious the output signal is indicative of the one or more physiological parameters. In monitoring one's health there is a constant need to know how many calories have been expended whether exercising or going about one's daily routine. A calorie is a measure of heat, generated when energy is produced in our bodies. The amount of calories burned during exercise is a measure of the total amount of energy used during a workout. This can be important, since increased energy usage through

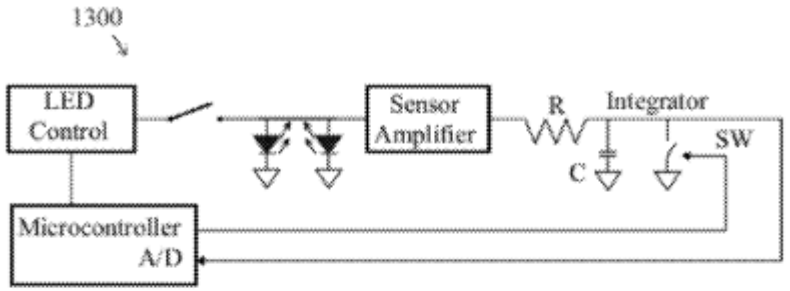
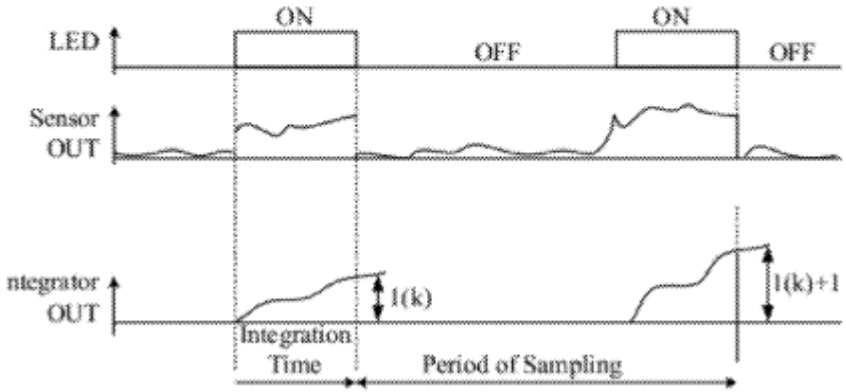
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	exercise helps reduce body fat. There are several means to measure this expenditure of energy. To calculate the calories burned during exercise one multiplies the intensity level of the exercise by one's body weight (in kilograms). This provides the amount of calories burned in an hour. A unit of measurement called a MET is used to rate the intensity of an exercise. One MET is equal to the amount of energy expended at rest. Rulkov at 2:9-23 Another aspect of the present invention is of the present invention is a system for monitoring a real-time vital sign of a user. The system for monitoring a real-time vital sign of a user comprises a monitoring device comprising an optical sensor for generating a real-time digitized optical signal corresponding to a flow of blood through an artery of the user and an accelerometer for generating real-time accelerometer data comprising a X-axis signal, a Y-axis signal and a Z-axis signal based on a movement of the user. The system further comprises a first transceiver for transmitting the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a mobile communication device comprising a second transceiver for receiving the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a processor in electrical communication with the second transceiver, the processor configured to receive the real-time digitized signal and the real-time accelerometer data, the processor configured to calculate a period of motion related harmonics from the real-time accelerometer data utilizing a repetitive motion pattern analyzer, the processor configured to modify the real-time digitized optical signal by suppressing the motion related harmonics calculated by the motion pattern analyzer to generate a modified optical signal, the processor configured to generate a real-time heart rate for the user from the modified optical signal, Rulkov at 3:1-27 Optionally, the modified optical signal is filtered with a narrow band filter adaptively tuned to a heart rate frequency calculated by a heart rate evaluator to generate the real-time heart rate for the user. Preferably, the repetitive motion pattern analyzer comprises an array of Comb filters. Preferably, the optical sensor comprises two green LEDs and a photodetector Rulkov at 3:28-34

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	 FIG. 6 Rulkov at Fig. 6 The right button 43 *c* is pushed to scroll through the choices of other output values, which comprises: basal metabolic rate; average heart rate; minimum heart rate; maximum heart rate; fat burn heart rate exercise target zone; cardio burn heart rate exercise target zone; and, summary of daily calories burned. The basal metabolic rate (displayed as “BMR”) is an estimate of the total calories burned by the user in one day without exercise, and is based on the user inputted personal data. The average heart rate (displayed as “avHR”) is the average heart rate of the user between resets, and is an overall indicator of fitness. The lower the average heart rate, the healthier the heart. The average heart rate is also a measure of the effectiveness of the exercise program employed by the user since a decrease in the average heart rate of the user will indicate the user's fitness has improved. The minimum heart rate (displayed as “mnHR”) of the user is typically measured during sleep and periods of relaxation. The maximum heart rate (displayed as “mxHR”) is typically measured during intense workouts. The fat burn heart rate exercise target zone (displayed as “fatB”) displays a low and high range for the heart rate of the user to optimize fat burning during exercise. The cardio burn heart rate exercise target zone provides a high and low range for the heart rate of the user to optimize cardio conditioning during exercise. The summary of daily calories burned (displayed as “cal”) displays the daily calories burned by the user.

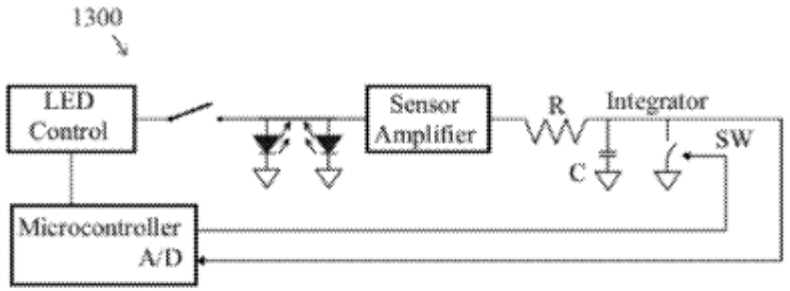
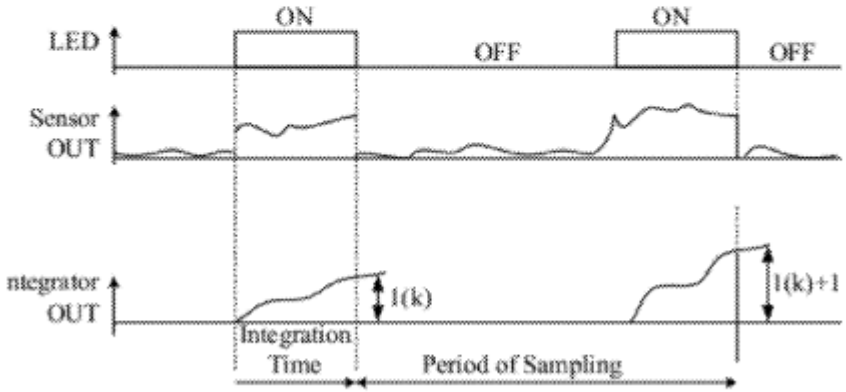
’475 Patent	Rulkov
	Rulkov at 7:39-64 One aspect of the present invention is a system for monitoring at least one vital sign of a user. The system comprises a smartphone and a monitoring device. The smartphone comprises a short range wireless transceiver, a processor and a display screen. The monitoring device comprises a housing, an optical sensor for measuring blood flow through an artery of a wrist, arm or ankle of the user, a processor, a short range wireless transceiver, and a power source. The short range wireless transceiver operates on a communication protocol using a 9 kHz communication format, a 125 kHz RFID communication format, a 13.56 MHz communication format, a 433 MHz communication format, a 433 MHz RFID communication format, or a 900 MHz RFID communication format. Rulkov at 13:55-67 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Rulkov discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. In a preferred embodiment, the optical sensor 30 is a plurality of light emitting diodes (“LED”) 35 based on green light wherein the LEDs 35 generate green light (wavelength of 500-570 nm), and a photodetector 36 detects the green light. Yet in an alternative embodiment, the optical sensor 30 is a photodetector 36 and a single LED 35 transmitting light at a wavelength of approximately 900 nanometers as a pulsed infrared LED. Yet further, the optical sensor is a combination of a green light LED and a pulsed infrared LED to offset noise affects of ambient light and sunlight. As the heart pumps blood through the arteries in the user's arm, ankle or wrist, the photodetector 36, which is typically a photodiode, detects reflectance/transmission at the wavelengths (green, red or infrared), and in response generates a radiation-induced signal.

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	Rulkov at 5:16-30 A motion sensor 1100 is included to assist in identifying motion noise and filtering the noise from the signal sent by the sensor 30. The motion sensor 1100, such as an accelerometer, is integrated into the circuitry and software of the monitoring device 20. As the motion sensor detects an arm swinging, the noise component is utilized with the signal processing noise filtering techniques to provide additional filtering to remove the noise element and improve the accuracy of the monitoring device 20. More specifically, the signal from the optical sensor 30 is transmitted to the processor where a custom blood pressure filter 41 w processes the signal which is further processed at by custom adaptive filter 41 x before being sent to a heart beat tracking system 41 y and then transmitted to a heart rate beat output 41 z. The heart rate beat output 41 z provides feedback to the custom adaptive filter 41 x which also receives input from the motion sensor 1100. Rulkov at 11:4-19 In a preferred design of the sensor 30, the distance between the centers of active areas of LEDs 35 is preferably 5-6 mm. The active area (photodetector 36) of a sensor 30 is placed in the middle of that distance. In the custom sensor, the distance of a custom sensor is preferably in the range of 3-4 mm (which means the spacing between the centers of photodetector 36 and LEDs 35 is about 1.5-2 mm). The distance is preferably sufficient for the placement of an opaque barrier between them. To control the amplitude of the LED intensity pulse a sufficient current (voltage) range of intensity ramp is used to control the LEDs 35 and to achieve the same levels of intensity in both LEDs 35 within a given range. The electrical characteristics of 520 nm SunLED in terms of voltage range for intensity ramp is sufficient. The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). LGA enables an easy way to seal the contact area from moisture. The preferred embodiment uses 250 microsecond LED pulses and a 12T photodetector 36 with second order active high pass filter (100 Hz cutoff). The DC output of the sensor 30 is monitored to ensure that it is not saturated by the effects of ambient light. The use of short-term pulses reduces ambient light. In the preferred embodiment, voltage is collected at the sensor output every 2 msec. Inside the microprocessor 741, an average 8 consecutive samples improve the SNR (signal to noise ratio) and then work with the averaged numbers. Therefore the sampling rate for raw data is preferably 2 msec, however if 8-samples averaging is utilized

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	in the integrated sensor the data output rate is reduced to sending a new averaged value every 16 msec. An ADC is used with a 12-bit resolution. The response of TSL 12T is acceptable. 100 Hz is the low limit for LPF cutoff. The selection of pulse duration is preferably based on the speed of the LED drivers, sensor electronics and output pick detection. The higher the low frequency cutoff that is implemented for the selected pulse duration, the better SNR. Rulkov at 12:52-13:25 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Rulkov discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off.

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	 FIG. 14  FIG. 15 Rulkov at Fig. 14-15 In reference to FIGS. 14 and 15, in the pulse mode the LED 35 is periodically activated for short intervals of time by a signal from the microcontroller. The reflected pulse of light is received by the sensor, with the generation of a voltage pulse having an amplitude proportional to the intensity of the reflected light. When the LED is activated, the switch, SW, is open by the action of the control signal from the microcontroller, and the capacitor, C, integrates the pulse generated from the sensor by charging through the resistor R. Immediately prior to deactivation of the LED, the analog-to-digital converter acquires the value of the voltage integrated across the capacitor, C. The analog-to-digital converter generates a data

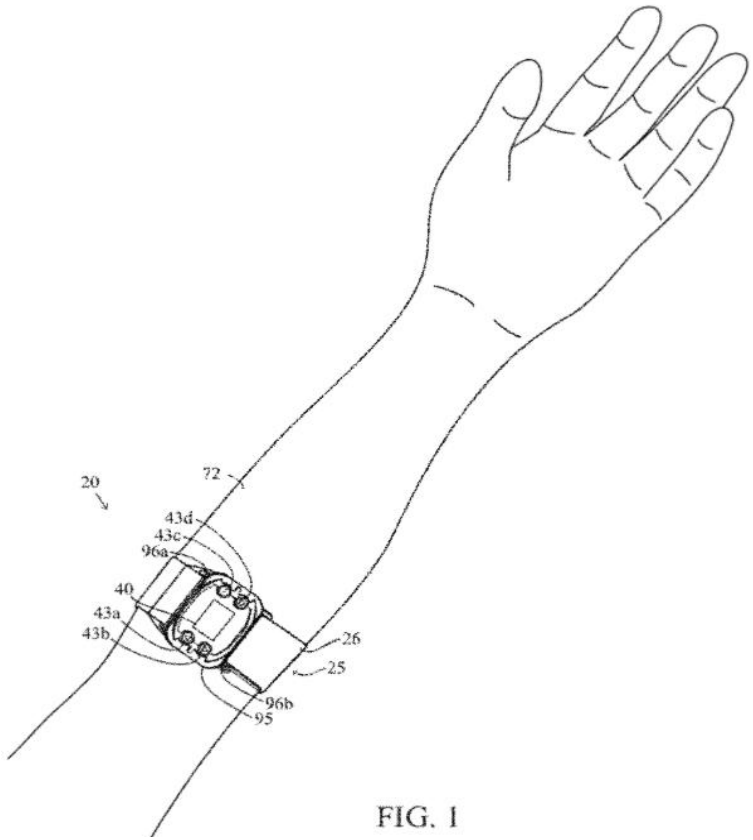
’475 Patent	Rulkov
	sample in digital form which is utilized by the microcontroller for evaluation of the heart rate the wearer. Subsequent to the sample being acquired by the analog-to-digital converter, the LED is deactivated and the capacitor, C, is shortcut by switch, SW, to reset the integrator, RC. A signal indicating sensor saturation is also sent to the microcontroller for light control of the LEDs. This states remains unchanged for a given time interval after which the process is repeated, which is illustrated in FIG. 15. The signals are shown in FIG. 15, with the raw sensor signal received from the sensor amplifier shown as varying between reflected light when the LEDs are on and an ambient light level when the LEDs are off. The filtered signal from the high pass filter (“HPF”) is shown as the filtered sensor signal in FIG. 14. The integrator reset signal is shown as integrator out signal in FIG. 15, and the integrator reset signal in FIG. 14. Rulkov at 10:4-31 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Rulkov discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on.

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	 FIG. 14  FIG. 15 Rulkov at Fig. 14-15 In reference to FIGS. 14 and 15, in the pulse mode the LED 35 is periodically activated for short intervals of time by a signal from the microcontroller. The reflected pulse of light is received by the sensor, with the generation of a voltage pulse having an amplitude proportional to the intensity of the reflected light. When the LED is activated, the switch, SW, is open by the action of the control signal from the microcontroller, and the capacitor, C, integrates the pulse generated from the sensor by charging through the resistor R. Immediately prior to deactivation of the LED, the analog-to-digital converter acquires the value of the voltage integrated across the capacitor, C. The analog-to-digital converter generates a data

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	sample in digital form which is utilized by the microcontroller for evaluation of the heart rate the wearer. Subsequent to the sample being acquired by the analog-to-digital converter, the LED is deactivated and the capacitor, C, is shortcut by switch, SW, to reset the integrator, RC. A signal indicating sensor saturation is also sent to the microcontroller for light control of the LEDs. This states remains unchanged for a given time interval after which the process is repeated, which is illustrated in FIG. 15. The signals are shown in FIG. 15, with the raw sensor signal received from the sensor amplifier shown as varying between reflected light when the LEDs are on and an ambient light level when the LEDs are off. The filtered signal from the high pass filter (“HPF”) is shown as the filtered sensor signal in FIG. 14. The integrator reset signal is shown as integrator out signal in FIG. 15, and the integrator reset signal in FIG. 14. Rulkov at 10:4-31 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Rulkov discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. A motion sensor 1100 is included to assist in identifying motion noise and filtering the noise from the signal sent by the sensor 30. The motion sensor 1100, such as an accelerometer, is integrated into the circuitry and software of the monitoring device 20. As the motion sensor detects an arm swinging, the noise component is utilized with the signal processing noise filtering techniques to provide additional filtering to remove the noise element and improve the accuracy of the monitoring device 20. Rulkov at 11:4-8 The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). LGA enables an easy way to seal the contact area from moisture.

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	The preferred embodiment uses 250 microsecond LED pulses and a 12T photodetector 36 with second order active high pass filter (100 Hz cutoff). The DC output of the sensor 30 is monitored to ensure that it is not saturated by the effects of ambient light. The use of short-term pulses reduces ambient light. In the preferred embodiment, voltage is collected at the sensor output every 2 msec. Inside the microprocessor 741, an average 8 consecutive samples improve the SNR (signal to noise ratio) and then work with the averaged numbers. Therefore the sampling rate for raw data is preferably 2 msec, however if 8-samples averaging is utilized in the integrated sensor the data output rate is reduced to sending a new averaged value every 16 msec. An ADC is used with a 12-bit resolution. The response of TSL 12T is acceptable. 100 Hz is the low limit for LPF cutoff. The selection of pulse duration is preferably based on the speed of the LED drivers, sensor electronics and output pick detection. The higher the low frequency cutoff that is implemented for the selected pulse duration, the better SNR. Rulkov at 13:1-25 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Rulkov discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. As shown in FIGS. 1-5, a monitoring device is generally designated 20. The monitoring device 20 preferably includes an article 25 and an attachment band 26 having an exterior surface 26 a and interior surface 26 b. The monitoring device 20 is preferably secured with VELCRO® hook and loop material 31 a and 31 b. The article 25 preferably includes an optical sensor 30, control components 43 a-43 c and optionally a display member 40. The monitoring device 20 is preferably worn on a user's wrist, arm or ankle. Rulkov at 4:36-47

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	It is desirous to adapt the monitoring device 20 to the anatomy of the user's arm or even the user's ankle. The band 26 is preferably composed of neoprene, leather, synthetic leather, LYCRA, another similar material, or a combination thereof. The article 25 is preferably composed of a semi-rigid or rigid plastic with a rubber-like or semi-flex plastic bottom layer for contact with the user's body. The bottom layer of the article 25 may have a curve surface for contact with a user's body. The article 25 preferably has a mass ranging from 5 grams to 50 grams. Preferably, the lower the mass of the article 25, the more comfort to the user. The article 25 preferably has a thickness ranging from 5 mm to 10 mm, and is most preferably 6.5 mm. Rulkov at 4:48-60 Although the monitoring device 20 is described in reference to an article worn on a user's arm, wrist or ankle, those skilled in the pertinent art will recognize that the monitoring device 20 may take other forms such as eyewear disclosed in Brady et al, U.S. Pat. No. 7,648,463, for a Monitoring Device, Method And System, which is hereby incorporated by reference in its entirety or a glove such as disclosed in Rulkov et al., U.S. Pat. No. 7,887,492, for a Monitoring Device, Method And System, which is hereby incorporated by reference in its entirety. Rulkov at 4:61-5:3

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	 FIG. 1 Rulkov at Fig. 1 The optical sensor 30 of the monitoring device 20 is preferably positioned over the radial artery or ulnar artery if the article 25 is worn on the user's arm. The optical sensor 30 of the monitoring device 20 is preferably positioned over the posterior tibial artery of a user if the article 25 is worn on the user's ankle. However, those skilled in the pertinent art will recognize that the optical sensor may be placed over other arteries of the user without departing from the scope and spirit of the present invention. Further, the optical sensor 30 need only be in proximity to an artery of the user in order to obtain a reading or signal. Rulkov at 5:4-15

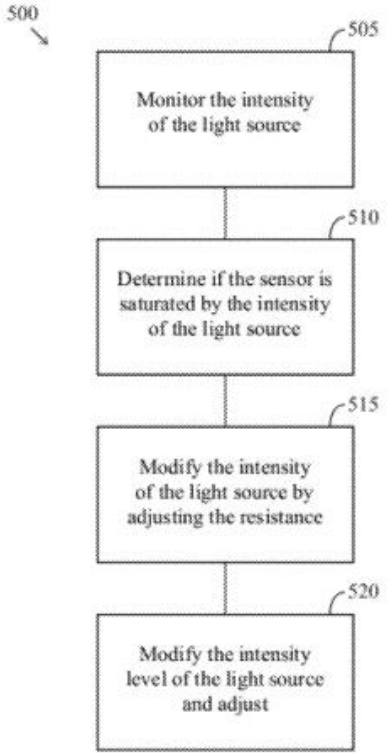
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	The right button 43 c is pushed to scroll through the choices of other output values, which comprises: basal metabolic rate; average heart rate; minimum heart rate; maximum heart rate; fat burn heart rate exercise target zone; cardio burn heart rate exercise target zone; and, summary of daily calories burned. The basal metabolic rate (displayed as “BMR”) is an estimate of the total calories burned by the user in one day without exercise, and is based on the user inputted personal data. Rulkov at 7:39-46 The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). Rulkov at 12:65-13:5 One aspect of the present invention is a system for monitoring at least one vital sign of a user. The system comprises a smartphone and a monitoring device. The smartphone comprises a short range wireless transceiver, a processor and a display screen. The monitoring device comprises a housing, an optical sensor for measuring blood flow through an artery of a wrist, arm or ankle of the user, a processor, a short range wireless transceiver, and a power source. The short range wireless transceiver operates on a communication protocol using a 9 kHz communication format, a 125 kHz RFID communication format, a 13.56 MHz communication format, a 433 MHz communication format, a 433 MHz RFID communication format, or a 900 MHz RFID communication format. Rulkov at 13:55-67 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.	See claim 1 above. Rulkov discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.. The computer controls in higher-quality exercise equipment can provide a calculation of how many calories are burned by an individual using the equipment. Based on the workload, the computer controls of the equipment calculate exercise intensity and calories burned according to established formulae. Rulkov at 2:27-32 Another aspect of the present invention is of the present invention is a system for monitoring a real-time vital sign of a user. The system for monitoring a real-time vital sign of a user comprises a monitoring device comprising an optical sensor for generating a real-time digitized optical signal corresponding to a flow of blood through an artery of the user and an accelerometer for generating real-time accelerometer data comprising a X-axis signal, a Y-axis signal and a Z-axis signal based on a movement of the user. The system further comprises a first transceiver for transmitting the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a mobile communication device comprising a second transceiver for receiving the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a processor in electrical communication with the second transceiver, the processor configured to receive the real-time digitized signal and the real-time accelerometer data, the processor configured to calculate a period of motion related harmonics from the real-time accelerometer data utilizing a repetitive motion pattern analyzer, the processor configured to modify the real-time digitized optical signal by suppressing the motion related harmonics calculated by the motion pattern analyzer to generate a modified optical signal, the processor configured to generate a real-time heart rate for the user from the modified optical signal, Rulkov at 3:1-27

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	A general method is as follows. The light source 35 transmits light through at least one artery of the user. The photo-detector 36 detects the light. The pulse rate is determined by the signals received by the photo-detector 36. Rulkov at 6:53-55 The microprocessor can use various methods to calculate calories burned by a user. One such method uses the Harris-Benedict formula. The Harris-Benedict formula uses the factors of height, weight, age, and sex to determine basal metabolic rate (BMR). This equation is very accurate in all but the extremely muscular (will underestimate calorie needs) and the extremely overweight (will overestimate caloric needs) user. Rulkov at 8:21-28 The heart rate may be used to dynamically determine an activity level and periodically recalculate the calories burned based upon that factor. An example of such an activity level look up table might be as follows: Activity/Intensity Multiplier Based on Heart Rate Sedentary=BMR×1.2 (little or no exercise, average heart rate 65-75 bpm or lower) Lightly active=BMR×3.5 (light exercise, 75 bpm-115 bpm) Mod. active=BMR×5.75 (moderate exercise, 115-140 pm) Very active=BMR×9.25 (hard exercise, 140-175 bpm) Extra active=BMR×13 (175 bpm−maximum heart rate as calculated with MHR formula) Rulkov at 9:31-43 FIG. 17 is a preferred method 500 for controlling the light intensity of the optical sensor 30. At block 505, the light intensity of the light source 35 is monitored. At block 510, the sensor/photodetector is determined to be saturated by the light source. At block 515, the intensity of the light source is modified by adjusting the resistance and the flow of current to the light source 35. At block 520, the light intensity is again monitored and adjusted if necessary. In a preferred embodiment, this automatic gain mechanism prevents the green light from overwhelming the photodetector 36 thereby maintaining an accurate reading no matter where the optical sensor is placed on the user.

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	Rulkov at 11:20-31 1. A system for monitoring a real-time vital sign of a user, the system comprising: an monitoring device comprising an optical sensor for generating a real-time digitized optical signal corresponding to a flow of blood through an artery of the user, an accelerometer for generating a real-time accelerometer data comprising a X-axis signal, a Y-axis signal and a Z-axis signal based on a movement of the user, and a first transceiver for transmitting the real-time digitized optical signal and the real-time accelerometer data from the monitoring device; a mobile communication device comprising a second transceiver for receiving the real-time digitized optical signal and the real-time accelerometer data from the monitoring device, a processor in electrical communication with the second transceiver, the processor configured to receive the real-time digitized signal and the real-time accelerometer data, the processor configured to calculate a period of motion related harmonics from the real-time accelerometer data utilizing a repetitive motion pattern analyzer, the processor configured to modify the real-time digitized optical signal by suppressing the motion related harmonics calculated by the motion pattern analyzer to generate a modified optical signal, the processor configured to generate a real-time heart rate for the user from the modified optical signal, and a display for displaying the real-time heart rate value for the user received from the processor. Rulkov at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	

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6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	See claim 1 above. Rulkov discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. In a preferred embodiment, the optical sensor30 is a plurality of light emitting diodes (“LED”) 35 based on green light wherein the LEDs35 generate green light (wavelength of 500-570 nm), and a photodetector36 detects the green light. Yet in an alternative embodiment, the optical sensor30 is a photodetector36 and a single LED35 transmitting light at a wavelength of approximately 900 nanometers as a pulsed infrared LED. Yet further, the optical sensor is a combination of a green light LED and a pulsed infrared LED to offset noise affects of ambient light and sunlight. As the heart pumps blood through the arteries in the user's arm, ankle or wrist, the photodetector36, which is typically a photodiode, detects reflectance/transmission at the wavelengths (green, red or infrared), and in response generates a radiation-induced signal. Rulkov at 5:16-30 A preferred optical sensor30 utilizing green light is a TRS1755 sensor from TAOS, Inc of Plano Tex. The TRS1755 comprises a green LED light source (567 nm wavelength) and a light-to-voltage converter. The output voltage is directly proportional to the reflected light intensity. Another preferred photodetector36 is a light-to-voltage photodetector such as the TSL260R and TSL261, TSL261R photodetectors available from TAOS, Inc of Plano Tex. Alternatively, the photodetector130 is a light-to-frequency photodetector such as the TSL245R, which is also available from TAOS, Inc. The light-to-voltage photodetectors have an integrated transimpedance amplifier on a single monolithic integrated circuit, which reduces the need for ambient light filtering. The TSL261 photodetector preferably operates at a wavelength greater than 750 nanometers, and optimally at 940 nanometers, which would preferably have a LED that radiates light at those wavelengths. Rulkov at 5:31-47 A connection wire arrangement 45 is shown in FIGS. 6 and 8, wherein the connection 45 between the microprocessor and the optical sensor 30 is preferably non-planar or non-straight in order to reduce noise in the signal. The optical sensor 30 preferably comprises a photodetector 36, and first and second

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	LEDs 35 which transmit light. Using two LEDs on each side of a photodetector creates a more mechanically stable optical sensor 30. Rulkov at 6:18-25  FIG. 17 Rulkov at Fig. 17 FIG. 17 is a preferred method 500 for controlling the light intensity of the optical sensor 30. At block 505, the light intensity of the light source 35 is monitored. At block 510, the

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	sensor/photodetector is determined to be saturated by the light source. At block 515, the intensity of the light source is modified by adjusting the resistance and the flow of current to the light source 35. At block 520, the light intensity is again monitored and adjusted if necessary. In a preferred embodiment, this automatic gain mechanism prevents the green light from overwhelming the photodetector 36 thereby maintaining an accurate reading no matter where the optical sensor is placed on the user. Rulkov at 11:20-31 FIG. 16 illustrates how the control mechanism operates to maintain a proper light intensity. As the signal reaches the upper limit, the photodetector becomes saturated and the processor lowers the current flow, which results in a break in the signal. Then as the signal is lowered it becomes too low and the processor increases the light intensity resulting in a break in the signal. Rulkov at 11:32-38 A block diagram for vital sign signal processing is shown in FIG. 18. The optical sensor730 is placed on or near an artery90 of a user of the monitoring device20. The optical sensor730 has a pair of LEDs735 and a photodetector736, which receives reflected light 737 from the LEDs735. The microprocessor741 has a LED control715 connected to DAC702 for controlling the intensity of the LEDs737. The signal from the photodetector736 is transmitted to a high pass filter (HPF) 703 which sends it to an analog to digital converter704, and the signal from the photodetector737 is also sent directly to a second analog to digital converter704. The real-time signal is then sent to a sensor data evaluation714 to provide feedback to the LED control715, and then is also sent to the filter of the signal processing for mitigations of noise and heart rate evaluations712. Simultaneously, the accelerometer710 transmits X-axis, Y-axis and Z-axis signals for the motion of the monitoring device20 to an accelerometer data evaluation711 of the microprocessor741. This signal is then sent to the signal processing for mitigations of noise and heart rate evaluations712. The output for the heart rate and/or calories is generated at block713 of the microprocessor741, which then sends the results to the display740. Rulkov at 11:39-60 FIGS. 9-11 illustrate the sensor 30. The sensor 30 has a photodetector 36, at least two LEDs 35 and an opaque light shield 57. The LEDs 35 are preferably green light LEDs. The sensor 30 preferably has a

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	length, L, of 7-10 mm on each side, as shown in FIG. 9. The sensor 30 preferably has a height, H, of 1-1.5 mm, as shown in FIG. 10. The opaque light shield 57 blocks the direct light from the LEDs 35 to the photodetector 36. Only the green light diffused and translucent through the media (skin of the user) 61, as shown in FIG. 11, is allowed to enter the chamber of the photodetector 36. This provides for a more accurate heart rate or vital sign signal. Rulkov at 12:41-51 In a preferred design of the sensor 30, the distance between the centers of active areas of LEDs 35 is preferably 5-6 mm. The active area (photodetector 36) of a sensor 30 is placed in the middle of that distance. In the custom sensor, the distance of a custom sensor is preferably in the range of 3-4 mm (which means the spacing between the centers of photodetector 36 and LEDs 35 is about 1.5-2 mm). The distance is preferably sufficient for the placement of an opaque barrier between them. To control the amplitude of the LED intensity pulse a sufficient current (voltage) range of intensity ramp is used to control the LEDs 35 and to achieve the same levels of intensity in both LEDs 35 within a given range. The electrical characteristics of 520 nm SunLED in terms of voltage range for intensity ramp is sufficient. The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). LGA enables an easy way to seal the contact area from moisture. The preferred embodiment uses 250 microsecond LED pulses and a 12T photodetector 36 with second order active high pass filter (100 Hz cutoff). The DC output of the sensor 30 is monitored to ensure that it is not saturated by the effects of ambient light. The use of short-term pulses reduces ambient light. In the preferred embodiment, voltage is collected at the sensor output every 2 msec. Inside the microprocessor 741, an average 8 consecutive samples improve the SNR (signal to noise ratio) and then work with the averaged numbers. Therefore the sampling rate for raw data is preferably 2 msec, however if 8-samples averaging is utilized in the integrated sensor the data output rate is reduced to sending a new averaged value every 16 msec. An ADC is used with a 12-bit resolution. The response of TSL 12T is acceptable. 100 Hz is the low limit for LPF cutoff. The selection of pulse duration is preferably based on the speed of the LED drivers, sensor electronics and output pick detection. The higher the low frequency cutoff that is implemented for the selected pulse duration, the better SNR. Rulkov at 12:52-13:25

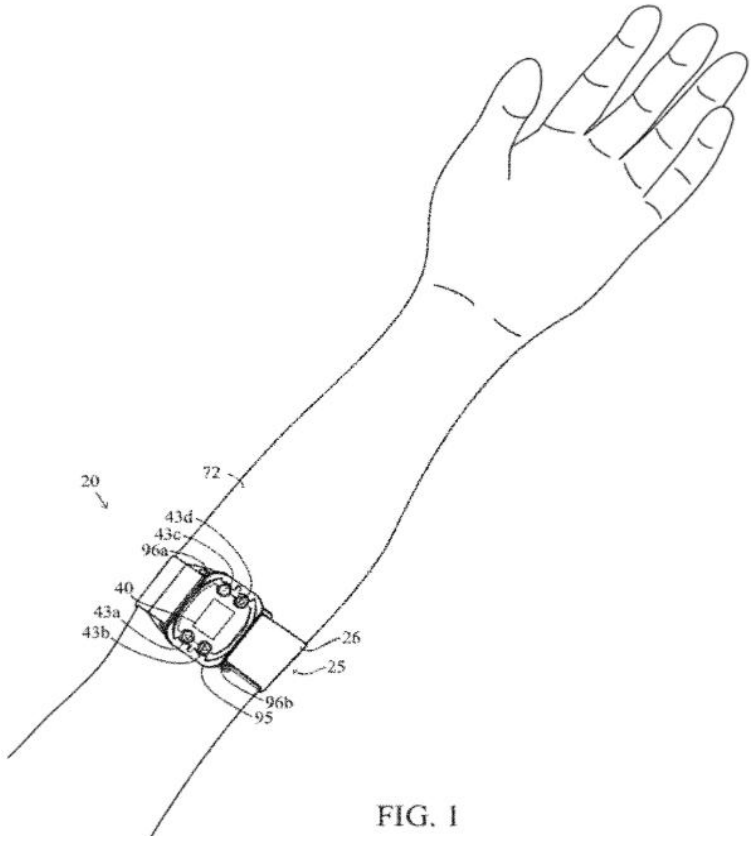
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	4. The system according to claim 1 wherein the optical sensor comprises two green LEDs and a photodetector. Rulkov at Claim 4 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	See claim 6 above. Rulkov discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. In one embodiment, discussed below, the display member40 is removed and the signal is sent to a device such as a personal digital assistant, laptop computer, mobile telephone, exercise equipment, or the like for display and even processing of the user's real-time vital signs information. Alternatively, the circuitry assembly includes a flexible microprocessor board which is a low power, micro-size easily integrated board which provides blood oxygenation level, pulse rate (heart rate), signal strength bargraph, plethysmogram and status bits data. The microprocessor can also store data. The microprocessor can process the data to display pulse rate, blood oxygenation levels, calories expended by the user of a pre-set time period, target zone activity, time and dynamic blood pressure. Further, microprocessor preferably includes an automatic gain control for preventing saturation of the photodetector, which allows for the device to be used on different portions of the human body. Rulkov at 5:48-64

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	The display member40 is preferably a light emitting diode (“LED”). Alternatively, the display member40 is a liquid crystal display (“LCD”) or other similar display device. A microprocessor processes the signal generated from the optical sensor30 to generate the plurality of vital sign information for the user which is displayed on the display member40. The control components 43a-c are connected to the processor to control the input of information and the output of information displayed on the display member40. Rulkov at 5:65-6:5 The monitoring device20 alternatively has a short-range wireless transceiver which is preferably a transmitter operating on a wireless protocol, e.g. BLUETOOTH, part-15, or 802.11. “Part-15” refers to a conventional low-power, short-range wireless protocol, such as that used in cordless telephones. Other communication protocols include a part 15 low power short range radio, standard BLUETOOTH or BLUETOOTH Low Energy to conserve power or other low power short range communications means. The short-range wireless transmitter (e.g., a BLUETOOTH transmitter) receives information from the microprocessor and transmits this information in the form of a packet through an antenna. An external laptop computer or hand-held device features a similar antenna coupled to a matched wireless, short-range receiver that receives the packet. In certain embodiments, the hand-held device is a cellular telephone with a Bluetooth circuit integrated directly into a chipset used in the cellular telephone. In this case, the cellular telephone may include a software application that receives, processes, and displays the information. The secondary wireless component may also include a long-range wireless transmitter that transmits information over a terrestrial, satellite, or 802.11-based wireless network. Suitable networks include those operating at least one of the following protocols: CDMA, GSM, GPRS, Mobitex, DataTac, iDEN, and analogs and derivatives thereof. Alternatively, the handheld device is a pager or PDA. Rulkov at 6:26-51 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Rulkov discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. See above at claim 1[pre] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Rulkov discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;. See above at claim 1[c], 1[j], 1[k] A preferred optical sensor 30 utilizing green light is a TRS1755 sensor from TAOS, Inc of Plano Tex. The TRS1755 comprises a green LED light source (567 nm wavelength) and a light-to-voltage converter. The output voltage is directly proportional to the reflected light intensity. Another preferred photodetector 36 is a light-to-voltage photodetector such as the TSL260R and TSL261, TSL261R photodetectors available from TAOS, Inc of Plano Tex. Alternatively, the photodetector 130 is a light-to-frequency photodetector such as the TSL245R, which is also available from TAOS, Inc. The light-to-voltage photodetectors have an integrated transimpedance amplifier on a single monolithic integrated circuit, which reduces the need for ambient light filtering. The TSL261 photodetector preferably operates at a wavelength greater than 750 nanometers, and optimally at 940 nanometers, which would preferably have a LED that radiates light at those wavelengths. Rulkov at 5:31-47

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	A general method is as follows. The light source 35 transmits light through at least one artery of the user. The photo-detector 36 detects the light. The pulse rate is determined by the signals received by the photo-detector 36. Rulkov at 6:52-55 In reference to FIGS. 14 and 15, in the pulse mode the LED 35 is periodically activated for short intervals of time by a signal from the microcontroller. The reflected pulse of light is received by the sensor, with the generation of a voltage pulse having an amplitude proportional to the intensity of the reflected light. When the LED is activated, the switch, SW, is open by the action of the control signal from the microcontroller, and the capacitor, C, integrates the pulse generated from the sensor by charging through the resistor R. Immediately prior to deactivation of the LED, the analog-to-digital converter acquires the value of the voltage integrated across the capacitor, C. The analog-to-digital converter generates a data sample in digital form which is utilized by the microcontroller for evaluation of the heart rate the wearer. Subsequent to the sample being acquired by the analog-to-digital converter, the LED is deactivated and the capacitor, C, is shortcut by switch, SW, to reset the integrator, RC. A signal indicating sensor saturation is also sent to the microcontroller for light control of the LEDs. This states remains unchanged for a given time interval after which the process is repeated, which is illustrated in FIG. 15. The signals are shown in FIG. 15, with the raw sensor signal received from the sensor amplifier shown as varying between reflected light when the LEDs are on and an ambient light level when the LEDs are off. The filtered signal from the high pass filter (“HPF”) is shown as the filtered sensor signal in FIG. 14. The integrator reset signal is shown as integrator out signal in FIG. 15, and the integrator reset signal in FIG. 14. Rulkov at 10:4-31 FIG. 17 is a preferred method 500 for controlling the light intensity of the optical sensor 30. At block 505, the light intensity of the light source 35 is monitored. At block 510, the sensor/photodetector is determined to be saturated by the light source. At block 515, the intensity of the light source is modified by adjusting the resistance and the flow of current to the light source 35. At block 520, the light intensity is again monitored and adjusted if necessary. In a preferred embodiment, this automatic gain mechanism prevents the green light from overwhelming the photodetector 36 thereby maintaining an accurate reading no matter where the optical sensor is placed on the user.

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	Rulkov at 11:20-31 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Rulkov discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. See above at claim 1[d] As shown in FIGS. 1-5, a monitoring device is generally designated 20. The monitoring device 20 preferably includes an article 25 and an attachment band 26 having an exterior surface 26 a and interior surface 26 b. The monitoring device 20 is preferably secured with VELCRO® hook and loop material 31 a and 31 b. The article 25 preferably includes an optical sensor 30, control components 43 a-43 c and optionally a display member 40. The monitoring device 20 is preferably worn on a user's wrist, arm or ankle. Rulkov at 4:36-47 It is desirous to adapt the monitoring device 20 to the anatomy of the user's arm or even the user's ankle. The band 26 is preferably composed of neoprene, leather, synthetic leather, LYCRA, another similar material, or a combination thereof. The article 25 is preferably composed of a semi-rigid or rigid plastic with a rubber-like or semi-flex plastic bottom layer for contact with the user's body. The bottom layer of the article 25 may have a curve surface for contact with a user's body. The article 25 preferably has a mass ranging from 5 grams to 50 grams. Preferably, the lower the mass of the article 25, the more comfort to the user. The article 25 preferably has a thickness ranging from 5 mm to 10 mm, and is most preferably 6.5 mm. Rulkov at 4:48-60

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	Although the monitoring device 20 is described in reference to an article worn on a user's arm, wrist or ankle, those skilled in the pertinent art will recognize that the monitoring device 20 may take other forms such as eyewear disclosed in Brady et al, U.S. Pat. No. 7,648,463, for a Monitoring Device, Method And System, which is hereby incorporated by reference in its entirety or a glove such as disclosed in Rulkov et al., U.S. Pat. No. 7,887,492, for a Monitoring Device, Method And System, which is hereby incorporated by reference in its entirety. Rulkov at 4:61-5:3  FIG. 1 Rulkov at Fig. 1

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	The optical sensor 30 of the monitoring device 20 is preferably positioned over the radial artery or ulnar artery if the article 25 is worn on the user's arm. The optical sensor 30 of the monitoring device 20 is preferably positioned over the posterior tibial artery of a user if the article 25 is worn on the user's ankle. However, those skilled in the pertinent art will recognize that the optical sensor may be placed over other arteries of the user without departing from the scope and spirit of the present invention. Further, the optical sensor 30 need only be in proximity to an artery of the user in order to obtain a reading or signal. Rulkov at 5:4-15 The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). Rulkov at 12:65-13:5 One aspect of the present invention is a system for monitoring at least one vital sign of a user. The system comprises a smartphone and a monitoring device. The smartphone comprises a short range wireless transceiver, a processor and a display screen. The monitoring device comprises a housing, an optical sensor for measuring blood flow through an artery of a wrist, arm or ankle of the user, a processor, a short range wireless transceiver, and a power source. The short range wireless transceiver operates on a communication protocol using a 9 kHz communication format, a 125 kHz RFID communication format, a 13.56 MHz communication format, a 433 MHz communication format, a 433 MHz RFID communication format, or a 900 MHz RFID communication format. Rulkov at 13:55-67 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Rulkov discloses or renders obvious a detector. See above at claim 1[e] In a preferred embodiment, the optical sensor30 is a plurality of light emitting diodes (“LED”) 35 based on green light wherein the LEDs35 generate green light (wavelength of 500-570 nm), and a photodetector36 detects the green light. Yet in an alternative embodiment, the optical sensor30 is a photodetector36 and a single LED35 transmitting light at a wavelength of approximately 900 nanometers as a pulsed infrared LED. Yet further, the optical sensor is a combination of a green light LED and a pulsed infrared LED to offset noise affects of ambient light and sunlight. As the heart pumps blood through the arteries in the user's arm, ankle or wrist, the photodetector36, which is typically a photodiode, detects reflectance/transmission at the wavelengths (green, red or infrared), and in response generates a radiation-induced signal. Rulkov at 5:16-30 A preferred optical sensor30 utilizing green light is a TRS1755 sensor from TAOS, Inc of Plano Tex. The TRS1755 comprises a green LED light source (567 nm wavelength) and a light-to-voltage converter. The output voltage is directly proportional to the reflected light intensity. Another preferred photodetector36 is a light-to-voltage photodetector such as the TSL260R and TSL261, TSL261R photodetectors available from TAOS, Inc of Plano Tex. Alternatively, the photodetector130 is a light-to-frequency photodetector such as the TSL245R, which is also available from TAOS, Inc. The light-to-voltage photodetectors have an integrated transimpedance amplifier on a single monolithic integrated circuit, which reduces the need for ambient light filtering. The TSL261 photodetector preferably operates at a wavelength greater than 750 nanometers, and optimally at 940 nanometers, which would preferably have a LED that radiates light at those wavelengths. Rulkov at 5:31-47 A connection wire arrangement 45 is shown in FIGS. 6 and 8, wherein the connection 45 between the microprocessor and the optical sensor 30 is preferably non-planar or non-straight in order to reduce noise in the signal. The optical sensor 30 preferably comprises a photodetector 36, and first and second

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	LEDs 35 which transmit light. Using two LEDs on each side of a photodetector creates a more mechanically stable optical sensor 30. Rulkov at 6:18-25 FIG. 17 is a preferred method 500 for controlling the light intensity of the optical sensor 30. At block 505, the light intensity of the light source 35 is monitored. At block 510, the sensor/photodetector is determined to be saturated by the light source. At block 515, the intensity of the light source is modified by adjusting the resistance and the flow of current to the light source 35. At block 520, the light intensity is again monitored and adjusted if necessary. In a preferred embodiment, this automatic gain mechanism prevents the green light from overwhelming the photodetector 36 thereby maintaining an accurate reading no matter where the optical sensor is placed on the user. Rulkov at 11:20-31 FIG. 16 illustrates how the control mechanism operates to maintain a proper light intensity. As the signal reaches the upper limit, the photodetector becomes saturated and the processor lowers the current flow, which results in a break in the signal. Then as the signal is lowered it becomes too low and the processor increases the light intensity resulting in a break in the signal. Rulkov at 11:32-38 A block diagram for vital sign signal processing is shown in FIG. 18. The optical sensor730 is placed on or near an artery90 of a user of the monitoring device20. The optical sensor730 has a pair of LEDs735 and a photodetector736, which receives reflected light 737 from the LEDs735. The microprocessor741 has a LED control715 connected to DAC702 for controlling the intensity of the LEDs737. The signal from the photodetector736 is transmitted to a high pass filter (HPF) 703 which sends it to an analog to digital converter704, and the signal from the photodetector737 is also sent directly to a second analog to digital converter704. The real-time signal is then sent to a sensor data evaluation714 to provide feedback to the LED control715, and then is also sent to the filter of the signal processing for mitigations of noise and heart rate evaluations712. Simultaneously, the accelerometer710 transmits X-axis, Y-axis and Z-axis signals for the motion of the monitoring device20 to an accelerometer data evaluation711 of the microprocessor741. This signal is then sent to the signal processing for mitigations of noise and heart rate evaluations712. The output for the heart rate

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	and/or calories is generated at block713 of the microprocessor741, which then sends the results to the display740. Rulkov at 11:39-60 FIGS. 9-11 illustrate the sensor 30. The sensor 30 has a photodetector 36, at least two LEDs 35 and an opaque light shield 57. The LEDs 35 are preferably green light LEDs. The sensor 30 preferably has a length, L, of 7-10 mm on each side, as shown in FIG. 9. The sensor 30 preferably has a height, H, of 1-1.5 mm, as shown in FIG. 10. The opaque light shield 57 blocks the direct light from the LEDs 35 to the photodetector 36. Only the green light diffused and translucent through the media (skin of the user) 61, as shown in FIG. 11, is allowed to enter the chamber of the photodetector 36. This provides for a more accurate heart rate or vital sign signal. Rulkov at 12:41-51 In a preferred design of the sensor 30, the distance between the centers of active areas of LEDs 35 is preferably 5-6 mm. The active area (photodetector 36) of a sensor 30 is placed in the middle of that distance. In the custom sensor, the distance of a custom sensor is preferably in the range of 3-4 mm (which means the spacing between the centers of photodetector 36 and LEDs 35 is about 1.5-2 mm). The distance is preferably sufficient for the placement of an opaque barrier between them. To control the amplitude of the LED intensity pulse a sufficient current (voltage) range of intensity ramp is used to control the LEDs 35 and to achieve the same levels of intensity in both LEDs 35 within a given range. The electrical characteristics of 520 nm SunLED in terms of voltage range for intensity ramp is sufficient. The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). LGA enables an easy way to seal the contact area from moisture. The preferred embodiment uses 250 microsecond LED pulses and a 12T photodetector 36 with second order active high pass filter (100 Hz cutoff). The DC output of the sensor 30 is monitored to ensure that it is not saturated by the effects of ambient light. The use of short-term pulses reduces ambient light. In the preferred embodiment, voltage is collected at the sensor output every 2 msec. Inside the microprocessor 741, an average 8 consecutive samples improve the SNR (signal to noise ratio) and then work with the averaged numbers. Therefore the sampling rate for raw data is preferably 2 msec, however if 8-samples averaging is utilized

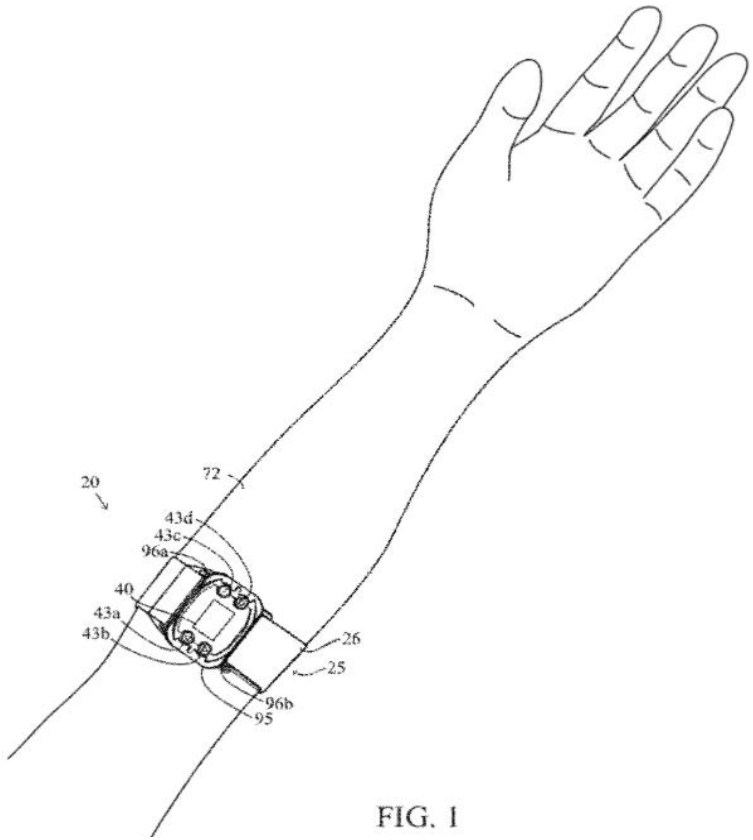
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	in the integrated sensor the data output rate is reduced to sending a new averaged value every 16 msec. An ADC is used with a 12-bit resolution. The response of TSL 12T is acceptable. 100 Hz is the low limit for LPF cutoff. The selection of pulse duration is preferably based on the speed of the LED drivers, sensor electronics and output pick detection. The higher the low frequency cutoff that is implemented for the selected pulse duration, the better SNR. Rulkov at 12:52-13:25 4. The system according to claim 1 wherein the optical sensor comprises two green LEDs and a photodetector. Rulkov at Claim 4 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Rulkov discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. See above at claim 1[e], 1[k], [5] In a preferred embodiment, the optical sensor 30 is a plurality of light emitting diodes ("LED") 35 based on green light wherein the LEDs 35 generate green light (wavelength of 500-570 nm), and a photodetector 36 detects the green light. Yet in an alternative embodiment, the optical sensor 30 is a photodetector 36 and a single LED 35 transmitting light at a wavelength of approximately 900 nanometers as a pulsed infrared LED. Yet further, the optical sensor is a combination of a green light LED and a pulsed infrared LED to offset noise affects of ambient light and sunlight. As the heart pumps blood through the arteries in the user's arm, ankle or wrist, the photodetector 36, which is typically a

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	photodiode, detects reflectance/transmission at the wavelengths (green, red or infrared), and in response generates a radiation-induced signal. Rulkov at 5:16-30 A motion sensor 1100 is included to assist in identifying motion noise and filtering the noise from the signal sent by the sensor 30. The motion sensor 1100, such as an accelerometer, is integrated into the circuitry and software of the monitoring device 20. As the motion sensor detects an arm swinging, the noise component is utilized with the signal processing noise filtering techniques to provide additional filtering to remove the noise element and improve the accuracy of the monitoring device 20. More specifically, the signal from the optical sensor 30 is transmitted to the processor where a custom blood pressure filter 41 w processes the signal which is further processed at by custom adaptive filter 41 x before being sent to a heart beat tracking system 41 y and then transmitted to a heart rate beat output 41 z. The heart rate beat output 41 z provides feedback to the custom adaptive filter 41 x which also receives input from the motion sensor 1100. Rulkov at 11:4-19 In a preferred design of the sensor 30, the distance between the centers of active areas of LEDs 35 is preferably 5-6 mm. The active area (photodetector 36) of a sensor 30 is placed in the middle of that distance. In the custom sensor, the distance of a custom sensor is preferably in the range of 3-4 mm (which means the spacing between the centers of photodetector 36 and LEDs 35 is about 1.5-2 mm). The distance is preferably sufficient for the placement of an opaque barrier between them. To control the amplitude of the LED intensity pulse a sufficient current (voltage) range of intensity ramp is used to control the LEDs 35 and to achieve the same levels of intensity in both LEDs 35 within a given range. The electrical characteristics of 520 nm SunLED in terms of voltage range for intensity ramp is sufficient. The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). LGA enables an easy way to seal the contact area from moisture. The preferred embodiment uses 250 microsecond LED pulses and a 12T photodetector 36 with second order active high pass filter (100 Hz cutoff). The DC output of the sensor 30 is monitored to ensure that it is not saturated by the effects of ambient light. The use of short-term pulses reduces ambient light. In the preferred embodiment,

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	voltage is collected at the sensor output every 2 msec. Inside the microprocessor 741, an average 8 consecutive samples improve the SNR (signal to noise ratio) and then work with the averaged numbers. Therefore the sampling rate for raw data is preferably 2 msec, however if 8-samples averaging is utilized in the integrated sensor the data output rate is reduced to sending a new averaged value every 16 msec. An ADC is used with a 12-bit resolution. The response of TSL 12T is acceptable. 100 Hz is the low limit for LPF cutoff. The selection of pulse duration is preferably based on the speed of the LED drivers, sensor electronics and output pick detection. The higher the low frequency cutoff that is implemented for the selected pulse duration, the better SNR. Rulkov at 12:52-13:25 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Rulkov discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. See above at claim 1[e], 1[j], [5] In a preferred embodiment, the optical sensor 30 is a plurality of light emitting diodes (“LED”) 35 based on green light wherein the LEDs 35 generate green light (wavelength of 500-570 nm), and a photodetector 36 detects the green light. Yet in an alternative embodiment, the optical sensor 30 is a photodetector 36 and a single LED 35 transmitting light at a wavelength of approximately 900 nanometers as a pulsed infrared LED. Yet further, the optical sensor is a combination of a green light LED and a pulsed infrared LED to offset noise affects of ambient light and sunlight. As the heart pumps blood through the arteries in the user's arm, ankle or wrist, the photodetector 36, which is typically a photodiode, detects reflectance/transmission at the wavelengths (green, red or infrared), and in response generates a radiation-induced signal.

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	Rulkov at 5:16-30 A motion sensor 1100 is included to assist in identifying motion noise and filtering the noise from the signal sent by the sensor 30. The motion sensor 1100, such as an accelerometer, is integrated into the circuitry and software of the monitoring device 20. As the motion sensor detects an arm swinging, the noise component is utilized with the signal processing noise filtering techniques to provide additional filtering to remove the noise element and improve the accuracy of the monitoring device 20. More specifically, the signal from the optical sensor 30 is transmitted to the processor where a custom blood pressure filter 41 w processes the signal which is further processed at by custom adaptive filter 41 x before being sent to a heart beat tracking system 41 y and then transmitted to a heart rate beat output 41 z. The heart rate beat output 41 z provides feedback to the custom adaptive filter 41 x which also receives input from the motion sensor 1100. Rulkov at 11:4-19 In a preferred design of the sensor 30, the distance between the centers of active areas of LEDs 35 is preferably 5-6 mm. The active area (photodetector 36) of a sensor 30 is placed in the middle of that distance. In the custom sensor, the distance of a custom sensor is preferably in the range of 3-4 mm (which means the spacing between the centers of photodetector 36 and LEDs 35 is about 1.5-2 mm). The distance is preferably sufficient for the placement of an opaque barrier between them. To control the amplitude of the LED intensity pulse a sufficient current (voltage) range of intensity ramp is used to control the LEDs 35 and to achieve the same levels of intensity in both LEDs 35 within a given range. The electrical characteristics of 520 nm SunLED in terms of voltage range for intensity ramp is sufficient. The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). LGA enables an easy way to seal the contact area from moisture. The preferred embodiment uses 250 microsecond LED pulses and a 12T photodetector 36 with second order active high pass filter (100 Hz cutoff). The DC output of the sensor 30 is monitored to ensure that it is not saturated by the effects of ambient light. The use of short-term pulses reduces ambient light. In the preferred embodiment, voltage is collected at the sensor output every 2 msec. Inside the microprocessor 741, an average 8 consecutive samples improve the SNR (signal to noise ratio) and then work with the averaged numbers. Therefore the sampling rate for raw data is preferably 2 msec, however if 8-samples averaging is utilized

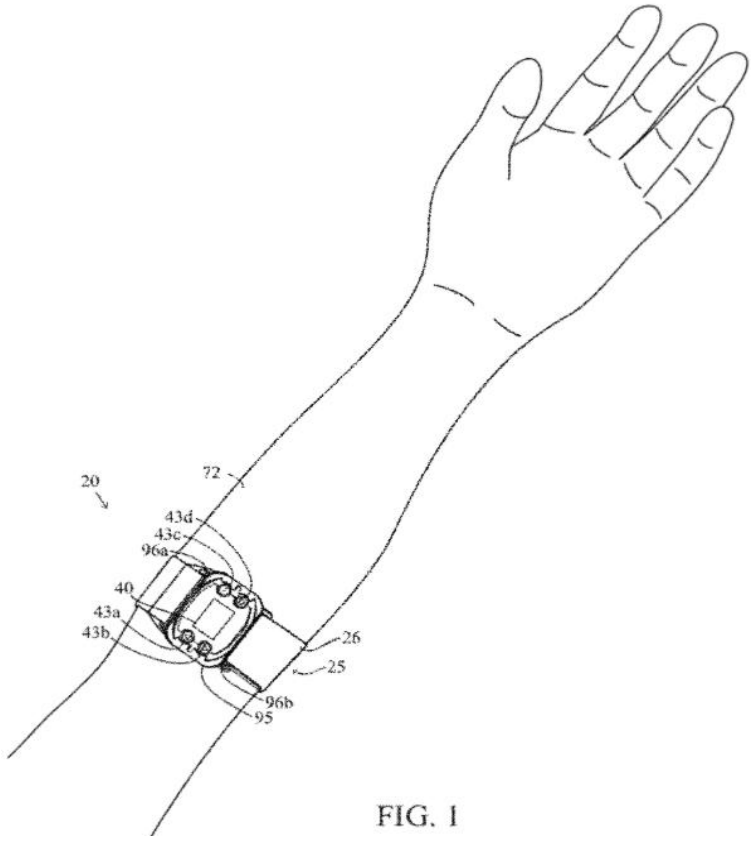
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	in the integrated sensor the data output rate is reduced to sending a new averaged value every 16 msec. An ADC is used with a 12-bit resolution. The response of TSL 12T is acceptable. 100 Hz is the low limit for LPF cutoff. The selection of pulse duration is preferably based on the speed of the LED drivers, sensor electronics and output pick detection. The higher the low frequency cutoff that is implemented for the selected pulse duration, the better SNR. Rulkov at 12:52-13:25 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	Rulkov discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. See above at claim 1[b], 1[e], 1[l], [5] It is desirous to adapt the monitoring device 20 to the anatomy of the user's arm or even the user's ankle. The band 26 is preferably composed of neoprene, leather, synthetic leather, LYCRA, another similar material, or a combination thereof. The article 25 is preferably composed of a semi-rigid or rigid plastic with a rubber-like or semi-flex plastic bottom layer for contact with the user's body. The bottom layer of the article 25 may have a curve surface for contact with a user's body. The article 25 preferably has a mass ranging from 5 grams to 50 grams. Preferably, the lower the mass of the article 25, the more comfort to the user. The article 25 preferably has a thickness ranging from 5 mm to 10 mm, and is most preferably 6.5 mm. Rulkov at 4:48-60

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	 FIG. 1 Rulkov at Fig. 1 The optical sensor 30 of the monitoring device 20 is preferably positioned over the radial artery or ulnar artery if the article 25 is worn on the user's arm. The optical sensor 30 of the monitoring device 20 is preferably positioned over the posterior tibial artery of a user if the article 25 is worn on the user's ankle. However, those skilled in the pertinent art will recognize that the optical sensor may be placed over other arteries of the user without departing from the scope and spirit of the present invention. Further, the optical sensor 30 need only be in proximity to an artery of the user in order to obtain a reading or signal. Rulkov at 5:4-15

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	In a preferred embodiment, the optical sensor 30 is a plurality of light emitting diodes (“LED”) 35 based on green light wherein the LEDs 35 generate green light (wavelength of 500-570 nm), and a photodetector 36 detects the green light. Yet in an alternative embodiment, the optical sensor 30 is a photodetector 36 and a single LED 35 transmitting light at a wavelength of approximately 900 nanometers as a pulsed infrared LED. Yet further, the optical sensor is a combination of a green light LED and a pulsed infrared LED to offset noise affects of ambient light and sunlight. As the heart pumps blood through the arteries in the user's arm, ankle or wrist, the photodetector 36, which is typically a photodiode, detects reflectance/transmission at the wavelengths (green, red or infrared), and in response generates a radiation-induced signal. Rulkov at 5:16-30 In one embodiment, discussed below, the display member 40 is removed and the signal is sent to a device such as a personal digital assistant, laptop computer, mobile telephone, exercise equipment, or the like for display and even processing of the user's real-time vital signs information. Alternatively, the circuitry assembly includes a flexible microprocessor board which is a low power, micro-size easily integrated board which provides blood oxygenation level, pulse rate (heart rate), signal strength bargraph, plethysmogram and status bits data. The microprocessor can also store data. The microprocessor can process the data to display pulse rate, blood oxygenation levels, calories expended by the user of a pre-set time period, target zone activity, time and dynamic blood pressure. Further, microprocessor preferably includes an automatic gain control for preventing saturation of the photodetector, which allows for the device to be used on different portions of the human body Rulkov at 5:48-64 A motion sensor 1100 is included to assist in identifying motion noise and filtering the noise from the signal sent by the sensor 30. The motion sensor 1100, such as an accelerometer, is integrated into the circuitry and software of the monitoring device 20. As the motion sensor detects an arm swinging, the noise component is utilized with the signal processing noise filtering techniques to provide additional filtering to remove the noise element and improve the accuracy of the monitoring device 20. More specifically, the signal from the optical sensor 30 is transmitted to the processor where a custom blood pressure filter 41 w processes the signal which is further processed at by custom adaptive filter 41 x before being sent to a heart beat tracking system 41 y and then transmitted to a heart rate beat output 41

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	z. The heart rate beat output 41 z provides feedback to the custom adaptive filter 41 x which also receives input from the motion sensor 1100. Rulkov at 11:4-19 In a preferred design of the sensor 30, the distance between the centers of active areas of LEDs 35 is preferably 5-6 mm. The active area (photodetector 36) of a sensor 30 is placed in the middle of that distance. In the custom sensor, the distance of a custom sensor is preferably in the range of 3-4 mm (which means the spacing between the centers of photodetector 36 and LEDs 35 is about 1.5-2 mm). The distance is preferably sufficient for the placement of an opaque barrier between them. To control the amplitude of the LED intensity pulse a sufficient current (voltage) range of intensity ramp is used to control the LEDs 35 and to achieve the same levels of intensity in both LEDs 35 within a given range. The electrical characteristics of 520 nm SunLED in terms of voltage range for intensity ramp is sufficient. The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). LGA enables an easy way to seal the contact area from moisture. The preferred embodiment uses 250 microsecond LED pulses and a 12T photodetector 36 with second order active high pass filter (100 Hz cutoff). The DC output of the sensor 30 is monitored to ensure that it is not saturated by the effects of ambient light. The use of short-term pulses reduces ambient light. In the preferred embodiment, voltage is collected at the sensor output every 2 msec. Inside the microprocessor 741, an average 8 consecutive samples improve the SNR (signal to noise ratio) and then work with the averaged numbers. Therefore the sampling rate for raw data is preferably 2 msec, however if 8-samples averaging is utilized in the integrated sensor the data output rate is reduced to sending a new averaged value every 16 msec. An ADC is used with a 12-bit resolution. The response of TSL 12T is acceptable. 100 Hz is the low limit for LPF cutoff. The selection of pulse duration is preferably based on the speed of the LED drivers, sensor electronics and output pick detection. The higher the low frequency cutoff that is implemented for the selected pulse duration, the better SNR. Rulkov at 12:52-13:25 One aspect of the present invention is a system for monitoring at least one vital sign of a user. The system comprises a smartphone and a monitoring device. The smartphone comprises a short range wireless

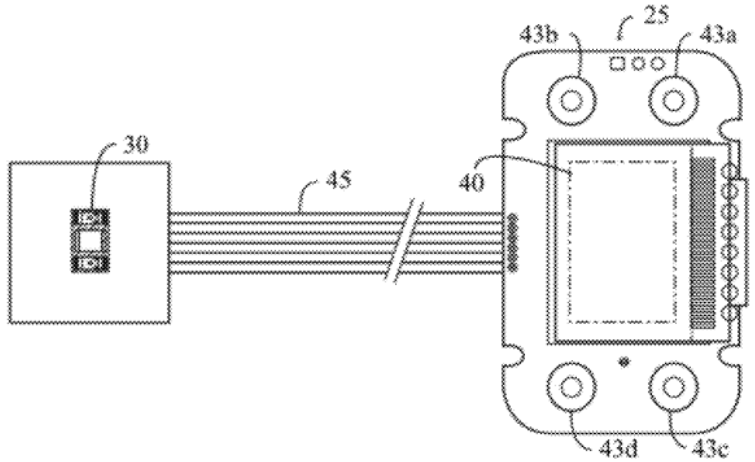
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	transceiver, a processor and a display screen. The monitoring device comprises a housing, an optical sensor for measuring blood flow through an artery of a wrist, arm or ankle of the user, a processor, a short range wireless transceiver, and a power source. The short range wireless transceiver operates on a communication protocol using a 9 kHz communication format, a 125 kHz RFID communication format, a 13.56 MHz communication format, a 433 MHz communication format, a 433 MHz RFID communication format, or a 900 MHz RFID communication format. Rulkov at 13:55-67 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.	Rulkov discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user. It is desirous to adapt the monitoring device 20 to the anatomy of the user's arm or even the user's ankle. The band 26 is preferably composed of neoprene, leather, synthetic leather, LYCRA, another similar material, or a combination thereof. The article 25 is preferably composed of a semi-rigid or rigid plastic with a rubber-like or semi-flex plastic bottom layer for contact with the user's body. The bottom layer of the article 25 may have a curve surface for contact with a user's body. The article 25 preferably has a mass ranging from 5 grams to 50 grams. Preferably, the lower the mass of the article 25, the more comfort to the user. The article 25 preferably has a thickness ranging from 5 mm to 10 mm, and is most preferably 6.5 mm. Rulkov at 4:48-60 In one embodiment, discussed below, the display member 40 is removed and the signal is sent to a device such as a personal digital assistant, laptop computer, mobile telephone, exercise equipment, or the like for display and even processing of the user's real-time vital signs information. Alternatively, the circuitry assembly includes a flexible microprocessor board which is a low power, micro-size easily integrated

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	board which provides blood oxygenation level, pulse rate (heart rate), signal strength bargraph, plethysmogram and status bits data. The microprocessor can also store data. The microprocessor can process the data to display pulse rate, blood oxygenation levels, calories expended by the user of a pre-set time period, target zone activity, time and dynamic blood pressure. Further, microprocessor preferably includes an automatic gain control for preventing saturation of the photodetector, which allows for the device to be used on different portions of the human body Rulkov at 5:48-64  FIG. 1 Rulkov at Fig. 1

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	The optical sensor 30 of the monitoring device 20 is preferably positioned over the radial artery or ulnar artery if the article 25 is worn on the user's arm. The optical sensor 30 of the monitoring device 20 is preferably positioned over the posterior tibial artery of a user if the article 25 is worn on the user's ankle. However, those skilled in the pertinent art will recognize that the optical sensor may be placed over other arteries of the user without departing from the scope and spirit of the present invention. Further, the optical sensor 30 need only be in proximity to an artery of the user in order to obtain a reading or signal. Rulkov at 5:4-15 The top surface of the sensor 30 is preferably flat and in steady contact with the skin. Under a strong motion condition, the skin moves at the border of the contact surface. The sizes of the sensor area and flat skin contact area are selected to reduce the border motion effects. If the distance between the LEDs and sensor is reduced, a lighted area of the skin is smaller, and the contact area is reduced (5×5 mm is acceptable). Rulkov at 12:65-13:5 One aspect of the present invention is a system for monitoring at least one vital sign of a user. The system comprises a smartphone and a monitoring device. The smartphone comprises a short range wireless transceiver, a processor and a display screen. The monitoring device comprises a housing, an optical sensor for measuring blood flow through an artery of a wrist, arm or ankle of the user, a processor, a short range wireless transceiver, and a power source. The short range wireless transceiver operates on a communication protocol using a 9 kHz communication format, a 125 kHz RFID communication format, a 13.56 MHz communication format, a 433 MHz communication format, a 433 MHz RFID communication format, or a 900 MHz RFID communication format. Rulkov at 13:55-67 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. Rulkov discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. In a preferred embodiment, the optical sensor30 is a plurality of light emitting diodes ("LED") 35 based on green light wherein the LEDs35 generate green light (wavelength of 500-570 nm), and a photodetector36 detects the green light. Yet in an alternative embodiment, the optical sensor30 is a photodetector36 and a single LED35 transmitting light at a wavelength of approximately 900 nanometers as a pulsed infrared LED. Yet further, the optical sensor is a combination of a green light LED and a pulsed infrared LED to offset noise affects of ambient light and sunlight. As the heart pumps blood through the arteries in the user's arm, ankle or wrist, the photodetector36, which is typically a photodiode, detects reflectance/transmission at the wavelengths (green, red or infrared), and in response generates a radiation-induced signal. Rulkov at 5:16-30 A preferred optical sensor30 utilizing green light is a TRS1755 sensor from TAOS, Inc of Plano Tex. The TRS1755 comprises a green LED light source (567 nm wavelength) and a light-to-voltage converter. The output voltage is directly proportional to the reflected light intensity. Another preferred photodetector36 is a light-to-voltage photodetector such as the TSL260R and TSL261, TSL261R photodetectors available from TAOS, Inc of Plano Tex. Alternatively, the photodetector130 is a light-to-frequency photodetector such as the TSL245R, which is also available from TAOS, Inc. The light-to-voltage photodetectors have an integrated transimpedance amplifier on a single monolithic integrated circuit, which reduces the need for ambient light filtering. The TSL261 photodetector preferably operates at a wavelength greater than 750 nanometers, and optimally at 940 nanometers, which would preferably have a LED that radiates light at those wavelengths. Rulkov at 5:31-47

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. Rulkov discloses or renders obvious the physiological parameter of the user is associated with a blood constituent or a blood flow of the user. Another aspect of the present invention is of the present invention is a system for monitoring a real-time vital sign of a user. The system for monitoring a real-time vital sign of a user comprises a monitoring device comprising an optical sensor for generating a real-time digitized optical signal corresponding to a flow of blood through an artery of the user and an accelerometer for generating real-time accelerometer data comprising a X-axis signal, a Y-axis signal and a Z-axis signal based on a movement of the user. The system further comprises a first transceiver for transmitting the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a mobile communication device comprising a second transceiver for receiving the real-time digitized optical signal and the real-time accelerometer data from the monitoring device. Additionally, the system comprises a processor in electrical communication with the second transceiver, the processor configured to receive the real-time digitized signal and the real-time accelerometer data, the processor configured to calculate a period of motion related harmonics from the real-time accelerometer data utilizing a repetitive motion pattern analyzer, the processor configured to modify the real-time digitized optical signal by suppressing the motion related harmonics calculated by the motion pattern analyzer to generate a modified optical signal, the processor configured to generate a real-time heart rate for the user from the modified optical signal, Rulkov at 3:1-27 Optionally, the modified optical signal is filtered with a narrow band filter adaptively tuned to a heart rate frequency calculated by a heart rate evaluator to generate the real-time heart rate for the user.

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	Preferably, the repetitive motion pattern analyzer comprises an array of Comb filters. Preferably, the optical sensor comprises two green LEDs and a photodetector Rulkov at 3:28-34  FIG. 6 Rulkov at Fig. 6 The right button 43 *c* is pushed to scroll through the choices of other output values, which comprises: basal metabolic rate; average heart rate; minimum heart rate; maximum heart rate; fat burn heart rate exercise target zone; cardio burn heart rate exercise target zone; and, summary of daily calories burned. The basal metabolic rate (displayed as “BMR”) is an estimate of the total calories burned by the user in one day without exercise, and is based on the user inputted personal data. The average heart rate (displayed as “avHR”) is the average heart rate of the user between resets, and is an overall indicator of fitness. The lower the average heart rate, the healthier the heart. The average heart rate is also a measure of the effectiveness of the exercise program employed by the user since a decrease in the average heart rate of the user will indicate the user's fitness has improved. The minimum heart rate (displayed as “mnHR”) of the user is typically measured during sleep and periods of relaxation. The maximum heart rate (displayed as “mxHR”) is typically measured during intense workouts. The fat burn heart rate

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	exercise target zone (displayed as "fatB") displays a low and high range for the heart rate of the user to optimize fat burning during exercise. The cardio burn heart rate exercise target zone provides a high and low range for the heart rate of the user to optimize cardio conditioning during exercise. The summary of daily calories burned (displayed as "cal") displays the daily calories burned by the user. Rulkov at 7:39-64 One aspect of the present invention is a system for monitoring at least one vital sign of a user. The system comprises a smartphone and a monitoring device. The smartphone comprises a short range wireless transceiver, a processor and a display screen. The monitoring device comprises a housing, an optical sensor for measuring blood flow through an artery of a wrist, arm or ankle of the user, a processor, a short range wireless transceiver, and a power source. The short range wireless transceiver operates on a communication protocol using a 9 kHz communication format, a 125 kHz RFID communication format, a 13.56 MHz communication format, a 433 MHz communication format, a 433 MHz RFID communication format, or a 900 MHz RFID communication format. Rulkov at 13:55-67 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	See claim 8 above. Rulkov discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency.. FIG. 17 is a preferred method 500 for controlling the light intensity of the optical sensor 30. At block 505, the light intensity of the light source 35 is monitored. At block 510, the sensor/photodetector is determined to be saturated by the light source. At block 515, the intensity of the light source is modified

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	by adjusting the resistance and the flow of current to the light source 35. At block 520, the light intensity is again monitored and adjusted if necessary. In a preferred embodiment, this automatic gain mechanism prevents the green light from overwhelming the photodetector 36 thereby maintaining an accurate reading no matter where the optical sensor is placed on the user. Rulkov at 11:20-31 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Rulkov, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Rulkov, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

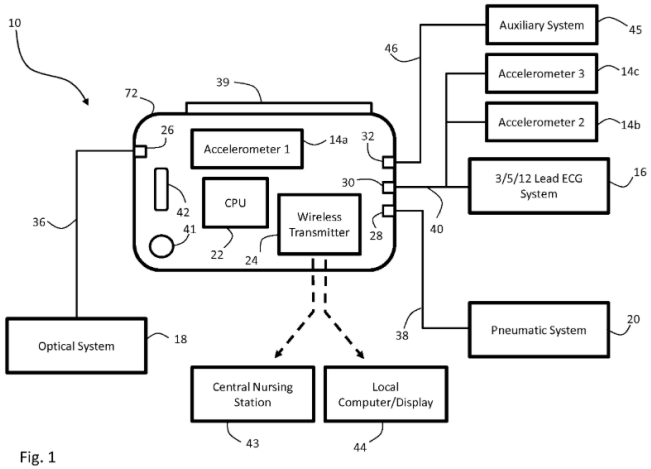
U.S. Pat. No. 12,268,475 in view of U.S. Patent Publication No. 2011/0066050 to Jim Moon ("Moon")

As described in detail below, Moon (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Moon. The cited portions of Moon are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Moon. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Moon "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Moon does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Moon (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Moon anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

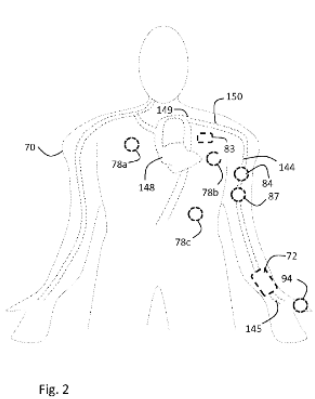
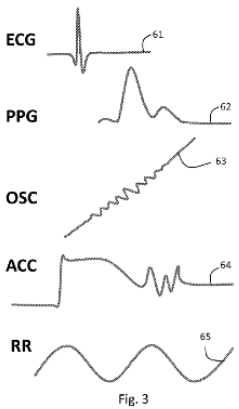
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

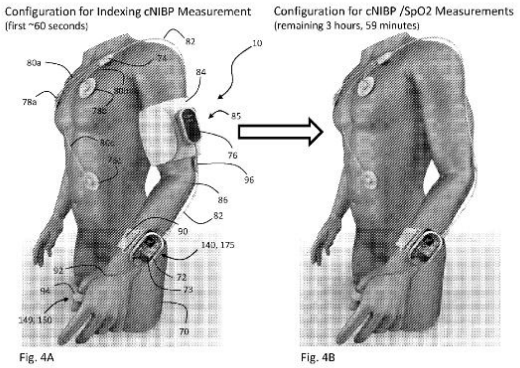
’475 Patent	Moon
Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Moon discloses or renders obvious an apparatus adapted to be worn by a user comprising. The invention provides a body-worn monitor featuring a processing system that receives a digital data stream from an ECG system. A cable houses the ECG system at one terminal end, and plugs into the processing system, which is worn on the patient's wrist like a conventional wristwatch. The ECG system features: i) a connecting portion connected to multiple electrodes worn by the patient; ii) a differential amplifier that receives electrical signals from each electrode and process them to generate an analog ECG waveform; iii) an analog-to-digital converter that converts the analog ECG waveform into a digital ECG waveform; and iv) a transceiver that transmits a digital data stream representing the digital ECG waveform (or information calculated from the waveform) through the cable and to the processing system. Different ECG systems, typically featuring three, five, or twelve electrodes, can be interchanged with one another. Moon at [Abstract] The body-worn monitor features a series of sensors that attach to the patient to measure time-dependent PPG, ECG, accelerometer-based motion (ACC), oscillometric (OSC), respiratory rate (RR), and impedance pneumography (IP) waveforms. A microprocessor (CPU) within the monitor continuously processes these waveforms to determine the patient's vital signs, degree of motion, posture and activity level. Sensors that measure these signals typically send digitized information to a wrist-worn transceiver through a serial interface, or bus, operating on a controlled area network (CAN) protocol. The CAN bus is typically used in the automotive industry, which allows different electronic systems to effectively and robustly communicate with each other with a small number of dropped packets, even in the presence of electrically noisy environments. This is particularly advantageous for ambulatory patients that may generate signals with large amounts of motion-induced noise. Moon at [0013] Blood pressure, a vital sign that is particularly useful for characterizing a patient's condition, is typically calculated from a PTT value determined from the PPG and ECG waveforms. Once determined, blood pressure and other vital signs can be further processed, typically with a server within a hospital, to alert a medical professional if the patient begins to decompensate.

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	Moon at [0014] FIG. 1 shows a schematic drawing of a body-worn monitor 10 according to the invention featuring a wrist-worn transceiver 72 that continuously determines vital signs (e.g. blood pressure, SpO2, heart rate, respiratory rate, and temperature) and motion-related properties (e.g. posture, arm height, activity level, and degree of motion) for an ambulatory patient in a hospital. The monitor 10 is small, lightweight, and comfortably worn on the patient's body during their stay in the hospital; its form factor is described in detail below. A medical professional can apply the monitor, for example, to a recently admitted patient waiting in the ED, and the same monitor can provide continuous monitoring during their stay in the hospital. For example, the patient can wear the monitor in their hospital room, as they receive specific procedures or tests, during transport to other rooms, and even during surgery. The monitor 10 provides continuous monitoring, and features a software framework that determines alarms/alerts if the patient begins to decompensate. The framework processes both the patient's motion and their vital sign information with algorithms that reduce the occurrence of false alarms. Moon at [0054]  Fig. 1 Moon at Fig.1 A combination of features makes the body-worn monitor 10 ideal for ambulatory patients within the hospital. For example, its wrist-worn transceiver 72 features a wireless transmitter 24 that communicates

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	through a hospital network to a computer (e.g. a portable tablet computer) at a central nursing station 43, and to a local computer 44 (e.g. a hand-held PDA) through a peer-to-peer connection. The specific mode of communication can be determined automatically (using, e.g., a signal strength associated with the wireless connection), or manually through an icon on the GUI. Moon at [0055] The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is ‘distributed’ on the patient to minimize the bulk and weight normally associated with conventional vital sign monitors, which typically incorporate all electronics associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. The ECG 16, pneumatic 20, and auxiliary 45 systems are stand-alone systems that include a separate CPU, analog-to-digital converter, and CAN transceiver. During a measurement, they connect to the transceiver 72 through cables 40, 38, 46 and connectors 30, 28, 32 to supply digital inputs over the CAN bus. The ECG system 16, for example, is completely embedded in a terminal portion of its associated

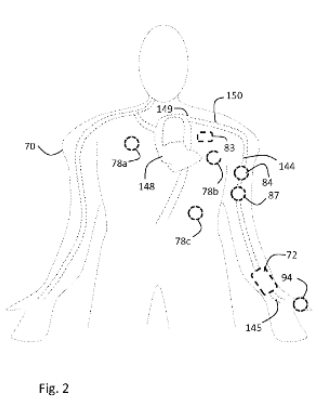
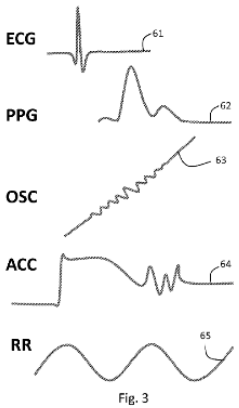
’475 Patent	Moon
	cable. Systems for three, five, and twelve-lead ECG monitoring can be swapped in an out simply by plugging the appropriate cable (which includes the ECG system 16) into a CAN connector 30 on the wrist-worn transceiver 72, and the attaching associated electrodes to the patient's body. The wrist-worn transceiver 72 renders separate GUIs that can be selected for a particular viewer, e.g., different displays directed to the patient as compared to a medical professional. To do this, the transceiver 72 includes a barcode scanner 42 that can scan an identifying barcode printed, e.g., on the medical professional's badge, which indicates the viewer's identity or type to the system. In response, the system renders a GUI featuring information (e.g. vital signs, waveforms) tailored for the indicated viewer; that is, a medical professional can receive information on the GUI that may not be suitable for viewing by the patient. So that the patient can communicate with the medical professional, the transceiver 72 includes a speaker 41 interfaced to the CPU 22 and wireless system 24 that allows the patient to communicate with a remote medical professional using a standard VOIP protocol. A Li:ion battery 39 powers the transceiver 72 for about four days on a single charge, and can be removed in a ‘hot swap’ manner so that after the battery change the transceiver remains wirelessly connected to the hospital's network and no information is lost. This is done simply by plugging a specialized ‘dongle’ into the CAN connector 32 for the auxiliary system 45, replacing the battery 39, and then removing the dongle. Moon at [0056-0058] FIGS. 2 and 3 show how a network of sensors 78 a-c, 83, 84, 87, 94 within the body-worn monitor 10 connect to a patient 70 to characterize them within a hospital. During a measurement, the sensors 78 a-c, 83, 84, 87, 94 measure signals that are processed by the monitor 10 to generate time-dependent ECG 61, PPG 62, OSC 63, ACC 64, and RR 65 waveforms. These, in turn, yield the patient's vital signs and motion parameters. Each waveform 61-65 relates to a unique physiological characteristic of the patient 70. For example, each of the patient's heartbeats generates electrical impulses that pass through the body near the speed of light, along with a pressure wave that propagates through the patient's vasculature at a significantly slower speed. Immediately after the heartbeat, the pressure wave leaves the heart 148 and aorta 149, passes through the subclavian artery 150 to the brachial artery 144, and from there through the radial and ulnar arteries 145 to smaller arteries in the patient's fingers. Three disposable electrodes 78 a-c attached to the patient's chest measure unique electrical signals which pass to a single-chip ECG circuit 83 that terminates a distal end of the ECG cable. Typically, these electrodes attach to the patient's chest in a conventional ‘Einthoven's triangle’ configuration featuring three unique ‘vectors’, each corresponding to a different lead (e.g. LEAD I, II, II). Related configurations can also be used when five and twelve-lead ECG systems are used in place of the three-lead system, as described below with reference to FIGS. 7A,B. Within the ECG circuit 83 signals are processed using an amplifier/filter circuit

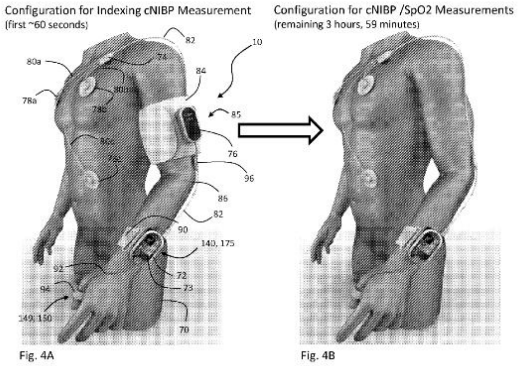
’475 Patent	Moon
	and analog-to-digital converter to generate a digital ECG waveform 61 corresponding to each lead. The ECG waveform 61 features a sharp, well-defined QRS complex corresponding to each heartbeat; this marks the initiation of the patient's cardiac cycle. Heart rate is determined directly from the ECG waveform 61 using known algorithms, such as those described in the following reference, the contents of which are incorporated herein by reference: ‘ECG Beat Detection Using Filter Banks’, Afonso et al., IEEE Trans. Biomed Eng., 46:192-202 (1999). Moon at [0063]  Fig. 2  Fig. 3 Moon at Fig. 2 & 3 FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing

’475 Patent	Moon
	measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]  Fig. 4A Fig. 4B Moon at Fig. 4A & 4B One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	Moon discloses or renders obvious one or more biosensors adapted to be placed on the user, wherein one or more physiological parameters are measured. The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is ‘distributed’ on the patient to minimize the bulk and weight normally associated with conventional vital sign monitors, which typically incorporate all electronics

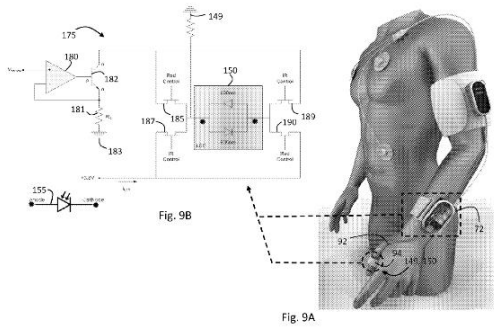
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	associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. Moon at [0056] To determine blood pressure, the transceiver 72 processes ECG and PPG waveforms measured, respectively, by the ECG 16 and optical 18 systems. The optical system 18 features a thumb-worn sensor that includes LEDs operating in the red (λ˜660 nm) and infrared (λ˜900 nm) spectral regions, and a photodetector that detects their radiation after it passes through arteries within the patient's thumb. The ECG waveform, as described above, is digitized and sent over the CAN interface to the wrist-worn transceiver 72, while the PPG waveform is transmitted in an analog form and digitized by an analog-to-digital converter within the transceiver's circuit board. The pneumatic system 20 provides a digitized pressure waveform and oscillometric blood pressure measurements (SYS, DIA, and MAP) through the CAN interface; these are processed by the CPU 22 to make cuff-based ‘indexing’ blood pressure measurements according to the Composite Technique. The indexing measurement typically only takes about 40-60 seconds, after which the pneumatic system 20 is unplugged from its connector 28 so that the patient can move within the hospital without wearing an uncomfortable cuff-based system.

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	Moon at [0060] FIGS. 2 and 3 show how a network of sensors 78 a-c, 83, 84, 87, 94 within the body-worn monitor 10 connect to a patient 70 to characterize them within a hospital. During a measurement, the sensors 78 a-c, 83, 84, 87, 94 measure signals that are processed by the monitor 10 to generate time-dependent ECG 61, PPG 62, OSC 63, ACC 64, and RR 65 waveforms. These, in turn, yield the patient's vital signs and motion parameters. Each waveform 61-65 relates to a unique physiological characteristic of the patient 70. For example, each of the patient's heartbeats generates electrical impulses that pass through the body near the speed of light, along with a pressure wave that propagates through the patient's vasculature at a significantly slower speed. Immediately after the heartbeat, the pressure wave leaves the heart 148 and aorta 149, passes through the subclavian artery 150 to the brachial artery 144, and from there through the radial and ulnar arteries 145 to smaller arteries in the patient's fingers. Three disposable electrodes 78 a-c attached to the patient's chest measure unique electrical signals which pass to a single-chip ECG circuit 83 that terminates a distal end of the ECG cable. Typically, these electrodes attach to the patient's chest in a conventional ‘Einthoven's triangle’ configuration featuring three unique ‘vectors’, each corresponding to a different lead (e.g. LEAD I, II, II). Related configurations can also be used when five and twelve-lead ECG systems are used in place of the three-lead system, as described below with reference to FIGS. 7A,B. Within the ECG circuit 83 signals are processed using an amplifier/filter circuit and analog-to-digital converter to generate a digital ECG waveform 61 corresponding to each lead. The ECG waveform 61 features a sharp, well-defined QRS complex corresponding to each heartbeat; this marks the initiation of the patient's cardiac cycle. Heart rate is determined directly from the ECG waveform 61 using known algorithms, such as those described in the following reference, the contents of which are incorporated herein by reference: ‘ECG Beat Detection Using Filter Banks’, Afonso et al., IEEE Trans. Biomed Eng., 46:192-202 (1999). Moon at [0063]

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	 Fig. 2  Fig. 3 Moon at Fig. 2 & 3 The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-

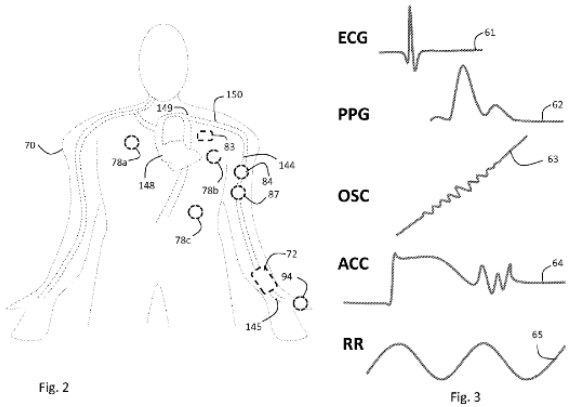
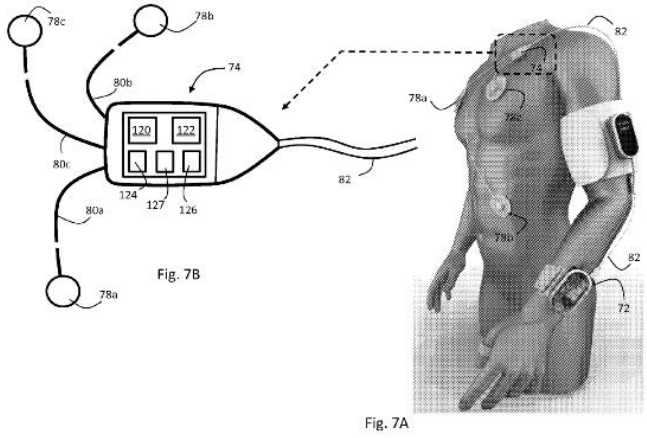
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	mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]  Moon at Fig. 4A & 4B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94

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	includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081] The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to

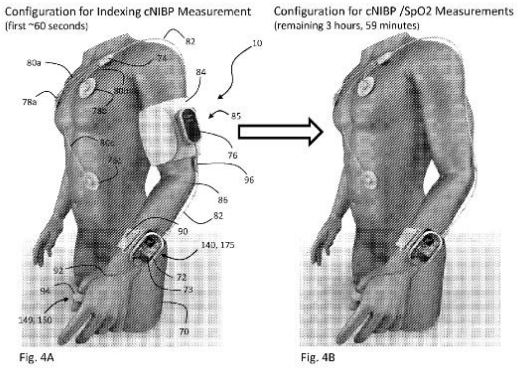
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	generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091]  Moon at Fig. 9A & 9B One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

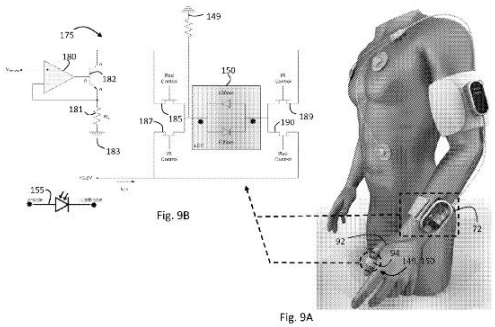
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1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	Moon discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is ‘distributed’ on the patient to minimize the bulk and weight normally associated with conventional vital sign monitors, which typically incorporate all electronics associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. Moon at [0056] To determine blood pressure, the transceiver 72 processes ECG and PPG waveforms measured, respectively, by the ECG 16 and optical 18 systems. The optical system 18 features a thumb-worn sensor that includes LEDs operating in the red (λ˜660 nm) and infrared (λ˜900 nm) spectral regions, and a

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	photodetector that detects their radiation after it passes through arteries within the patient's thumb. The ECG waveform, as described above, is digitized and sent over the CAN interface to the wrist-worn transceiver 72, while the PPG waveform is transmitted in an analog form and digitized by an analog-to-digital converter within the transceiver's circuit board. The pneumatic system 20 provides a digitized pressure waveform and oscillometric blood pressure measurements (SYS, DIA, and MAP) through the CAN interface; these are processed by the CPU 22 to make cuff-based ‘indexing’ blood pressure measurements according to the Composite Technique. The indexing measurement typically only takes about 40-60 seconds, after which the pneumatic system 20 is unplugged from its connector 28 so that the patient can move within the hospital without wearing an uncomfortable cuff-based system. Moon at [0060] FIGS. 2 and 3 show how a network of sensors 78 a-c, 83, 84, 87, 94 within the body-worn monitor 10 connect to a patient 70 to characterize them within a hospital. During a measurement, the sensors 78 a-c, 83, 84, 87, 94 measure signals that are processed by the monitor 10 to generate time-dependent ECG 61, PPG 62, OSC 63, ACC 64, and RR 65 waveforms. These, in turn, yield the patient's vital signs and motion parameters. Each waveform 61-65 relates to a unique physiological characteristic of the patient 70. For example, each of the patient's heartbeats generates electrical impulses that pass through the body near the speed of light, along with a pressure wave that propagates through the patient's vasculature at a significantly slower speed. Immediately after the heartbeat, the pressure wave leaves the heart 148 and aorta 149, passes through the subclavian artery 150 to the brachial artery 144, and from there through the radial and ulnar arteries 145 to smaller arteries in the patient's fingers. Three disposable electrodes 78 a-c attached to the patient's chest measure unique electrical signals which pass to a single-chip ECG circuit 83 that terminates a distal end of the ECG cable. Typically, these electrodes attach to the patient's chest in a conventional ‘Einthoven's triangle’ configuration featuring three unique ‘vectors’, each corresponding to a different lead (e.g. LEAD I, II, II). Related configurations can also be used when five and twelve-lead ECG systems are used in place of the three-lead system, as described below with reference to FIGS. 7A,B. Within the ECG circuit 83 signals are processed using an amplifier/filter circuit and analog-to-digital converter to generate a digital ECG waveform 61 corresponding to each lead. The ECG waveform 61 features a sharp, well-defined QRS complex corresponding to each heartbeat; this marks the initiation of the patient's cardiac cycle. Heart rate is determined directly from the ECG waveform 61 using known algorithms, such as those described in the following reference, the contents of which are incorporated herein by reference: ‘ECG Beat Detection Using Filter Banks’, Afonso et al., IEEE Trans. Biomed Eng., 46:192-202 (1999).

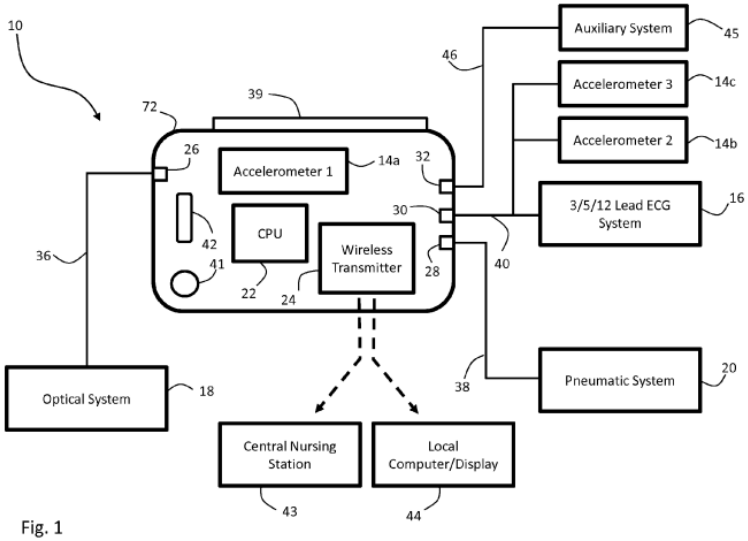
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	Moon at [0063]  Fig. 2 Fig. 3 Moon at Fig. 2 & 3  Fig. 7B Fig. 7A

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	Moon at Fig. 7A & 7B The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing

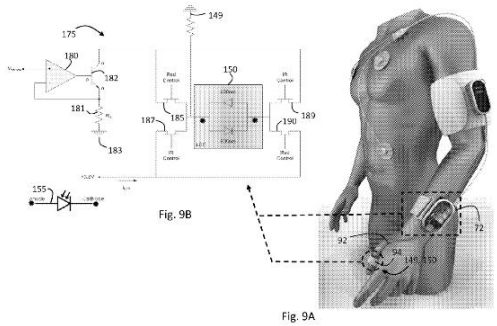
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	measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]  Fig. 4A Fig. 4B Moon at Fig. 4A & 4B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby

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	supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081]  Fig. 9B Fig. 9A Moon at Fig. 9A & 9B The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary

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	waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	Moon discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. Typically the optical signal is generated with an optical sensor configured to be worn around the patient's thumb. PTT is typically calculated from a time difference separating a QRS complex in the ECG waveform and a foot of a PPG waveform. In other embodiments the same optical sensor used to measure the optical waveform features a first LED operating in the red spectral range, and a second LED operating in the infrared spectral range. Optical waveforms measured with these LEDs can additionally be processed to determine SpO2, as is described in detail below. Moon at [0023] FIG. 1 shows a schematic drawing of a body-worn monitor 10 according to the invention featuring a wrist-worn transceiver 72 that continuously determines vital signs (e.g. blood pressure, SpO2, heart rate,

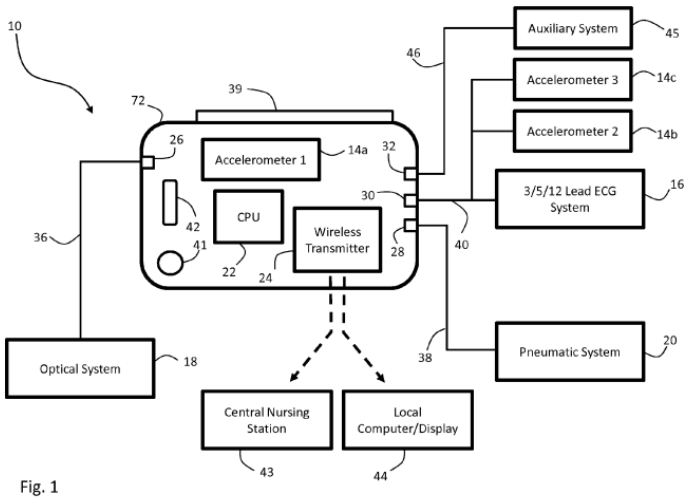
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	respiratory rate, and temperature) and motion-related properties (e.g. posture, arm height, activity level, and degree of motion) for an ambulatory patient in a hospital. The monitor 10 is small, lightweight, and comfortably worn on the patient's body during their stay in the hospital; its form factor is described in detail below. A medical professional can apply the monitor, for example, to a recently admitted patient waiting in the ED, and the same monitor can provide continuous monitoring during their stay in the hospital. For example, the patient can wear the monitor in their hospital room, as they receive specific procedures or tests, during transport to other rooms, and even during surgery. The monitor 10 provides continuous monitoring, and features a software framework that determines alarms/alerts if the patient begins to decompensate. The framework processes both the patient's motion and their vital sign information with algorithms that reduce the occurrence of false alarms. Moon at [0054]  Fig. 1 Moon at Fig. 01 To determine blood pressure, the transceiver 72 processes ECG and PPG waveforms measured, respectively, by the ECG 16 and optical 18 systems. The optical system 18 features a thumb-worn sensor that includes LEDs operating in the red (λ˜660 nm) and infrared (λ˜900 nm) spectral regions, and a photodetector that detects their radiation after it passes through arteries within the patient's thumb. The

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	ECG waveform, as described above, is digitized and sent over the CAN interface to the wrist-worn transceiver 72, while the PPG waveform is transmitted in an analog form and digitized by an analog-to-digital converter within the transceiver's circuit board. The pneumatic system 20 provides a digitized pressure waveform and oscillometric blood pressure measurements (SYS, DIA, and MAP) through the CAN interface; these are processed by the CPU 22 to make cuff-based ‘indexing’ blood pressure measurements according to the Composite Technique. The indexing measurement typically only takes about 40-60 seconds, after which the pneumatic system 20 is unplugged from its connector 28 so that the patient can move within the hospital without wearing an uncomfortable cuff-based system. Moon at [0060] The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065]

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	 Moon at Fig. 9A & 9B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases

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	the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0089] During a measurement, the CPU in the wrist-worn transceiver determines the value of the resistor 149 by monitoring a voltage drop across it; this value, in turn, is compared to a value stored in memory to select the appropriate coefficients relating a parameter called a ‘ratio of ratios’ (RoR) to SpO2. This calculation is described in detail in the above-referenced patent application describing SpO2, the contents of which have been incorporated herein by reference. The probe 94 generates alternating red and infrared radiation at 500 Hz that passes through the base of the patient's thumb 151, where it is partially absorbed by underlying vasculature according to the patient's heart rate and SpO2 values. Radiation that transmits through the thumb 151 illuminates a photodiode 155 that, in response, generates a photocurrent varying in magnitude with the degree of optical absorption in the patient's thumb. An amplifier circuit 140 beginning with a transimpedance amplifier 156 receives the photocurrent and converts it to a corresponding voltage which is then amplified and filtered to generate the PPGs waveforms with both red and infrared wavelengths used to determine SpO2 and cNIBP. Moon at [0090] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	Moon discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin. In other embodiments, PTT can be calculated from time-dependent waveforms other than the ECG and PPG, and then processed to determine blood pressure. In general, PTT can be calculated by measuring a temporal separation between features in two or more time-dependent waveforms measured from the human body. For example, PTT can be calculated from two separate PPGs measured by different optical sensors disposed on the patient's fingers, wrist, arm, chest, or virtually any other location where an optical

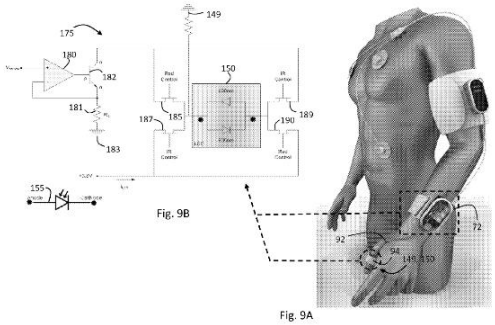
’475 Patent	Moon
	signal can be measured using a transmission or reflection-mode optical configuration. In other embodiments, PTT can be calculated using at least one time-dependent waveform measured with an acoustic sensor, typically disposed on the patient's chest. Or it can be calculated using at least one time-dependent waveform measured using a pressure sensor, typically disposed on the patient's bicep, wrist, or finger. The pressure sensor can include, for example, a pressure transducer, piezoelectric sensor, actuator, polymer material, or inflatable cuff. Moon at [0015] The system can also connect through one of its serial ports to an ancillary third system that can be, for example, a system that delivers a compound or other therapeutic intervention to the patient, or that can gather other data from the patient. Such systems include infusion pumps, insulin pumps, hemodialysis machines, glucometers, and systems for delivering oxygen, such as a mechanical ventilator. This list is not meant to be limiting. In the case of a therapeutic compound, the data portion of the packet can indicate the type of compound delivered to the patient, a dosage of the compound, and a rate of delivery of the compound. The third system can also be a sensor configured to measure a signal from the patient. Such sensors include, for example, a pulse oximeter, EEG monitor, temperature sensor, respiratory rate sensor, motion sensor, camera, impedance plethysmography sensor, optical spectrometer, and skin-conductance sensor. Again, this list is not meant to be limiting. Here, the data portion of the packet can include waveform information, heart rate, pulse rate, SpO2 value, EEG waveform, temperature, respiratory rate, degree of motion, posture, activity level, arm height, an image, a property of the patient measurable optically, and a property of the patient measurable electrically. Moon at [0019] FIG. 1 shows a schematic drawing of a body-worn monitor 10 according to the invention featuring a wrist-worn transceiver 72 that continuously determines vital signs (e.g. blood pressure, SpO2, heart rate, respiratory rate, and temperature) and motion-related properties (e.g. posture, arm height, activity level, and degree of motion) for an ambulatory patient in a hospital. The monitor 10 is small, lightweight, and comfortably worn on the patient's body during their stay in the hospital; its form factor is described in detail below. A medical professional can apply the monitor, for example, to a recently admitted patient waiting in the ED, and the same monitor can provide continuous monitoring during their stay in the hospital. For example, the patient can wear the monitor in their hospital room, as they receive specific procedures or tests, during transport to other rooms, and even during surgery. The monitor 10 provides

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	continuous monitoring, and features a software framework that determines alarms/alerts if the patient begins to decompensate. The framework processes both the patient's motion and their vital sign information with algorithms that reduce the occurrence of false alarms. Moon at [0054]  Fig. 1 Moon at Fig. 01 A combination of features makes the body-worn monitor 10 ideal for ambulatory patients within the hospital. For example, its wrist-worn transceiver 72 features a wireless transmitter 24 that communicates through a hospital network to a computer (e.g. a portable tablet computer) at a central nursing station 43, and to a local computer 44 (e.g. a hand-held PDA) through a peer-to-peer connection. The specific mode of communication can be determined automatically (using, e.g., a signal strength associated with the wireless connection), or manually through an icon on the GUI. Moon at [0055] The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference:

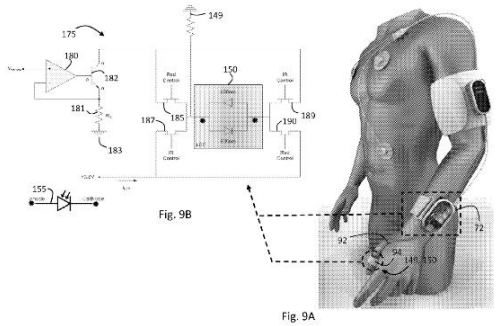
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	BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	Moon discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. In other embodiments, PTT can be calculated from time-dependent waveforms other than the ECG and PPG, and then processed to determine blood pressure. In general, PTT can be calculated by measuring a temporal separation between features in two or more time-dependent waveforms measured from the human body. For example, PTT can be calculated from two separate PPGs measured by different optical sensors disposed on the patient's fingers, wrist, arm, chest, or virtually any other location where an optical signal can be measured using a transmission or reflection-mode optical configuration. In other

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	embodiments, PTT can be calculated using at least one time-dependent waveform measured with an acoustic sensor, typically disposed on the patient's chest. Or it can be calculated using at least one time-dependent waveform measured using a pressure sensor, typically disposed on the patient's bicep, wrist, or finger. The pressure sensor can include, for example, a pressure transducer, piezoelectric sensor, actuator, polymer material, or inflatable cuff. Moon at [0015] The system can also connect through one of its serial ports to an ancillary third system that can be, for example, a system that delivers a compound or other therapeutic intervention to the patient, or that can gather other data from the patient. Such systems include infusion pumps, insulin pumps, hemodialysis machines, glucometers, and systems for delivering oxygen, such as a mechanical ventilator. This list is not meant to be limiting. In the case of a therapeutic compound, the data portion of the packet can indicate the type of compound delivered to the patient, a dosage of the compound, and a rate of delivery of the compound. The third system can also be a sensor configured to measure a signal from the patient. Such sensors include, for example, a pulse oximeter, EEG monitor, temperature sensor, respiratory rate sensor, motion sensor, camera, impedance plethysmography sensor, optical spectrometer, and skin-conductance sensor. Again, this list is not meant to be limiting. Here, the data portion of the packet can include waveform information, heart rate, pulse rate, SpO2 value, EEG waveform, temperature, respiratory rate, degree of motion, posture, activity level, arm height, an image, a property of the patient measurable optically, and a property of the patient measurable electrically. Moon at [0019] The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is ‘distributed’ on the patient to minimize the bulk and weight normally associated with conventional vital sign monitors, which typically incorporate all electronics associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low

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	signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. Moon at [0056] The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation

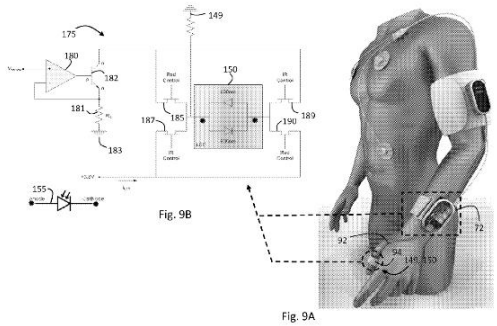
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	to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065]  Moon at Fig. 9A & 9B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage

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	flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081] The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091]

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	 Fig. 9B Fig. 9A Moon at Fig. 9A & 9B One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Moon discloses or renders obvious, the detection system is configured to be synchronized to the light source. The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is ‘distributed’ on the patient to minimize the bulk and weight normally associated with conventional vital sign monitors, which typically incorporate all electronics associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the

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	remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. Moon at [0056] The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation

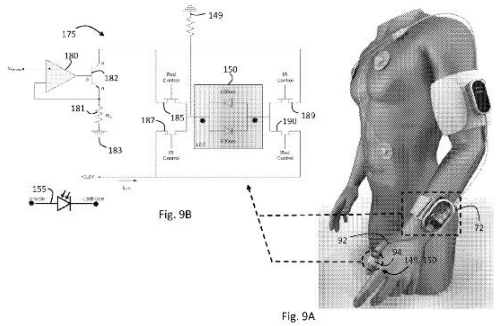
’475 Patent	Moon
	to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081]

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	 Moon at Fig. 9A & 9B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz.

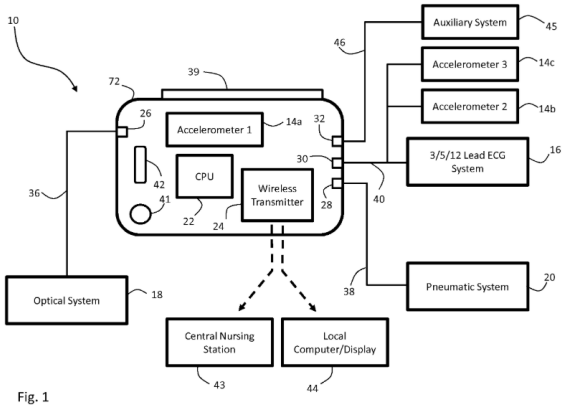
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	Moon at [0089] The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	Moon discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. SpO2 is typically measured with a bandage or clothespin-shaped sensor that clips to a patient's finger and includes optical systems operating in both the red and infrared spectral regions. A photodetector measures radiation emitted from the optical systems that transmits through the patient's finger. Other body sites, e.g., the ear, forehead, and nose, can also be used in place of the finger. During a measurement, a microprocessor analyses both red and infrared radiation detected by the photodetector to determine the patient's blood oxygen saturation level and a time-dependent waveform called a photoplethysmograph (PPG). Time-dependent features of the PPG indicate both pulse rate and a volumetric absorbance change in an underlying artery caused by the propagating pressure pulse. Moon at [0008] In other embodiments, PTT can be calculated from time-dependent waveforms other than the ECG and PPG, and then processed to determine blood pressure. In general, PTT can be calculated by measuring a temporal separation between features in two or more time-dependent waveforms measured from the human body. For example, PTT can be calculated from two separate PPGs measured by different optical sensors disposed on the patient's fingers, wrist, arm, chest, or virtually any other location where an optical signal can be measured using a transmission or reflection-mode optical configuration. In other embodiments, PTT can be calculated using at least one time-dependent waveform measured with an acoustic sensor, typically disposed on the patient's chest. Or it can be calculated using at least one time-dependent waveform measured using a pressure sensor, typically disposed on the patient's bicep, wrist, or finger. The pressure sensor can include, for example, a pressure transducer, piezoelectric sensor, actuator, polymer material, or inflatable cuff. Moon at [0015] To determine blood pressure, the transceiver 72 processes ECG and PPG waveforms measured, respectively, by the ECG 16 and optical 18 systems. The optical system 18 features a thumb-worn sensor that includes LEDs operating in the red (λ˜660 nm) and infrared (λ˜900 nm) spectral regions, and a photodetector that detects their radiation after it passes through arteries within the patient's thumb. The

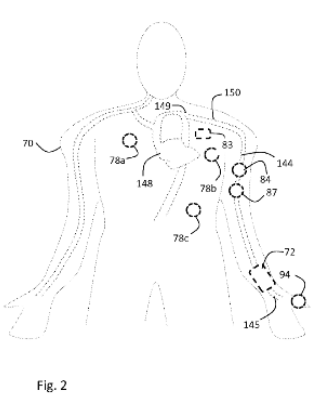
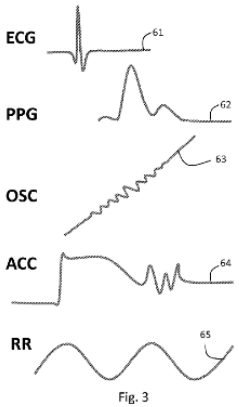
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	ECG waveform, as described above, is digitized and sent over the CAN interface to the wrist-worn transceiver 72, while the PPG waveform is transmitted in an analog form and digitized by an analog-to-digital converter within the transceiver's circuit board. The pneumatic system 20 provides a digitized pressure waveform and oscillometric blood pressure measurements (SYS, DIA, and MAP) through the CAN interface; these are processed by the CPU 22 to make cuff-based ‘indexing’ blood pressure measurements according to the Composite Technique. The indexing measurement typically only takes about 40-60 seconds, after which the pneumatic system 20 is unplugged from its connector 28 so that the patient can move within the hospital without wearing an uncomfortable cuff-based system. Moon at [0060] The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065]

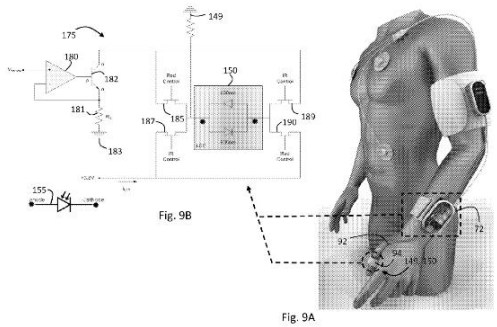
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	 Moon at Fig. 9A & 9B The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and

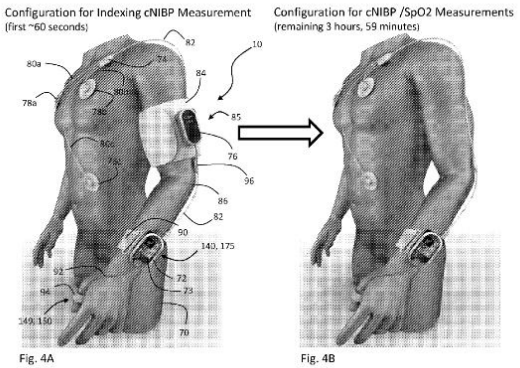
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1[h]. wherein the output signal is indicative of the one or more physiological parameters;	Moon discloses or renders obvious the output signal is indicative of the one or more physiological parameters. The body-worn monitor features a series of sensors that attach to the patient to measure time-dependent PPG, ECG, accelerometer-based motion (ACC), oscillometric (OSC), respiratory rate (RR), and impedance pneumography (IP) waveforms. A microprocessor (CPU) within the monitor continuously processes these waveforms to determine the patient's vital signs, degree of motion, posture and activity level. Sensors that measure these signals typically send digitized information to a wrist-worn transceiver through a serial interface, or bus, operating on a controlled area network (CAN) protocol. The CAN bus is typically used in the automotive industry, which allows different electronic systems to effectively and robustly communicate with each other with a small number of dropped packets, even in the presence of electrically noisy environments. This is particularly advantageous for ambulatory patients that may generate signals with large amounts of motion-induced noise. Moon at [0013] Blood pressure, a vital sign that is particularly useful for characterizing a patient's condition, is typically calculated from a PTT value determined from the PPG and ECG waveforms. Once determined, blood pressure and other vital signs can be further processed, typically with a server within a hospital, to alert a medical professional if the patient begins to decompensate. Moon at [0014]

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	 Fig. 1 Moon at Fig.1 FIG. 1 shows a schematic drawing of a body-worn monitor 10 according to the invention featuring a wrist-worn transceiver 72 that continuously determines vital signs (e.g. blood pressure, SpO2, heart rate, respiratory rate, and temperature) and motion-related properties (e.g. posture, arm height, activity level, and degree of motion) for an ambulatory patient in a hospital. The monitor 10 is small, lightweight, and comfortably worn on the patient's body during their stay in the hospital; its form factor is described in detail below. A medical professional can apply the monitor, for example, to a recently admitted patient waiting in the ED, and the same monitor can provide continuous monitoring during their stay in the hospital. For example, the patient can wear the monitor in their hospital room, as they receive specific procedures or tests, during transport to other rooms, and even during surgery. The monitor 10 provides continuous monitoring, and features a software framework that determines alarms/alerts if the patient begins to decompensate. The framework processes both the patient's motion and their vital sign information with algorithms that reduce the occurrence of false alarms. Moon at [0054] To determine blood pressure, the transceiver 72 processes ECG and PPG waveforms measured, respectively, by the ECG 16 and optical 18 systems. The optical system 18 features a thumb-worn sensor that includes LEDs operating in the red (λ˜660 nm) and infrared (λ˜900 nm) spectral regions, and a photodetector that detects their radiation after it passes through arteries within the patient's thumb. The

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	ECG waveform, as described above, is digitized and sent over the CAN interface to the wrist-worn transceiver 72, while the PPG waveform is transmitted in an analog form and digitized by an analog-to-digital converter within the transceiver's circuit board. The pneumatic system 20 provides a digitized pressure waveform and oscillometric blood pressure measurements (SYS, DIA, and MAP) through the CAN interface; these are processed by the CPU 22 to make cuff-based ‘indexing’ blood pressure measurements according to the Composite Technique. The indexing measurement typically only takes about 40-60 seconds, after which the pneumatic system 20 is unplugged from its connector 28 so that the patient can move within the hospital without wearing an uncomfortable cuff-based system. Moon at [0060] FIGS. 2 and 3 show how a network of sensors 78 a-c, 83, 84, 87, 94 within the body-worn monitor 10 connect to a patient 70 to characterize them within a hospital. During a measurement, the sensors 78 a-c, 83, 84, 87, 94 measure signals that are processed by the monitor 10 to generate time-dependent ECG 61, PPG 62, OSC 63, ACC 64, and RR 65 waveforms. These, in turn, yield the patient's vital signs and motion parameters. Each waveform 61-65 relates to a unique physiological characteristic of the patient 70. For example, each of the patient's heartbeats generates electrical impulses that pass through the body near the speed of light, along with a pressure wave that propagates through the patient's vasculature at a significantly slower speed. Immediately after the heartbeat, the pressure wave leaves the heart 148 and aorta 149, passes through the subclavian artery 150 to the brachial artery 144, and from there through the radial and ulnar arteries 145 to smaller arteries in the patient's fingers. Three disposable electrodes 78 a-c attached to the patient's chest measure unique electrical signals which pass to a single-chip ECG circuit 83 that terminates a distal end of the ECG cable. Typically, these electrodes attach to the patient's chest in a conventional ‘Einthoven's triangle’ configuration featuring three unique ‘vectors’, each corresponding to a different lead (e.g. LEAD I, II, II). Related configurations can also be used when five and twelve-lead ECG systems are used in place of the three-lead system, as described below with reference to FIGS. 7A,B. Within the ECG circuit 83 signals are processed using an amplifier/filter circuit and analog-to-digital converter to generate a digital ECG waveform 61 corresponding to each lead. The ECG waveform 61 features a sharp, well-defined QRS complex corresponding to each heartbeat; this marks the initiation of the patient's cardiac cycle. Heart rate is determined directly from the ECG waveform 61 using known algorithms, such as those described in the following reference, the contents of which are incorporated herein by reference: ‘ECG Beat Detection Using Filter Banks’, Afonso et al., IEEE Trans. Biomed Eng., 46:192-202 (1999). Moon at [0063]

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	 Fig. 2  Fig. 3 Moon at Fig. 2 & 3 The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is

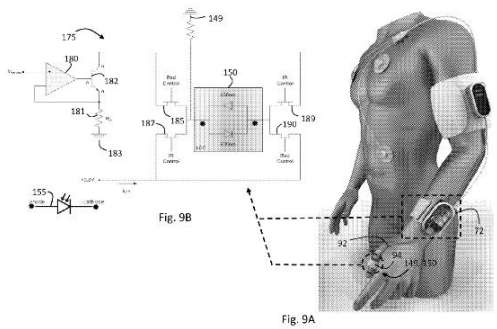
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	the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065]  Moon at Fig. 9A & 9B FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]

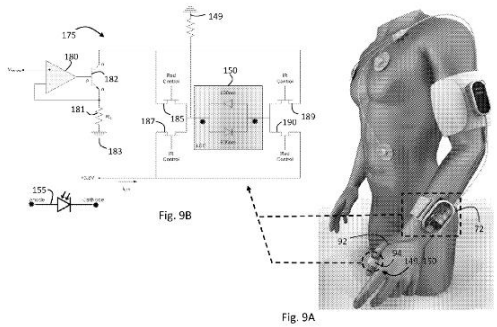
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	 Moon at Fig. 4A & 4B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control

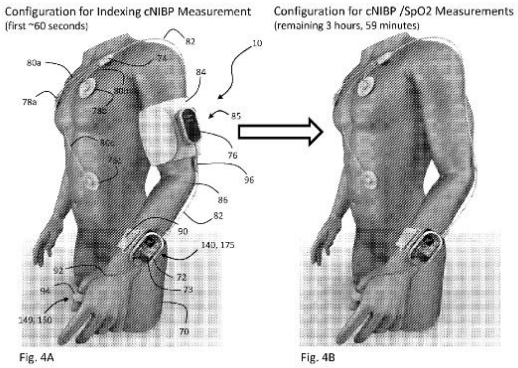
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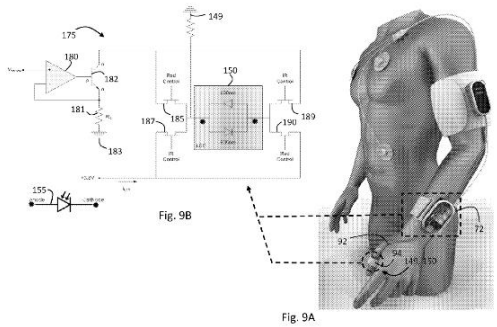
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	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Moon discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is 'distributed' on the patient to minimize the bulk and weight normally associated with conventional vital sign monitors, which typically incorporate all electronics associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. Moon at [0056]

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	The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091]

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	 Fig. 9B Fig. 9A Moon at Fig. 9A & 9B One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Moon discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,. The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and

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	decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065]  Moon at Fig. 9A & 9B FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing

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	measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]  Fig. 4A Fig. 4B Moon at Fig. 4A & 4B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby

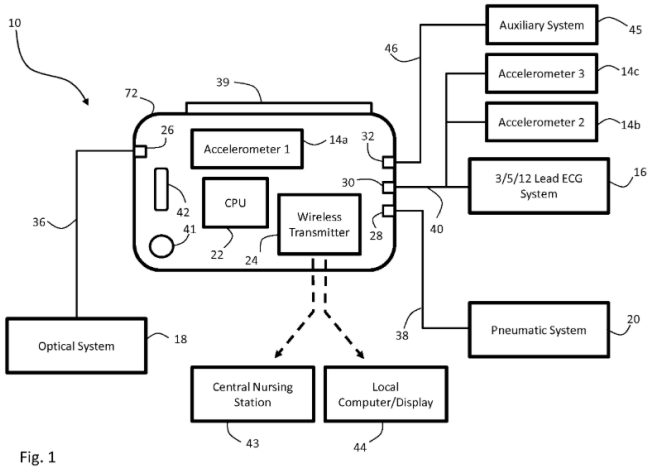
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	supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081]  Fig. 9B Fig. 9A Moon at Fig. 9A & 9B The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency

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	noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Moon discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes

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	through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Moon discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio**.** The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit

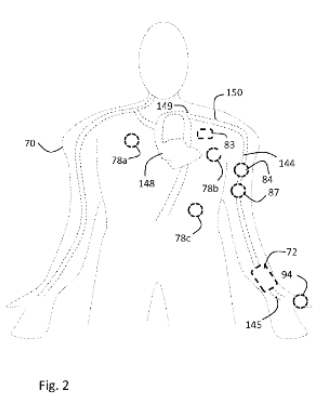
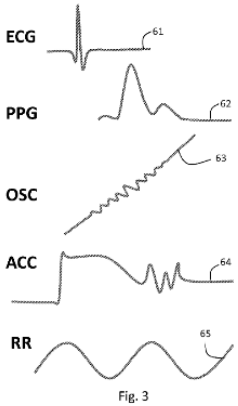
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	157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Moon discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. The invention provides a body-worn monitor featuring a processing system that receives a digital data stream from an ECG system. A cable houses the ECG system at one terminal end, and plugs into the processing system, which is worn on the patient's wrist like a conventional wristwatch. The ECG system features: i) a connecting portion connected to multiple electrodes worn by the patient; ii) a differential amplifier that receives electrical signals from each electrode and process them to generate an analog ECG waveform; iii) an analog-to-digital converter that converts the analog ECG waveform into a digital ECG waveform; and iv) a transceiver that transmits a digital data stream representing the digital ECG waveform (or information calculated from the waveform) through the cable and to the processing system.

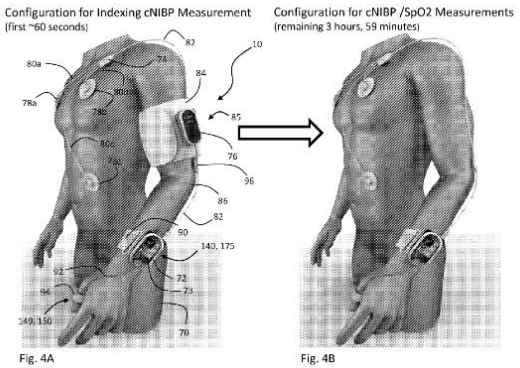
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	Different ECG systems, typically featuring three, five, or twelve electrodes, can be interchanged with one another. Moon at [Abstract] The body-worn monitor features a series of sensors that attach to the patient to measure time-dependent PPG, ECG, accelerometer-based motion (ACC), oscillometric (OSC), respiratory rate (RR), and impedance pneumography (IP) waveforms. A microprocessor (CPU) within the monitor continuously processes these waveforms to determine the patient's vital signs, degree of motion, posture and activity level. Sensors that measure these signals typically send digitized information to a wrist-worn transceiver through a serial interface, or bus, operating on a controlled area network (CAN) protocol. The CAN bus is typically used in the automotive industry, which allows different electronic systems to effectively and robustly communicate with each other with a small number of dropped packets, even in the presence of electrically noisy environments. This is particularly advantageous for ambulatory patients that may generate signals with large amounts of motion-induced noise. Moon at [0013] Blood pressure, a vital sign that is particularly useful for characterizing a patient's condition, is typically calculated from a PTT value determined from the PPG and ECG waveforms. Once determined, blood pressure and other vital signs can be further processed, typically with a server within a hospital, to alert a medical professional if the patient begins to decompensate. Moon at [0014] FIG. 1 shows a schematic drawing of a body-worn monitor 10 according to the invention featuring a wrist-worn transceiver 72 that continuously determines vital signs (e.g. blood pressure, SpO2, heart rate, respiratory rate, and temperature) and motion-related properties (e.g. posture, arm height, activity level, and degree of motion) for an ambulatory patient in a hospital. The monitor 10 is small, lightweight, and comfortably worn on the patient's body during their stay in the hospital; its form factor is described in detail below. A medical professional can apply the monitor, for example, to a recently admitted patient waiting in the ED, and the same monitor can provide continuous monitoring during their stay in the hospital. For example, the patient can wear the monitor in their hospital room, as they receive specific procedures or tests, during transport to other rooms, and even during surgery. The monitor 10 provides continuous monitoring, and features a software framework that determines alarms/alerts if the patient

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	begins to decompensate. The framework processes both the patient's motion and their vital sign information with algorithms that reduce the occurrence of false alarms. Moon at [0054]  Fig. 1 Moon at Fig.1 A combination of features makes the body-worn monitor 10 ideal for ambulatory patients within the hospital. For example, its wrist-worn transceiver 72 features a wireless transmitter 24 that communicates through a hospital network to a computer (e.g. a portable tablet computer) at a central nursing station 43, and to a local computer 44 (e.g. a hand-held PDA) through a peer-to-peer connection. The specific mode of communication can be determined automatically (using, e.g., a signal strength associated with the wireless connection), or manually through an icon on the GUI. Moon at [0055] The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is ‘distributed’ on the patient to minimize the bulk and weight normally associated with conventional vital sign monitors, which typically incorporate all electronics associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to

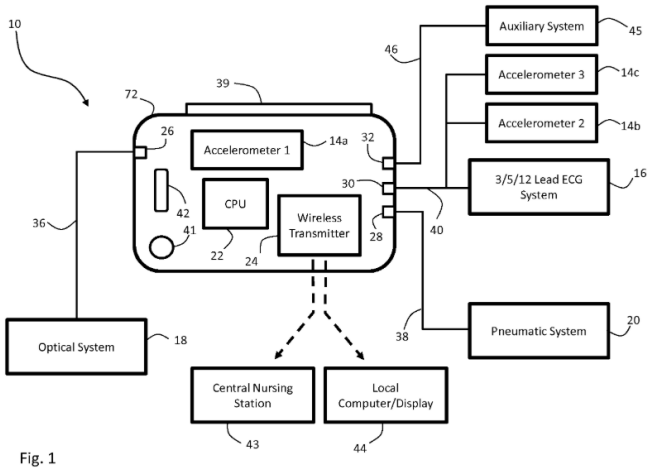
’475 Patent	Moon
	generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. The ECG 16, pneumatic 20, and auxiliary 45 systems are stand-alone systems that include a separate CPU, analog-to-digital converter, and CAN transceiver. During a measurement, they connect to the transceiver 72 through cables 40, 38, 46 and connectors 30, 28, 32 to supply digital inputs over the CAN bus. The ECG system 16, for example, is completely embedded in a terminal portion of its associated cable. Systems for three, five, and twelve-lead ECG monitoring can be swapped in an out simply by plugging the appropriate cable (which includes the ECG system 16) into a CAN connector 30 on the wrist-worn transceiver 72, and the attaching associated electrodes to the patient's body. The wrist-worn transceiver 72 renders separate GUIs that can be selected for a particular viewer, e.g., different displays directed to the patient as compared to a medical professional. To do this, the transceiver 72 includes a barcode scanner 42 that can scan an identifying barcode printed, e.g., on the medical professional's badge, which indicates the viewer's identity or type to the system. In response, the system renders a GUI featuring information (e.g. vital signs, waveforms) tailored for the indicated viewer; that is, a medical professional can receive information on the GUI that may not be suitable for viewing by the patient. So that the patient can communicate with the medical professional, the transceiver 72 includes a speaker 41 interfaced to the CPU 22 and wireless system 24 that allows the patient to communicate with a remote medical professional using a standard VOIP protocol. A Li:ion battery 39 powers the transceiver 72 for about four days on a single charge, and can be removed in a ‘hot swap’

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	manner so that after the battery change the transceiver remains wirelessly connected to the hospital's network and no information is lost. This is done simply by plugging a specialized ‘dongle’ into the CAN connector 32 for the auxiliary system 45, replacing the battery 39, and then removing the dongle. Moon at [0056-0058] FIGS. 2 and 3 show how a network of sensors 78 a-c, 83, 84, 87, 94 within the body-worn monitor 10 connect to a patient 70 to characterize them within a hospital. During a measurement, the sensors 78 a-c, 83, 84, 87, 94 measure signals that are processed by the monitor 10 to generate time-dependent ECG 61, PPG 62, OSC 63, ACC 64, and RR 65 waveforms. These, in turn, yield the patient's vital signs and motion parameters. Each waveform 61-65 relates to a unique physiological characteristic of the patient 70. For example, each of the patient's heartbeats generates electrical impulses that pass through the body near the speed of light, along with a pressure wave that propagates through the patient's vasculature at a significantly slower speed. Immediately after the heartbeat, the pressure wave leaves the heart 148 and aorta 149, passes through the subclavian artery 150 to the brachial artery 144, and from there through the radial and ulnar arteries 145 to smaller arteries in the patient's fingers. Three disposable electrodes 78 a-c attached to the patient's chest measure unique electrical signals which pass to a single-chip ECG circuit 83 that terminates a distal end of the ECG cable. Typically, these electrodes attach to the patient's chest in a conventional ‘Einthoven's triangle’ configuration featuring three unique ‘vectors’, each corresponding to a different lead (e.g. LEAD I, II, II). Related configurations can also be used when five and twelve-lead ECG systems are used in place of the three-lead system, as described below with reference to FIGS. 7A,B. Within the ECG circuit 83 signals are processed using an amplifier/filter circuit and analog-to-digital converter to generate a digital ECG waveform 61 corresponding to each lead. The ECG waveform 61 features a sharp, well-defined QRS complex corresponding to each heartbeat; this marks the initiation of the patient's cardiac cycle. Heart rate is determined directly from the ECG waveform 61 using known algorithms, such as those described in the following reference, the contents of which are incorporated herein by reference: ‘ECG Beat Detection Using Filter Banks’, Afonso et al., IEEE Trans. Biomed Eng., 46:192-202 (1999). Moon at [0063]

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	 Fig. 2  Fig. 3 Moon at Fig. 2 & 3 FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]

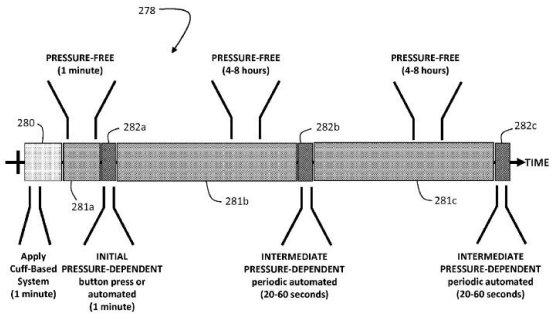
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	 Moon at Fig. 4A & 4B One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making	See claim 1 above. Moon discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal. To improve the safety of hospitalized patients, particularly those in lower-acuity areas, it is desirable to have a body-worn monitor that continuously measures a plurality of vital signs from a patient, and wirelessly transmits these directly to a nurse or to a central nursing station. Preferably the monitor operates algorithms featuring: 1) a low percentage of false positive alarms/alerts; and 2) a high

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decisions associated with at least a portion of the output signal.	percentage of true positive alarms/alerts. The term ‘alarm/alert’, as used herein, refers to an audio and/or visual alarm generated directly by a monitor worn on the patient's body, or alternatively a remote monitor (e.g., a central nursing station). To accomplish this, the invention provides a body-worn monitor that measures a patient's vital signs (e.g. blood pressure, SpO2, heart rate, respiratory rate, and temperature) while simultaneously characterizing their activity state (e.g. resting, walking, convulsing, falling) and posture (upright, supine). The body-worn monitor processes this information to minimize corruption of the vital signs and associated alarms/alerts by motion-related artifacts. Moon at [0011] In yet another aspect, the invention provides a body-worn monitor featuring a ‘hot swappable’ battery. Here, the transceiver operates an algorithm that performs the following steps: (b) display on a GUI that the battery needs to be replaced; (c) detect when a secondary device is plugged into one of the serial ports, the secondary device indicating that the battery is about to be replaced; (d) store settings corresponding to the wireless system (e.g. IP and/or MAC addresses, passwords, encryption keys) and the patient's vital signs in the non-volatile memory; and (e) indicate on the GUI that the battery can be replaced. Once this is done, the depleted battery is replaced with a new one, and a button on the GUI is pressed to resume a wireless connection to the hospital's network. Continuous monitoring of the patient resumes once this is complete. Typically the secondary device plugs into a serial port on the transceiver, and sends a serial packet over the CAN bus indicating the battery is ready to be swapped. Moon at [0028] The body-worn monitor can determine a patient's location in addition to their vital signs and motion-related properties. Typically, the location-determining sensor and the wireless transceiver operate on an industry-standard communications system, e.g. a wireless system based on 802.11, 802.15.4, or cellular protocols. In this case a location is determined by processing the wireless signal with one or more algorithms known in the art. These include, for example, triangulating signals received from at least three different wireless base stations, or simply estimating a location based on signal strength and proximity to a particular base station. In still other embodiments the location sensor includes a conventional global positioning system (GPS). Moon at [0029]

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	FIG. 1 shows a schematic drawing of a body-worn monitor 10 according to the invention featuring a wrist-worn transceiver 72 that continuously determines vital signs (e.g. blood pressure, SpO2, heart rate, respiratory rate, and temperature) and motion-related properties (e.g. posture, arm height, activity level, and degree of motion) for an ambulatory patient in a hospital. The monitor 10 is small, lightweight, and comfortably worn on the patient's body during their stay in the hospital; its form factor is described in detail below. A medical professional can apply the monitor, for example, to a recently admitted patient waiting in the ED, and the same monitor can provide continuous monitoring during their stay in the hospital. For example, the patient can wear the monitor in their hospital room, as they receive specific procedures or tests, during transport to other rooms, and even during surgery. The monitor 10 provides continuous monitoring, and features a software framework that determines alarms/alerts if the patient begins to decompensate. The framework processes both the patient's motion and their vital sign information with algorithms that reduce the occurrence of false alarms. Moon at [0054]  Fig. 1 Moon at Fig.1 A combination of features makes the body-worn monitor 10 ideal for ambulatory patients within the hospital. For example, its wrist-worn transceiver 72 features a wireless transmitter 24 that communicates through a hospital network to a computer (e.g. a portable tablet computer) at a central nursing station 43, and to a local computer 44 (e.g. a hand-held PDA) through a peer-to-peer connection. The specific mode

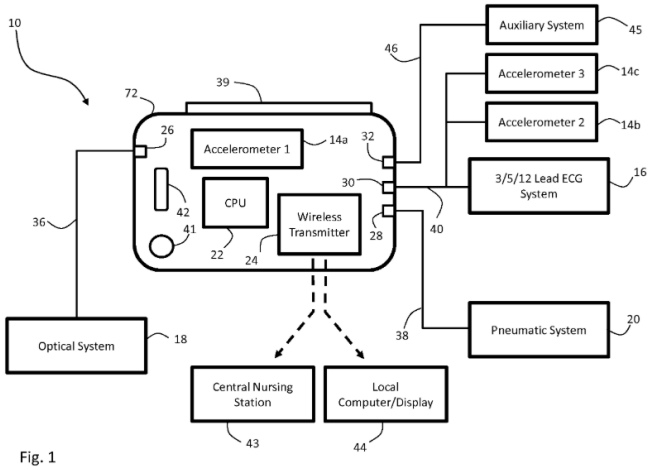
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	of communication can be determined automatically (using, e.g., a signal strength associated with the wireless connection), or manually through an icon on the GUI. Moon at [0055] Three separate digital accelerometers 14 a-c are non-obtrusively integrated into the monitor's form factor; two of them 14 b-c are located on the patient's body, separate from the wrist-worn transceiver 72, and send digitized, motion-related information through the CAN bus to the CPU 22. The first accelerometer 14 a is mounted on a circuit board within the transceiver 72, and monitors motion of the patient's wrist. The second accelerometer 14 b is incorporated directly into the cable 40 connecting the ECG system 16 to the transceiver 72 so that it can easily attach to the patient's bicep and measure motion and position of the patient's upper arm. As described below, this can be used to compensate for hydrostatic forces associated with changes in the patient's arm height that affect the monitor's blood pressure measurement, and can be additionally used to calibrate the monitor's blood pressure measurement through the patient's ‘natural’ motion. The third accelerometer 14 c is typically mounted to a circuit board that supports the ECG system 16 on the terminal end of the cable, and typically attaches to the patient's chest. Motion and position of the patient's chest can be used to determine their posture and activity states, which as described below can be used with vital signs for generating alarm/alerts. Each accelerometer 14 a-c measures three unique ACC waveforms, each corresponding to a separate axis (x, y, or z) representing a different component of the patient's motion. To determine posture, arm height, activity level, and degree of motion, the transceiver's CPU 22 processes signals from each accelerometer 14 a-c with a series of algorithms, described in the following pending patent applications, the contents of which are incorporated herein by reference: BODY-WORN MONITOR FEATURING ALARM SYSTEM THAT PROCESSES A PATIENT'S MOTION AND VITAL SIGNS (U.S.S.N 12/469,182; filed May 20, 2009) and BODY-WORN VITAL SIGN MONITOR WITH SYSTEM FOR DETECTING AND ANALYZING MOTION (U.S.S.N 12/469,094; filed May 20, 2009). In total, the CPU 22 can process nine unique, time-dependent signals (ACC1-9) corresponding to the three axes measured by the three separate accelerometers. Algorithms determine parameters such as the patient's posture (e.g., sitting, standing, walking, resting, convulsing, falling), the degree of motion, the specific orientation of the patient's arm and how this affects vital signs (particularly blood pressure), and whether or not time-dependent signals measured by the ECG 16, optical 18, or pneumatic 20 systems are corrupted by motion. Moon at [0059] During a measurement, the CPU in the wrist-worn transceiver determines the value of the resistor 149 by monitoring a voltage drop across it; this value, in turn, is compared to a value stored in memory to

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	select the appropriate coefficients relating a parameter called a ‘ratio of ratios’ (RoR) to SpO2. This calculation is described in detail in the above-referenced patent application describing SpO2, the contents of which have been incorporated herein by reference. The probe 94 generates alternating red and infrared radiation at 500 Hz that passes through the base of the patient's thumb 151, where it is partially absorbed by underlying vasculature according to the patient's heart rate and SpO2 values. Radiation that transmits through the thumb 151 illuminates a photodiode 155 that, in response, generates a photocurrent varying in magnitude with the degree of optical absorption in the patient's thumb. An amplifier circuit 140 beginning with a transimpedance amplifier 156 receives the photocurrent and converts it to a corresponding voltage which is then amplified and filtered to generate the PPGs waveforms with both red and infrared wavelengths used to determine SpO2 and cNIBP. Moon at [0090] Upon completion of the measurement, the wrist-worn transceiver 72 receives all the CAN packets 201 a-d, and synchronizes them in time according to the sequence number 212 a-d and identifier 210 a-d in the initial portions 216 of each packet. Every second, the CPU updates the time-dependent waveforms and calculates the patient's vital signs and motion-related properties, as described above. Typically these values are calculated as a ‘rolling average’ with an averaging window ranging from 10-20 seconds. The rolling average is typically updated every second, resulting in a new value that is displayed on the wrist-worn transceiver 72. Each packet received by the transceiver 72 is also wirelessly retransmitted as a new packet 201 b′ to a remote computer 43 connected to an in-hospital network. The new packet 201 b′ includes the same header information 210 b′, 212 b′ and data field information 214 b′ as the CAN packets transmitted between systems within the body-worn monitor. Also transmitted are additional packets encoding the cNIBP, SpO2, and processed motion states (e.g. posture, activity level, degree of motion), which unlike heart rate and SYS, DIA, and MAP are calculated by the CPU in the wrist-worn transceiver. Upon receipt of the packet 201 b′, the remote computer 43 displays vital signs, waveforms, motion information, and alarms/alerts, typically with a large monitor that is easily viewed by a medical professional. Additionally the remote computer 43 can send information through the hospital network (e.g. in the case of an alarm/alert), and store information in an internal database. Moon at [0103] The initial, approximate value for the patient's blood pressure and heart rate determined during the first pressure-free measurement (step 281 a) can then be used to set certain parameters during the following first pressure-dependent measurement (step 282 a). Knowledge of these parameters may ultimately

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	increase the accuracy of the initial pressure-dependent measurement (step 282 a). Such parameters, for example, may include inflation time and rate, fitting parameters for determining the time-dependent increase in PTT and the time-dependent decrease in PPG waveform amplitude during the pressure-dependent measurement. Of particular importance is an accurate value of the patient's heart rate determined during the first pressure-free measurement (step 281 a). Since both PTT and amplitude can only be measured from a pulse induced by a heartbeat, the algorithm can process heart rate and use it in the fitting process to accurately determine the pressure at which the PPG waveform amplitude crosses zero. Using parameters such as heart rate and initial estimated blood pressure, the first pressure-dependent measurement (step 282 a) determines a relationship between PTT and blood pressure as described above. This takes about 60 seconds. This measurement may occur automatically (e.g., after about 1 minute), or may be driven by the medical professional (e.g., through a button press). The microprocessor then uses this relationship and a measured value of PTT to determine blood pressure during the following pressure-free measurement (step 281 b). This measurement step typically proceeds for a well-defined period of time (typically 4-8 hours), during which it continuously determines blood pressure. Typically, the body sensor averages PTT values over a 10-20 second period, and displays a new blood pressure measurement every second using a rolling average. Moon at [0113-0114]  Fig. 16 Moon at Fig.16

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	The microprocessor may also perform a pre-programmed or automated intermediate pressure-dependent measurement (step 282 b) to correct any drift in the blood pressure measurement. This measurement is similar to the initial pressure-dependent measurement 282 a. At some later time, if the patient experiences a sudden change in other vital signs (e.g., respiratory rate, heart rate, body temperature), the CPU in the wrist-worn transceiver may analyze this condition and initiate another pressure-dependent blood pressure measurement (step 282 c) to most accurately determine the patient's blood pressure. Moon at [0115] In another aspect, the invention provides a body-worn vital sign monitor featuring a processing component that includes a system for detecting an identifying code from a medical professional, and in response rendering a specific graphical user interface (GUI) on the wrist-worn transceiver. Preferably the system for detecting an identifying code is a barcode scanner, and the identifying code is a barcode printed on, e.g., the badge of the medical professional. Alternatively, a system based on radio-frequency identifying codes (RFID) is used in place of the barcode scanner. In still other embodiments the identifying code is simply an alphanumeric password entered into a GUI on the transceiver by the medical professional. In all cases, the identifying code prompts the transceiver to render a GUI that is appropriate for the medical professional, but not necessarily for the patient. Such a GUI may include, for example, time-domain waveforms, vital sign information, and parameters relating to alarms/alerts. The GUI for the patient is typically much simpler, and includes information such as the time of day and a ‘nurse call’ button. To support this feature, the wrist-worn transceiver typically includes a speaker and system for communicating over the hospital's wireless network using standard voice over IP (VOIP) protocols. The speaker can also play pre-recorded messages that may be germane to the patient. Moon at [0125] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	

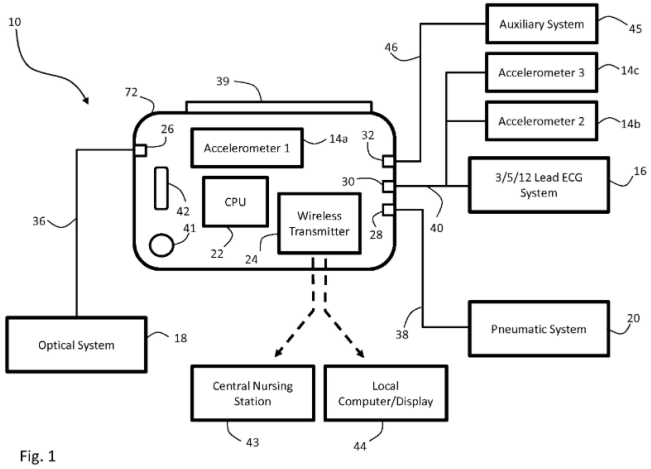
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6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	See claim 1 above. Moon discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. Typically the optical signal is generated with an optical sensor configured to be worn around the patient's thumb. PTT is typically calculated from a time difference separating a QRS complex in the ECG waveform and a foot of a PPG waveform. In other embodiments the same optical sensor used to measure the optical waveform features a first LED operating in the red spectral range, and a second LED operating in the infrared spectral range. Optical waveforms measured with these LEDs can additionally be processed to determine SpO2, as is described in detail below. Moon at [0023] The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is ‘distributed’ on the patient to minimize the bulk and weight normally associated with conventional vital sign monitors, which typically incorporate all electronics associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an

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	ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. Moon at [0056] To determine blood pressure, the transceiver 72 processes ECG and PPG waveforms measured, respectively, by the ECG 16 and optical 18 systems. The optical system 18 features a thumb-worn sensor that includes LEDs operating in the red (λ˜660 nm) and infrared (λ˜900 nm) spectral regions, and a photodetector that detects their radiation after it passes through arteries within the patient's thumb. The ECG waveform, as described above, is digitized and sent over the CAN interface to the wrist-worn transceiver 72, while the PPG waveform is transmitted in an analog form and digitized by an analog-to-digital converter within the transceiver's circuit board. The pneumatic system 20 provides a digitized pressure waveform and oscillometric blood pressure measurements (SYS, DIA, and MAP) through the CAN interface; these are processed by the CPU 22 to make cuff-based ‘indexing’ blood pressure measurements according to the Composite Technique. The indexing measurement typically only takes about 40-60 seconds, after which the pneumatic system 20 is unplugged from its connector 28 so that the patient can move within the hospital without wearing an uncomfortable cuff-based system. Moon at [0060]  Fig. 1 Moon at Fig.1

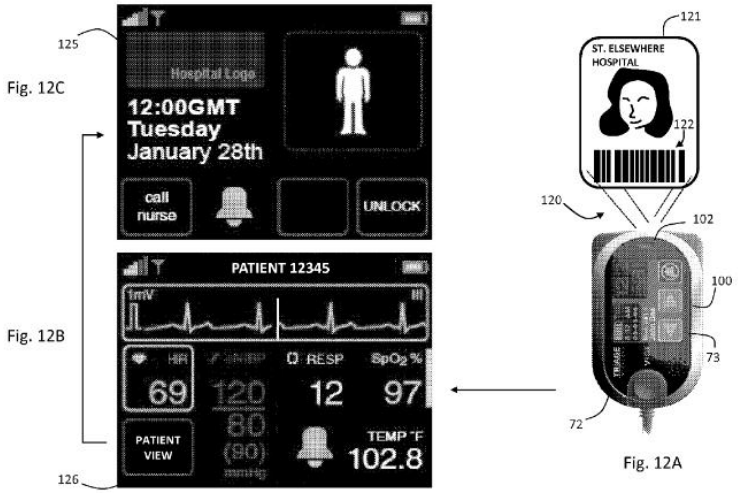
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	The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency

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	noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons	See claim 6 above. Moon discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. The body-worn monitor features a series of sensors that attach to the patient to measure time-dependent PPG, ECG, accelerometer-based motion (ACC), oscillometric (OSC), respiratory rate (RR), and impedance pneumography (IP) waveforms. A microprocessor (CPU) within the monitor continuously processes these waveforms to determine the patient's vital signs, degree of motion, posture and activity level. Sensors that measure these signals typically send digitized information to a wrist-worn transceiver

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or knobs, a microprocessor, and a touch screen.	through a serial interface, or bus, operating on a controlled area network (CAN) protocol. The CAN bus is typically used in the automotive industry, which allows different electronic systems to effectively and robustly communicate with each other with a small number of dropped packets, even in the presence of electrically noisy environments. This is particularly advantageous for ambulatory patients that may generate signals with large amounts of motion-induced noise. Moon at [0013] The wrist-worn transceiver can communicate with a remote device through a wireless connection that operates on the hospital's wireless network, or alternatively through a peer-to-peer connection. In another aspect of the invention, for example, the remote device is configured to simultaneously display vital signs for each patient in a group when a signal strength corresponding to each wrist-worn transceiver in the group is below a pre-determined threshold value. When the signal strength from the wireless system worn by a patient exceeds the pre-determine threshold, the remote monitor displays information for that particular patient. Such a situation would occur, for example, if a tablet computer normally disposed at a central nursing station was brought into the patient's room. Typically the pre-determined threshold value is between about −100 and −80 dB, and the wireless system used by each wrist-worn transceiver operates on an industry-standard communications protocol, preferably selected from 802.11, 802.15.4, and cellular wireless protocols. In embodiments, the remote device is a device comprising a microprocessor, a display, and a compatible communications transceiver. Examples include a computing device selected from the group consisting of a desktop computer, a portable computer, a tablet computer, a cellular telephone, and a personal digital assistant. This list is not meant to be limiting. Moon at [0027] A combination of features makes the body-worn monitor 10 ideal for ambulatory patients within the hospital. For example, its wrist-worn transceiver 72 features a wireless transmitter 24 that communicates through a hospital network to a computer (e.g. a portable tablet computer) at a central nursing station 43, and to a local computer 44 (e.g. a hand-held PDA) through a peer-to-peer connection. The specific mode of communication can be determined automatically (using, e.g., a signal strength associated with the wireless connection), or manually through an icon on the GUI. Moon at [0055]

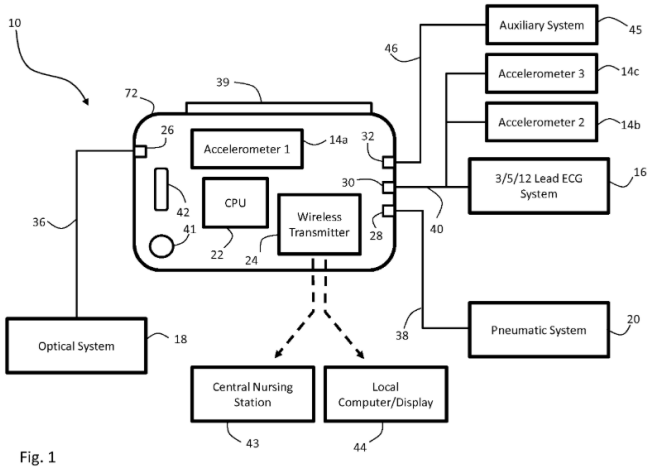
’475 Patent	Moon
	The body-worn monitor 10 features a wrist-worn transceiver 72 with a touch panel interface 73 that displays numerical values for all the vital signs. A wrist strap 90 affixes the transceiver 72 to the patient's wrist like a conventional wristwatch. A five-wire cable 92 connects the transceiver 72 to an optical sensor 94 that wraps around the base of the patient's thumb. During a measurement, the optical sensor 94 generates a time-dependent PPG which is processed along with an ECG to measure cNIBP and SpO2, as described above. Moon at [0073]  Moon at Fig.1 The transceiver 72 attaches to the patient's wrist using a flexible strap 90 which threads through two D-ring openings in the plastic housing 106. The strap 90 features mated Velcro patches on each side that secure it to the patient's wrist during operation. The transceiver 72 houses the circuits 175, 140 described in FIGS. 9B and 10 and, as shown in FIG. 5C, additionally features a touchpanel display 100 that renders a GUI 73. The GUI 72, for example, can be altered depending on the viewer (typically the patient or a medical professional). These features are described in more detail with reference to FIGS. 12A-12C. Moon at [0078] Referring to FIGS. 12A-C, the transceiver 72 features a touchpanel display 100 that renders a multi-window GUI 73 which can be tailored to both medical professionals and the patient. To select the

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	appropriate GUI, the transceiver 72 includes a small-scale infrared barcode scanner 102 that emits radiation 120 to scan a barcode 122 worn on a badge 121 of a medical professional. Information encoded on the barcode 122 is compared to a database stored within the transceiver 72 to indicate, for example, that a nurse or doctor is viewing the user interface. This database can be updated through the hospital's network. In response, the GUI 73 displays vital sign data, waveforms, alarms/alerts and other medical diagnostic information appropriate for medical professionals, as shown by the screen 126 in FIG. 12B. Using this GUI 73, the medical professional can view the vital sign information, set alarm parameters, and enter information about the patient (e.g. their posture, demographic information, medication, or medical condition). The nurse can press a ‘Patient View’ button on the GUI 73 indicating that these operations are complete. The patient view is shown by the screen 125 in FIG. 12C, and purposefully lacks any content related to vital signs. Instead is designed to be relatively generic, featuring the time, date, and icons indicating the patient's activity level, whether or not an alarm has been generated, battery life, and wireless signal strength. The GUI also features a graphical ‘call nurse’ button that, once depressed, wirelessly sends a signal to the central nursing station indicating that the patient needs assistance from a nurse. The patient view screen 125 includes a button labeled ‘UNLOCK’ that, once activated, allows a nurse or doctor to activate the medical professional view 126 shown in FIG. 11B. Tapping the UNLOCK button powers the barcode scanner in the body-worn monitor; this scans a barcode printed on a badge of the nurse of doctor, as described above, and prompts the monitor to render the medical professional view screen 126, shown in FIG. 12B. Moon at [0104]

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	 Fig. 12C Fig. 12B Fig. 12A Moon at Fig. 12A,12B & 12C Using parameters such as heart rate and initial estimated blood pressure, the first pressure-dependent measurement (step 282 a) determines a relationship between PTT and blood pressure as described above. This takes about 60 seconds. This measurement may occur automatically (e.g., after about 1 minute), or may be driven by the medical professional (e.g., through a button press). The microprocessor then uses this relationship and a measured value of PTT to determine blood pressure during the following pressure-free measurement (step 281 b). This measurement step typically proceeds for a well-defined period of time (typically 4-8 hours), during which it continuously determines blood pressure. Typically, the body sensor averages PTT values over a 10-20 second period, and displays a new blood pressure measurement every second using a rolling average. Moon at [0114] The microprocessor may also perform a pre-programmed or automated intermediate pressure-dependent measurement (step 282 b) to correct any drift in the blood pressure measurement. This measurement is

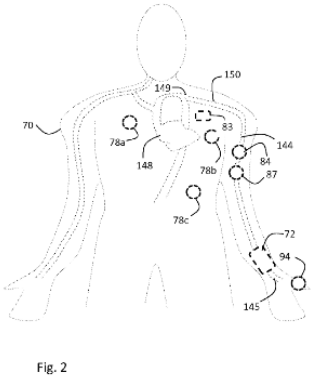
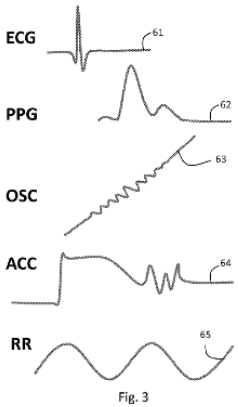
’475 Patent	Moon
	similar to the initial pressure-dependent measurement 282 a. At some later time, if the patient experiences a sudden change in other vital signs (e.g., respiratory rate, heart rate, body temperature), the CPU in the wrist-worn transceiver may analyze this condition and initiate another pressure-dependent blood pressure measurement (step 282 c) to most accurately determine the patient's blood pressure. Moon at [0115] In another aspect, the invention provides a body-worn vital sign monitor featuring a processing component that includes a system for detecting an identifying code from a medical professional, and in response rendering a specific graphical user interface (GUI) on the wrist-worn transceiver. Preferably the system for detecting an identifying code is a barcode scanner, and the identifying code is a barcode printed on, e.g., the badge of the medical professional. Alternatively, a system based on radio-frequency identifying codes (RFID) is used in place of the barcode scanner. In still other embodiments the identifying code is simply an alphanumeric password entered into a GUI on the transceiver by the medical professional. In all cases, the identifying code prompts the transceiver to render a GUI that is appropriate for the medical professional, but not necessarily for the patient. Such a GUI may include, for example, time-domain waveforms, vital sign information, and parameters relating to alarms/alerts. The GUI for the patient is typically much simpler, and includes information such as the time of day and a ‘nurse call’ button. To support this feature, the wrist-worn transceiver typically includes a speaker and system for communicating over the hospital's wireless network using standard voice over IP (VOIP) protocols. The speaker can also play pre-recorded messages that may be germane to the patient. Moon at [0125] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Moon discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising.

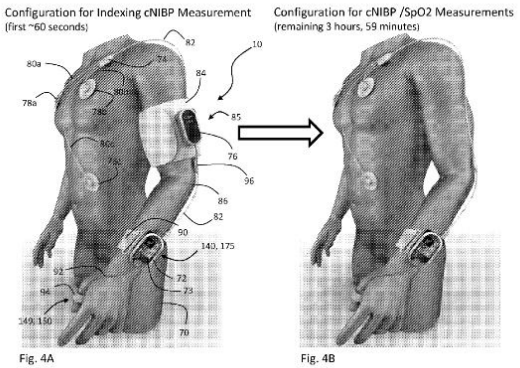
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	The invention provides a body-worn monitor featuring a processing system that receives a digital data stream from an ECG system. A cable houses the ECG system at one terminal end, and plugs into the processing system, which is worn on the patient's wrist like a conventional wristwatch. The ECG system features: i) a connecting portion connected to multiple electrodes worn by the patient; ii) a differential amplifier that receives electrical signals from each electrode and process them to generate an analog ECG waveform; iii) an analog-to-digital converter that converts the analog ECG waveform into a digital ECG waveform; and iv) a transceiver that transmits a digital data stream representing the digital ECG waveform (or information calculated from the waveform) through the cable and to the processing system. Different ECG systems, typically featuring three, five, or twelve electrodes, can be interchanged with one another. Moon at [Abstract] The body-worn monitor features a series of sensors that attach to the patient to measure time-dependent PPG, ECG, accelerometer-based motion (ACC), oscillometric (OSC), respiratory rate (RR), and impedance pneumography (IP) waveforms. A microprocessor (CPU) within the monitor continuously processes these waveforms to determine the patient's vital signs, degree of motion, posture and activity level. Sensors that measure these signals typically send digitized information to a wrist-worn transceiver through a serial interface, or bus, operating on a controlled area network (CAN) protocol. The CAN bus is typically used in the automotive industry, which allows different electronic systems to effectively and robustly communicate with each other with a small number of dropped packets, even in the presence of electrically noisy environments. This is particularly advantageous for ambulatory patients that may generate signals with large amounts of motion-induced noise. Moon at [0013] Blood pressure, a vital sign that is particularly useful for characterizing a patient's condition, is typically calculated from a PTT value determined from the PPG and ECG waveforms. Once determined, blood pressure and other vital signs can be further processed, typically with a server within a hospital, to alert a medical professional if the patient begins to decompensate. Moon at [0014] FIG. 1 shows a schematic drawing of a body-worn monitor 10 according to the invention featuring a wrist-worn transceiver 72 that continuously determines vital signs (e.g. blood pressure, SpO2, heart rate,

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	respiratory rate, and temperature) and motion-related properties (e.g. posture, arm height, activity level, and degree of motion) for an ambulatory patient in a hospital. The monitor 10 is small, lightweight, and comfortably worn on the patient's body during their stay in the hospital; its form factor is described in detail below. A medical professional can apply the monitor, for example, to a recently admitted patient waiting in the ED, and the same monitor can provide continuous monitoring during their stay in the hospital. For example, the patient can wear the monitor in their hospital room, as they receive specific procedures or tests, during transport to other rooms, and even during surgery. The monitor 10 provides continuous monitoring, and features a software framework that determines alarms/alerts if the patient begins to decompensate. The framework processes both the patient's motion and their vital sign information with algorithms that reduce the occurrence of false alarms. Moon at [0054]  Moon at Fig.1 A combination of features makes the body-worn monitor 10 ideal for ambulatory patients within the hospital. For example, its wrist-worn transceiver 72 features a wireless transmitter 24 that communicates through a hospital network to a computer (e.g. a portable tablet computer) at a central nursing station 43, and to a local computer 44 (e.g. a hand-held PDA) through a peer-to-peer connection. The specific mode of communication can be determined automatically (using, e.g., a signal strength associated with the wireless connection), or manually through an icon on the GUI. Moon at [0055]

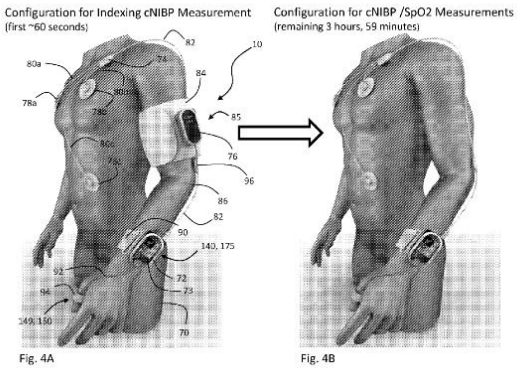
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	The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is ‘distributed’ on the patient to minimize the bulk and weight normally associated with conventional vital sign monitors, which typically incorporate all electronics associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. The ECG 16, pneumatic 20, and auxiliary 45 systems are stand-alone systems that include a separate CPU, analog-to-digital converter, and CAN transceiver. During a measurement, they connect to the transceiver 72 through cables 40, 38, 46 and connectors 30, 28, 32 to supply digital inputs over the CAN bus. The ECG system 16, for example, is completely embedded in a terminal portion of its associated cable. Systems for three, five, and twelve-lead ECG monitoring can be swapped in an out simply by plugging the appropriate cable (which includes the ECG system 16) into a CAN connector 30 on the wrist-worn transceiver 72, and the attaching associated electrodes to the patient's body. The wrist-worn transceiver 72 renders separate GUIs that can be selected for a particular viewer, e.g., different displays directed to the patient as compared to a medical professional. To do this, the transceiver 72 includes a barcode scanner 42 that can scan an identifying barcode printed, e.g., on the medical

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	professional's badge, which indicates the viewer's identity or type to the system. In response, the system renders a GUI featuring information (e.g. vital signs, waveforms) tailored for the indicated viewer; that is, a medical professional can receive information on the GUI that may not be suitable for viewing by the patient. So that the patient can communicate with the medical professional, the transceiver 72 includes a speaker 41 interfaced to the CPU 22 and wireless system 24 that allows the patient to communicate with a remote medical professional using a standard VOIP protocol. A Li:ion battery 39 powers the transceiver 72 for about four days on a single charge, and can be removed in a ‘hot swap’ manner so that after the battery change the transceiver remains wirelessly connected to the hospital's network and no information is lost. This is done simply by plugging a specialized ‘dongle’ into the CAN connector 32 for the auxiliary system 45, replacing the battery 39, and then removing the dongle. Moon at [0056-0058] FIGS. 2 and 3 show how a network of sensors 78 a-c, 83, 84, 87, 94 within the body-worn monitor 10 connect to a patient 70 to characterize them within a hospital. During a measurement, the sensors 78 a-c, 83, 84, 87, 94 measure signals that are processed by the monitor 10 to generate time-dependent ECG 61, PPG 62, OSC 63, ACC 64, and RR 65 waveforms. These, in turn, yield the patient's vital signs and motion parameters. Each waveform 61-65 relates to a unique physiological characteristic of the patient 70. For example, each of the patient's heartbeats generates electrical impulses that pass through the body near the speed of light, along with a pressure wave that propagates through the patient's vasculature at a significantly slower speed. Immediately after the heartbeat, the pressure wave leaves the heart 148 and aorta 149, passes through the subclavian artery 150 to the brachial artery 144, and from there through the radial and ulnar arteries 145 to smaller arteries in the patient's fingers. Three disposable electrodes 78 a-c attached to the patient's chest measure unique electrical signals which pass to a single-chip ECG circuit 83 that terminates a distal end of the ECG cable. Typically, these electrodes attach to the patient's chest in a conventional ‘Einthoven's triangle’ configuration featuring three unique ‘vectors’, each corresponding to a different lead (e.g. LEAD I, II, II). Related configurations can also be used when five and twelve-lead ECG systems are used in place of the three-lead system, as described below with reference to FIGS. 7A,B. Within the ECG circuit 83 signals are processed using an amplifier/filter circuit and analog-to-digital converter to generate a digital ECG waveform 61 corresponding to each lead. The ECG waveform 61 features a sharp, well-defined QRS complex corresponding to each heartbeat; this marks the initiation of the patient's cardiac cycle. Heart rate is determined directly from the ECG waveform 61 using known algorithms, such as those described in the following reference, the contents of which are incorporated herein by reference: ‘ECG Beat Detection Using Filter Banks’, Afonso et al., IEEE Trans. Biomed Eng., 46:192-202 (1999). Moon at [0063]

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	 Fig. 2  Fig. 3 Moon at Fig. 2 & 3 FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]

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	 Moon at Fig. 4A & 4B One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Moon discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;. The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb

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	according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]

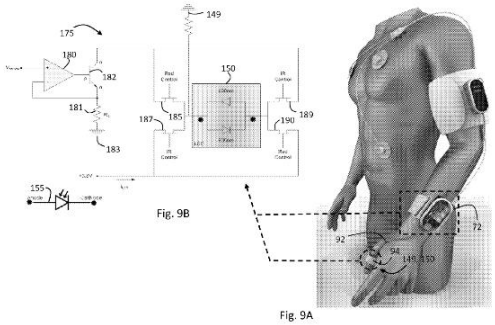
’475 Patent	Moon
	 Moon at Fig. 4A & 4B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control

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	lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081] The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Moon discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. In other embodiments, PTT can be calculated from time-dependent waveforms other than the ECG and PPG, and then processed to determine blood pressure. In general, PTT can be calculated by measuring a temporal separation between features in two or more time-dependent waveforms measured from the human body. For example, PTT can be calculated from two separate PPGs measured by different optical sensors disposed on the patient's fingers, wrist, arm, chest, or virtually any other location where an optical signal can be measured using a transmission or reflection-mode optical configuration. In other embodiments, PTT can be calculated using at least one time-dependent waveform measured with an acoustic sensor, typically disposed on the patient's chest. Or it can be calculated using at least one time-dependent waveform measured using a pressure sensor, typically disposed on the patient's bicep, wrist, or finger. The pressure sensor can include, for example, a pressure transducer, piezoelectric sensor, actuator, polymer material, or inflatable cuff. Moon at [0015] The system can also connect through one of its serial ports to an ancillary third system that can be, for example, a system that delivers a compound or other therapeutic intervention to the patient, or that can gather other data from the patient. Such systems include infusion pumps, insulin pumps, hemodialysis machines, glucometers, and systems for delivering oxygen, such as a mechanical ventilator. This list is not meant to be limiting. In the case of a therapeutic compound, the data portion of the packet can indicate the type of compound delivered to the patient, a dosage of the compound, and a rate of delivery of the compound. The third system can also be a sensor configured to measure a signal from the patient. Such sensors include, for example, a pulse oximeter, EEG monitor, temperature sensor, respiratory rate sensor, motion sensor, camera, impedance plethysmography sensor, optical spectrometer, and skin-conductance sensor. Again, this list is not meant to be limiting. Here, the data portion of the packet can include waveform information, heart rate, pulse rate, SpO2 value, EEG waveform, temperature, respiratory rate, degree of motion, posture, activity level, arm height, an image, a property of the patient measurable optically, and a property of the patient measurable electrically.

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	Moon at [0019] The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is ‘distributed’ on the patient to minimize the bulk and weight normally associated with conventional vital sign monitors, which typically incorporate all electronics associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. Moon at [0056] The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is

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	irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control

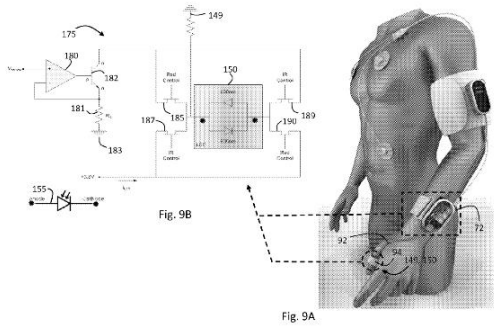
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	lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081]  Moon at Fig. 9A & 9B The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a

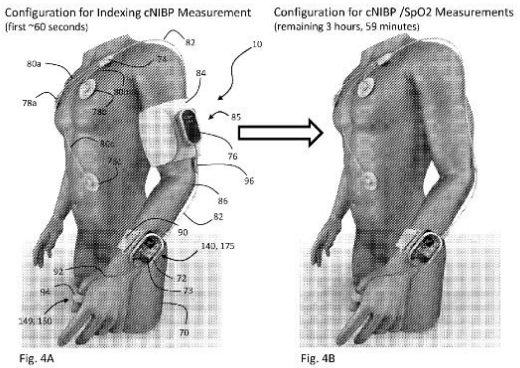
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	standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Moon discloses or renders obvious a detector. To determine blood pressure, the transceiver 72 processes ECG and PPG waveforms measured, respectively, by the ECG 16 and optical 18 systems. The optical system 18 features a thumb-worn sensor that includes LEDs operating in the red (λ˜660 nm) and infrared (λ˜900 nm) spectral regions, and a photodetector that detects their radiation after it passes through arteries within the patient's thumb. The ECG waveform, as described above, is digitized and sent over the CAN interface to the wrist-worn transceiver 72, while the PPG waveform is transmitted in an analog form and digitized by an analog-to-digital converter within the transceiver's circuit board. The pneumatic system 20 provides a digitized pressure waveform and oscillometric blood pressure measurements (SYS, DIA, and MAP) through the CAN interface; these are processed by the CPU 22 to make cuff-based ‘indexing’ blood pressure measurements according to the Composite Technique. The indexing measurement typically only takes about 40-60 seconds, after which the pneumatic system 20 is unplugged from its connector 28 so that the patient can move within the hospital without wearing an uncomfortable cuff-based system. Moon at [0060]

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	The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-

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	worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0089] During a measurement, the CPU in the wrist-worn transceiver determines the value of the resistor 149 by monitoring a voltage drop across it; this value, in turn, is compared to a value stored in memory to select the appropriate coefficients relating a parameter called a ‘ratio of ratios’ (RoR) to SpO2. This calculation is described in detail in the above-referenced patent application describing SpO2, the contents of which have been incorporated herein by reference. The probe 94 generates alternating red and infrared radiation at 500 Hz that passes through the base of the patient's thumb 151, where it is partially absorbed by underlying vasculature according to the patient's heart rate and SpO2 values. Radiation that transmits through the thumb 151 illuminates a photodiode 155 that, in response, generates a photocurrent varying in magnitude with the degree of optical absorption in the patient's thumb. An amplifier circuit 140 beginning with a transimpedance amplifier 156 receives the photocurrent and converts it to a corresponding voltage which is then amplified and filtered to generate the PPGs waveforms with both red and infrared wavelengths used to determine SpO2 and cNIBP. Moon at [0090] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

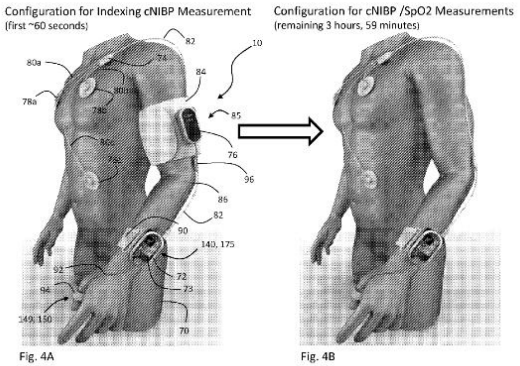
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8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Moon discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065]

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	 Fig. 9B Fig. 9A Moon at Fig. 9A & 9B FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]

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	 Moon at Fig. 4A & 4B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control

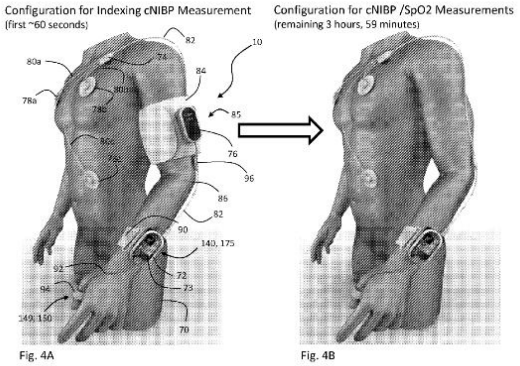
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	lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081] The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Moon discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the

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	patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]  Moon at Fig. 4A & 4B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185,

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	190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081] The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process

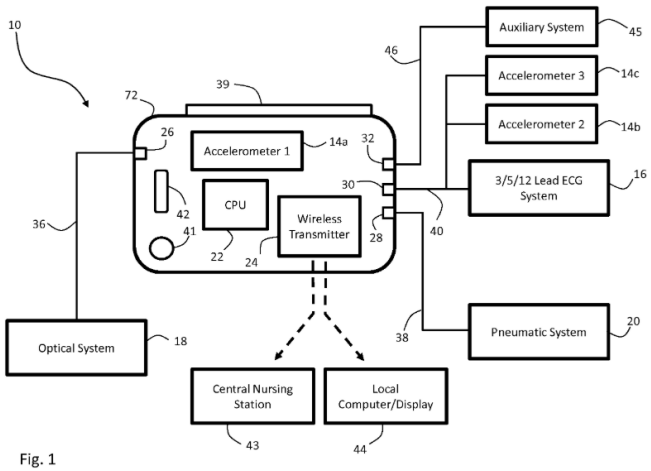
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	results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	Moon discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-

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	mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]  Moon at Fig. 4A & 4B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94

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	includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081] The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to

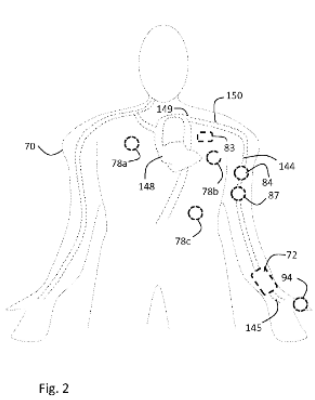
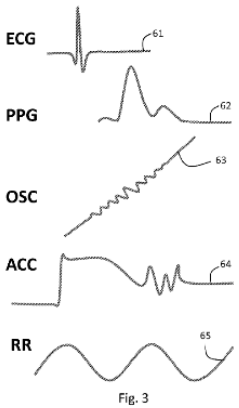
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	generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.	Moon discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user. The invention provides a body-worn monitor featuring a processing system that receives a digital data stream from an ECG system. A cable houses the ECG system at one terminal end, and plugs into the processing system, which is worn on the patient's wrist like a conventional wristwatch. The ECG system features: i) a connecting portion connected to multiple electrodes worn by the patient; ii) a differential amplifier that receives electrical signals from each electrode and process them to generate an analog ECG waveform; iii) an analog-to-digital converter that converts the analog ECG waveform into a digital ECG waveform; and iv) a transceiver that transmits a digital data stream representing the digital ECG waveform (or information calculated from the waveform) through the cable and to the processing system. Different ECG systems, typically featuring three, five, or twelve electrodes, can be interchanged with one another. Moon at [Abstract]

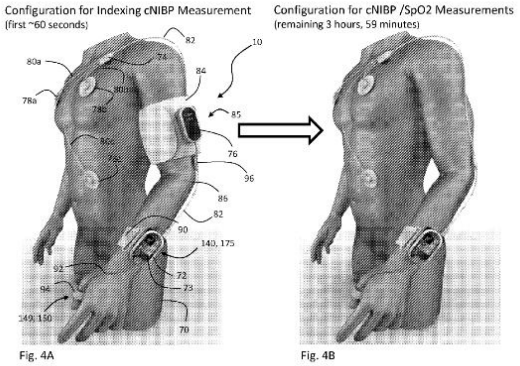
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	The body-worn monitor features a series of sensors that attach to the patient to measure time-dependent PPG, ECG, accelerometer-based motion (ACC), oscillometric (OSC), respiratory rate (RR), and impedance pneumography (IP) waveforms. A microprocessor (CPU) within the monitor continuously processes these waveforms to determine the patient's vital signs, degree of motion, posture and activity level. Sensors that measure these signals typically send digitized information to a wrist-worn transceiver through a serial interface, or bus, operating on a controlled area network (CAN) protocol. The CAN bus is typically used in the automotive industry, which allows different electronic systems to effectively and robustly communicate with each other with a small number of dropped packets, even in the presence of electrically noisy environments. This is particularly advantageous for ambulatory patients that may generate signals with large amounts of motion-induced noise. Moon at [0013] Blood pressure, a vital sign that is particularly useful for characterizing a patient's condition, is typically calculated from a PTT value determined from the PPG and ECG waveforms. Once determined, blood pressure and other vital signs can be further processed, typically with a server within a hospital, to alert a medical professional if the patient begins to decompensate. Moon at [0014] FIG. 1 shows a schematic drawing of a body-worn monitor 10 according to the invention featuring a wrist-worn transceiver 72 that continuously determines vital signs (e.g. blood pressure, SpO2, heart rate, respiratory rate, and temperature) and motion-related properties (e.g. posture, arm height, activity level, and degree of motion) for an ambulatory patient in a hospital. The monitor 10 is small, lightweight, and comfortably worn on the patient's body during their stay in the hospital; its form factor is described in detail below. A medical professional can apply the monitor, for example, to a recently admitted patient waiting in the ED, and the same monitor can provide continuous monitoring during their stay in the hospital. For example, the patient can wear the monitor in their hospital room, as they receive specific procedures or tests, during transport to other rooms, and even during surgery. The monitor 10 provides continuous monitoring, and features a software framework that determines alarms/alerts if the patient begins to decompensate. The framework processes both the patient's motion and their vital sign information with algorithms that reduce the occurrence of false alarms. Moon at [0054]

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	 Fig. 1 Moon at Fig.1 A combination of features makes the body-worn monitor 10 ideal for ambulatory patients within the hospital. For example, its wrist-worn transceiver 72 features a wireless transmitter 24 that communicates through a hospital network to a computer (e.g. a portable tablet computer) at a central nursing station 43, and to a local computer 44 (e.g. a hand-held PDA) through a peer-to-peer connection. The specific mode of communication can be determined automatically (using, e.g., a signal strength associated with the wireless connection), or manually through an icon on the GUI. Moon at [0055] The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is ‘distributed’ on the patient to minimize the bulk and weight normally associated with conventional vital sign monitors, which typically incorporate all electronics associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low

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	signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. The ECG 16, pneumatic 20, and auxiliary 45 systems are stand-alone systems that include a separate CPU, analog-to-digital converter, and CAN transceiver. During a measurement, they connect to the transceiver 72 through cables 40, 38, 46 and connectors 30, 28, 32 to supply digital inputs over the CAN bus. The ECG system 16, for example, is completely embedded in a terminal portion of its associated cable. Systems for three, five, and twelve-lead ECG monitoring can be swapped in an out simply by plugging the appropriate cable (which includes the ECG system 16) into a CAN connector 30 on the wrist-worn transceiver 72, and the attaching associated electrodes to the patient's body. The wrist-worn transceiver 72 renders separate GUIs that can be selected for a particular viewer, e.g., different displays directed to the patient as compared to a medical professional. To do this, the transceiver 72 includes a barcode scanner 42 that can scan an identifying barcode printed, e.g., on the medical professional's badge, which indicates the viewer's identity or type to the system. In response, the system renders a GUI featuring information (e.g. vital signs, waveforms) tailored for the indicated viewer; that is, a medical professional can receive information on the GUI that may not be suitable for viewing by the patient. So that the patient can communicate with the medical professional, the transceiver 72 includes a speaker 41 interfaced to the CPU 22 and wireless system 24 that allows the patient to communicate with a remote medical professional using a standard VOIP protocol. A Li:ion battery 39 powers the transceiver 72 for about four days on a single charge, and can be removed in a ‘hot swap’ manner so that after the battery change the transceiver remains wirelessly connected to the hospital's network and no information is lost. This is done simply by plugging a specialized ‘dongle’ into the CAN connector 32 for the auxiliary system 45, replacing the battery 39, and then removing the dongle. Moon at [0056-0058]

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	FIGS. 2 and 3 show how a network of sensors 78 a-c, 83, 84, 87, 94 within the body-worn monitor 10 connect to a patient 70 to characterize them within a hospital. During a measurement, the sensors 78 a-c, 83, 84, 87, 94 measure signals that are processed by the monitor 10 to generate time-dependent ECG 61, PPG 62, OSC 63, ACC 64, and RR 65 waveforms. These, in turn, yield the patient's vital signs and motion parameters. Each waveform 61-65 relates to a unique physiological characteristic of the patient 70. For example, each of the patient's heartbeats generates electrical impulses that pass through the body near the speed of light, along with a pressure wave that propagates through the patient's vasculature at a significantly slower speed. Immediately after the heartbeat, the pressure wave leaves the heart 148 and aorta 149, passes through the subclavian artery 150 to the brachial artery 144, and from there through the radial and ulnar arteries 145 to smaller arteries in the patient's fingers. Three disposable electrodes 78 a-c attached to the patient's chest measure unique electrical signals which pass to a single-chip ECG circuit 83 that terminates a distal end of the ECG cable. Typically, these electrodes attach to the patient's chest in a conventional ‘Einthoven's triangle’ configuration featuring three unique ‘vectors’, each corresponding to a different lead (e.g. LEAD I, II, II). Related configurations can also be used when five and twelve-lead ECG systems are used in place of the three-lead system, as described below with reference to FIGS. 7A,B. Within the ECG circuit 83 signals are processed using an amplifier/filter circuit and analog-to-digital converter to generate a digital ECG waveform 61 corresponding to each lead. The ECG waveform 61 features a sharp, well-defined QRS complex corresponding to each heartbeat; this marks the initiation of the patient's cardiac cycle. Heart rate is determined directly from the ECG waveform 61 using known algorithms, such as those described in the following reference, the contents of which are incorporated herein by reference: ‘ECG Beat Detection Using Filter Banks’, Afonso et al., IEEE Trans. Biomed Eng., 46:192-202 (1999). Moon at [0063]

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	 Fig. 2  Fig. 3 Moon at Fig. 2 & 3 The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-

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	mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]  Moon at Fig. 4A & 4B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94

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	includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081] The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to

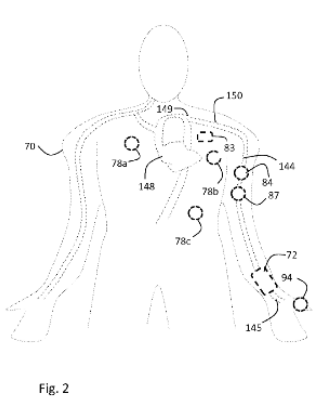
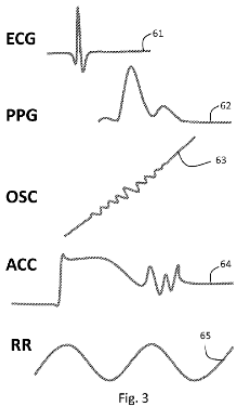
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	generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. Moon discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. To determine blood pressure, the transceiver 72 processes ECG and PPG waveforms measured, respectively, by the ECG 16 and optical 18 systems. The optical system 18 features a thumb-worn sensor that includes LEDs operating in the red (λ˜660 nm) and infrared (λ˜900 nm) spectral regions, and a photodetector that detects their radiation after it passes through arteries within the patient's thumb. The ECG waveform, as described above, is digitized and sent over the CAN interface to the wrist-worn transceiver 72, while the PPG waveform is transmitted in an analog form and digitized by an analog-to-digital converter within the transceiver's circuit board. The pneumatic system 20 provides a digitized pressure waveform and oscillometric blood pressure measurements (SYS, DIA, and MAP) through the

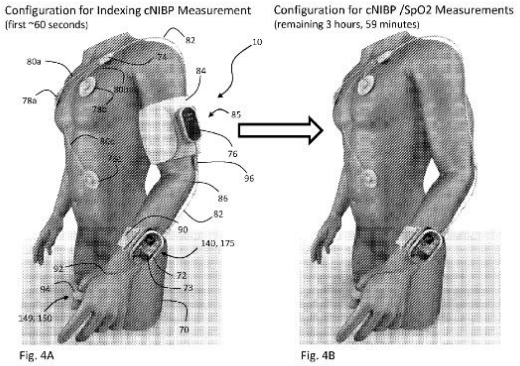
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	CAN interface; these are processed by the CPU 22 to make cuff-based ‘indexing’ blood pressure measurements according to the Composite Technique. The indexing measurement typically only takes about 40-60 seconds, after which the pneumatic system 20 is unplugged from its connector 28 so that the patient can move within the hospital without wearing an uncomfortable cuff-based system. Moon at [0060] The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94 includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150,

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	as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0089] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. Moon discloses or renders obvious the physiological parameter of the user is associated with a blood constituent or a blood flow of the user. The transceiver 72 features a CPU 22 that communicates through a digital CAN interface, or bus, to external systems featuring ECG 16, external accelerometers 14 b-c, pneumatic 20, and auxiliary 45 sensors. Each sensor 16, 14 b-c, 20, 45 is 'distributed' on the patient to minimize the bulk and weight

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	normally associated with conventional vital sign monitors, which typically incorporate all electronics associated with measuring vital signs in a single plastic box. Moreover, each of these sensors 16, 14 b-c, 20, 45 generate digital signals close to where they actually attach to the patient, as opposed to generating an analog signal and sending it through a relatively long cable to a central unit for processing. This can reduce noise due to cable motion which is often mapped onto analog signals. Cables 40, 38, 46 used in the body-worn monitor 10 to transmit packets over the CAN bus typically include 5 separate wires bundled together with a single protective cladding: the wires supply power and ground to the remote ECG system 16, accelerometers 14 b-c, pneumatic 20, and auxiliary systems 45; provide high/low signal transmission lines for data transmitted over the CAN protocol; and provide a grounded electrical shield for each of these four wires. There are several advantages to this approach. First, a single pair of transmission lines in the cable (i.e. the high/low signal transmission lines) can transmit multiple digital waveforms generated by completely different sensors. This includes multiple ECG waveforms (corresponding, e.g., to vectors associated with three, five, and twelve-lead ECG systems) from the ECG circuit, along with ACC waveforms associated with the x, y, and z axes of accelerometers within the body-worn monitor 10. The same two wires, for example, can transmit up to twelve ECG waveforms (measured by a 12-lead ECG system), and six ACC waveforms (measured by the accelerometers 14 b-c). Limiting the transmission line to a pair of conductors reduces the number of wires attached to the patient, thereby decreasing the weight and any cable-related clutter. Second, cable motion induced by an ambulatory patient can change the electrical properties (e.g. electrical impendence) of its internal wires. This, in turn, can add noise to an analog signal and ultimately the vital sign calculated from it. A digital signal, in contrast, is relatively immune to such motion-induced artifacts. Moon at [0056] To determine blood pressure, the transceiver 72 processes ECG and PPG waveforms measured, respectively, by the ECG 16 and optical 18 systems. The optical system 18 features a thumb-worn sensor that includes LEDs operating in the red (λ˜660 nm) and infrared (λ˜900 nm) spectral regions, and a photodetector that detects their radiation after it passes through arteries within the patient's thumb. The ECG waveform, as described above, is digitized and sent over the CAN interface to the wrist-worn transceiver 72, while the PPG waveform is transmitted in an analog form and digitized by an analog-to-digital converter within the transceiver's circuit board. The pneumatic system 20 provides a digitized pressure waveform and oscillometric blood pressure measurements (SYS, DIA, and MAP) through the CAN interface; these are processed by the CPU 22 to make cuff-based ‘indexing’ blood pressure measurements according to the Composite Technique. The indexing measurement typically only takes

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	about 40-60 seconds, after which the pneumatic system 20 is unplugged from its connector 28 so that the patient can move within the hospital without wearing an uncomfortable cuff-based system. Moon at [0060] FIGS. 2 and 3 show how a network of sensors 78 a-c, 83, 84, 87, 94 within the body-worn monitor 10 connect to a patient 70 to characterize them within a hospital. During a measurement, the sensors 78 a-c, 83, 84, 87, 94 measure signals that are processed by the monitor 10 to generate time-dependent ECG 61, PPG 62, OSC 63, ACC 64, and RR 65 waveforms. These, in turn, yield the patient's vital signs and motion parameters. Each waveform 61-65 relates to a unique physiological characteristic of the patient 70. For example, each of the patient's heartbeats generates electrical impulses that pass through the body near the speed of light, along with a pressure wave that propagates through the patient's vasculature at a significantly slower speed. Immediately after the heartbeat, the pressure wave leaves the heart 148 and aorta 149, passes through the subclavian artery 150 to the brachial artery 144, and from there through the radial and ulnar arteries 145 to smaller arteries in the patient's fingers. Three disposable electrodes 78 a-c attached to the patient's chest measure unique electrical signals which pass to a single-chip ECG circuit 83 that terminates a distal end of the ECG cable. Typically, these electrodes attach to the patient's chest in a conventional ‘Einthoven's triangle’ configuration featuring three unique ‘vectors’, each corresponding to a different lead (e.g. LEAD I, II, II). Related configurations can also be used when five and twelve-lead ECG systems are used in place of the three-lead system, as described below with reference to FIGS. 7A,B. Within the ECG circuit 83 signals are processed using an amplifier/filter circuit and analog-to-digital converter to generate a digital ECG waveform 61 corresponding to each lead. The ECG waveform 61 features a sharp, well-defined QRS complex corresponding to each heartbeat; this marks the initiation of the patient's cardiac cycle. Heart rate is determined directly from the ECG waveform 61 using known algorithms, such as those described in the following reference, the contents of which are incorporated herein by reference: ‘ECG Beat Detection Using Filter Banks’, Afonso et al., IEEE Trans. Biomed Eng., 46:192-202 (1999). Moon at [0063]

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	 Fig. 2  Fig. 3 Moon at Fig. 2 & 3 The optical sensor 94, described in detail with reference to FIGS. 9A,B, features two LEDs and a single photodetector that collectively measure a time-dependent PPG waveform 62 corresponding to each of the LEDs. The sensor and algorithms for processing the PPG waveforms are described in detail in the following co-pending patent application, the contents of which are fully incorporated herein by reference: BODY-WORN PULSE OXIMETER (U.S. Ser. No. 61/218,062; filed Jun. 17, 2009). The waveform 62 represents a time-dependent volumetric change in vasculature (e.g. arteries and capillaries) that is irradiated with the sensor's optical components. Volumetric changes are induced by a pressure pulse launched by each heartbeat that travels from the heart 148 to arteries and capillaries in the thumb according to the above-describe arterial pathway. Pressure from the pressure pulse forces a bolus of blood into this vasculature, causing it to expand and increase the amount of radiation absorbed, and decrease the transmitted radiation at the photodetector. The pulse shown in the PPG waveform 62 therefore represents the inverse of the actual radiation detected at the photodetector. It follows the QRS complex in the ECG waveform 61, typically by about one to two hundred milliseconds. The temporal difference between the peak of the QRS complex and the foot of the pulse in the PPG waveform 62 is the PTT, which as described in detail below is used to determine blood pressure according to the Composite Technique. PPG waveforms generated by both the red and infrared LEDs are also processed by the CPU within the wrist-worn transceiver to determine SpO2, as is described in detail in the above-

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	mentioned patent application. PTT-based measurements made from the thumb yield excellent correlation to blood pressure measured with a femoral arterial line. This provides an accurate representation of blood pressure in the central regions of the patient's body. Moon at [0065] FIGS. 4A and 4B shows the specific form factor of the exemplary body-worn monitor 10 described in FIGS. 1 and 2, and how the monitor 10 attaches to a patient 70. Two configurations of the system are shown with these figures: FIG. 4A shows the system used during the pressure-dependent indexing portion of the Composite Technique, and includes a pneumatic, cuff-based system 85 attached to the patient's bicep; FIG. 4B shows the system used for subsequent SpO2 and cNIBP measurements, which rely solely on PTT. The indexing measurement typically takes about 60 seconds, and is typically performed once at the beginning of a measurement, and every 4-8 hours afterwards. Once the indexing measurement is complete the cuff-based system 85 is typically removed from the patient. The remainder of the time the monitor 10 measures other vital signs and cNIBP according to the Composite Technique. Moon at [0072]  Moon at Fig. 4A & 4B FIGS. 9A,B show an exemplary optical sensor 94 that measures PPG signals from both red and infrared LEDs which the wrist-worn transceiver 72 processes to determine cNIBP and SpO2. The sensor 94

’475 Patent	Moon
	includes a dual LED 150 operating at 660 and 905 nm, depending on the direction of bias, a photodetector 155 for detecting radiation from the LED 150 after it passes through a portion of the patient's thumb, and a laser-trimmed resistor 149 indicating the specific wavelength of the red portion of the dual LED 150, as described below. Powering these components is a circuit 175 within the wrist-worn transceiver that generates time-dependent current pulses to drive the LEDs. The circuit 175 features an operational amplifier 180 that receives a control voltage (Vcontrol) on its gating pin. The amplifier 180 is connected to a transistor 182 and resistor 181 that, along with a supply voltage of 3.3V (typically from a Li:ion battery), generate the current pulses used to drive the dual LED 150. To select the biasing direction of the LED, and thus choose the wavelength that is emitted, the circuit 175 features red control lines 185, 190 and infrared control lines 187, 189 that connect directly to 110 lines in the CPU within the wrist-worn transceiver. During a measurement, current pulses flow from the 3.3V supply voltage, across one direction of the LED 150, and ultimately through the transistor 182 and resistor 181 to ground 183. The LED 150 is biased in a forward direction when control lines 185, 190 are toggled closed, thereby supplying a drive current pulse of iLED=Vcontrol/R1 to the LED 150 to generate red radiation. Voltage flowing across the LED 150 is also decreased because it is a diode. In this case the control lines 187, 189 for infrared radiation are left open. This configuration persists for 100 μs, after which the red control lines 185, 190 are switched closed, and the infrared control lines 187, 189 are switched open. This biases the LED 150 in a backwards direction to generate infrared radiation according to the above-described drive current. The alternating process is repeated at 500 Hz. Moon at [0081] The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to

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	generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	See claim 8 above. Moon discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency. The body-worn monitor features a series of sensors that attach to the patient to measure time-dependent PPG, ECG, accelerometer-based motion (ACC), oscillometric (OSC), respiratory rate (RR), and impedance pneumography (IP) waveforms. A microprocessor (CPU) within the monitor continuously processes these waveforms to determine the patient's vital signs, degree of motion, posture and activity level. Sensors that measure these signals typically send digitized information to a wrist-worn transceiver through a serial interface, or bus, operating on a controlled area network (CAN) protocol. The CAN bus is typically used in the automotive industry, which allows different electronic systems to effectively and robustly communicate with each other with a small number of dropped packets, even in the presence of

’475 Patent	Moon
	electrically noisy environments. This is particularly advantageous for ambulatory patients that may generate signals with large amounts of motion-induced noise. Moon at [0013] The wrist-worn transceiver can communicate with a remote device through a wireless connection that operates on the hospital's wireless network, or alternatively through a peer-to-peer connection. In another aspect of the invention, for example, the remote device is configured to simultaneously display vital signs for each patient in a group when a signal strength corresponding to each wrist-worn transceiver in the group is below a pre-determined threshold value. When the signal strength from the wireless system worn by a patient exceeds the pre-determine threshold, the remote monitor displays information for that particular patient. Such a situation would occur, for example, if a tablet computer normally disposed at a central nursing station was brought into the patient's room. Typically the pre-determined threshold value is between about −100 and −80 dB, and the wireless system used by each wrist-worn transceiver operates on an industry-standard communications protocol, preferably selected from 802.11, 802.15.4, and cellular wireless protocols. In embodiments, the remote device is a device comprising a microprocessor, a display, and a compatible communications transceiver. Examples include a computing device selected from the group consisting of a desktop computer, a portable computer, a tablet computer, a cellular telephone, and a personal digital assistant. This list is not meant to be limiting. Moon at [0027] During a measurement, the pressure waveform 63 increases in a mostly linear fashion as pressure applied by the cuff 84 to the brachial artery 144 increases. When it reaches a pressure slightly below the patient's diastolic pressure, the brachial artery 144 begins to compress, resulting in a series time-dependent pulsations caused by each heartbeat that couple into the cuff 84. The pulsations modulate the OSC waveform 63 with an amplitude that varies in a Gaussian-like distribution, with maximum modulation occurring when the applied pressure is equivalent to the patient's MAP. The pulsations can be filtered out and processed using digital filtering techniques, such as a digital bandpass filter that passes frequencies ranging from 0.5-20 Hz. The resulting waveform can be processed to determine SYS, DIA, and MAP, as is described in detail in the above-referenced patent application, the contents of which have been previously incorporated herein by reference. The cuff 84 and pneumatic system are removed from the patient's bicep once the pressure-dependent component of the Composite Technique is complete. Moon at [0068]

’475 Patent	Moon
	The amplifier circuit 140 features separate channels for amplifying and filtering signals corresponding to red radiation, infrared radiation, and ambient light detected by the photodiode 155 when the LED is not biased to generate radiation. This occurs, for example, during the time periods when neither the red or infrared LED is driven. Once detected, the degree of ambient light can be subtracted from both the red and infrared signals to improve their resultant signal-to-noise ratio. The amplifier channel corresponding to red radiation is activated by a sample-and-hold integrated circuit 157 that is controlled by the same control lines 185, 190 that drive the red LED, as shown in FIG. 9B. When the red LED is driven, the sample-and-hold circuit 157 is switched on, while similar components 164, 172 corresponding to the infrared signals and ambient light are switched off. The sample-and-hold circuit 157 samples and maintains an analog voltage from the transimpedance amplifier 156, which then passes through a low-pass filter 158 characterized by a 20 Hz cutoff. This filter removes any high-frequency noise (e.g. 60 Hz electrical noise) that is not related to the PPG waveform, and yields a preliminary waveform that is digitized with an analog-to-digital converter 176, and processed as described above to generate a DC portion of the PPG. The preliminary waveform then passes through a high-pass filter 160 with a cutoff of 0.1 Hz to remove the DC portion and leave only the AC portion, which typically represents about 0.5-1% of the total signal magnitude. The AC portion is further amplified with a standard instrumentation amplifier 162 featuring a programmable gain that is controlled with a 1.65 reference voltage and a digital potentiometer (not shown in the figure; this component may be included directly in the instrumentation amplifier) featuring a variable resistance controlled by the CPU within the wrist-worn transceiver. The CPU selects the resistance (according to a predetermined command) and corresponding gain to maximize the dynamic range of the analog-to-digital converter 176. This process results in an amplified version of the AC portion of the red PPG waveform, which is then digitized with the analog-to-digital converter 176 and then processed as described above. Moon at [0091] The above-described filtering and amplification processes are repeated when the infrared LED and a sample-and-hold integrated circuit 164 corresponding to the infrared channel are activated with infrared control lines 187, 189. The low-pass 166 and high-pass 168 filters corresponding to this channel are identical to those used for the red channel. The instrumentation amplifier 170 is also identical, but is controlled by a separate digital potentiometer to have a unique, uncoupled gain. This is because the infrared PPG waveform typically has a relatively large amplitude, and thus requires less amplification, than the red PPG waveform. The channel corresponding to ambient light only requires processing of DC signals, and thus includes a sample-and-hold integrated circuit 172 that passes an analog voltage to a

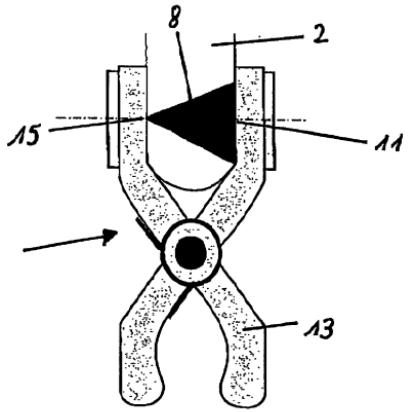
’475 Patent	Moon
	low-pass filter 174 featuring a 20 Hz cutoff. The filtered value corresponding to ambient light is then digitized with the analog-to-digital converter and then processed as described above. Moon at [0092] Using parameters such as heart rate and initial estimated blood pressure, the first pressure-dependent measurement (step 282 a) determines a relationship between PTT and blood pressure as described above. This takes about 60 seconds. This measurement may occur automatically (e.g., after about 1 minute), or may be driven by the medical professional (e.g., through a button press). The microprocessor then uses this relationship and a measured value of PTT to determine blood pressure during the following pressure-free measurement (step 281 b). This measurement step typically proceeds for a well-defined period of time (typically 4-8 hours), during which it continuously determines blood pressure. Typically, the body sensor averages PTT values over a 10-20 second period, and displays a new blood pressure measurement every second using a rolling average. Moon at [0114] The microprocessor may also perform a pre-programmed or automated intermediate pressure-dependent measurement (step 282 b) to correct any drift in the blood pressure measurement. This measurement is similar to the initial pressure-dependent measurement 282 a. At some later time, if the patient experiences a sudden change in other vital signs (e.g., respiratory rate, heart rate, body temperature), the CPU in the wrist-worn transceiver may analyze this condition and initiate another pressure-dependent blood pressure measurement (step 282 c) to most accurately determine the patient's blood pressure. Moon at [0115] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Moon, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Moon, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

U.S. Pat. No. 12,268,475 in view of U.S. Patent Publication No. 2005/0049468 to Sven-Erik Carlson ("Carlson")

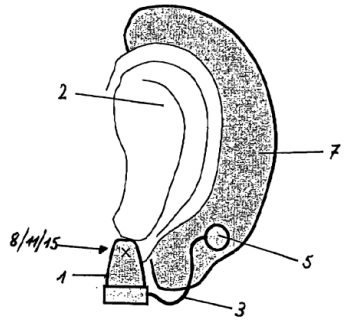
As described in detail below, Carlson (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Carlson. The cited portions of Carlson are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Carlson. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Carlson "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Carlson does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Carlson (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Carlson anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

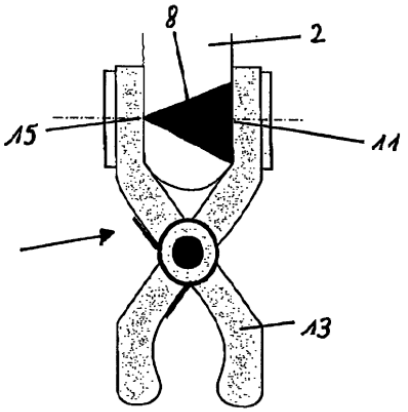
’475 Patent	Carlson
Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Carlson discloses or renders obvious An apparatus adapted to be worn by a user comprising. Proposed is a configuration for the acquisition and/or monitoring of medical data, in particular the state of the cardiovascular and pulmonary system, blood values or blood composition, characterised by at least one measuring sensor for the acquisition of the medical data such as the state of the cardiovascular system, etc. of a person comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted and/or reflected through a tissue portion of a person or an animal further comprising means in order to increase the optical Signal-to-Noise and/or Signal-to-Background ratio. Carlson at [Abstract]  Figure 2 Carlson at Fig.2 In FIG. 2, **the ear clip 1 is shown in cross section where it can specifically be seen that the sensor is designed in form on a clip 13. The sensor or ear clip 13 furthermore includes a light source 15 which emits a light beam 8 to a light receiver 11. The light is guided or emitted through the ear skin or earlobe 2**.

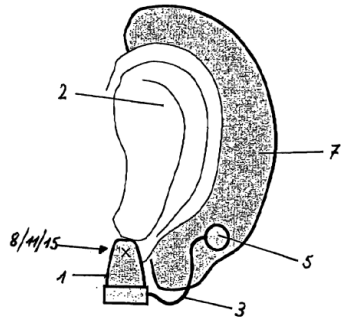
’475 Patent	Carlson
	Carlson at [0049] **Of course, the sensor can also be arranged at other parts of the human body, such as e.g. at a finger or a toe**. In addition, the monitoring can also be executed at animals, which means that pulsoximetric sensors can also be arranged e.g. at the ear of animals, such as e.g. cows. According to an alternative design of the sensor, it could also be possible to arrange the light receiver in such a way so that the light reflected through the earlobe is determined. Again, according to a further alternative, it could even be possible by arranging at least two light receivers to determine the light transmitted through the earlobe and the light reflected by the earlobe. Carlson at [0052] As an alternative or in addition to using beam shaping optics, it is also possible to influence the sensor architecture of the pulsoximetric sensor. First of all, it is possible to use a light receiving or light sensitive element 11 with reduced light sensitivity outside the spectral range of the band limited light source as LEDs. FIG. 5 a shows the light absorption curves of with oxygen saturated 22 and unsaturated 23 blood. As visible from the shown diagram, the sensor architecture, which means the spectrum sensitivity, should be in the range within approximately 500 nm to approximately 1000 nm. In addition, in FIG. 5 a the two wavelengths $\lambda 1$ and $\lambda 2$ are indicated at which the pulsoximetric sensor is operated. Carlson at [0055] By using one of the proposed devices or methods, respectively, according to the present invention or a combination thereof, it is possible to use pulsoximetric measurement or monitoring to survey the health condition of a person or an animal which is mobile. In other words, pulsoximetric measurement is not restricted for use in, e.g., a hospital but can also be used, if a person is travelling, is staying at home, etc. Furthermore, it is also possible to study health conditions of animals living in nature such as e.g. cows feeding outside. Carlson at [0072]

’475 Patent	Carlson
	 Figure 1 Carlson at Fig.1 Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Carlson at [0073] Furthermore, all the above mentioned means for improving the measurement of the oxygen saturation of blood using a light source can, of course, also be used by any further kind of measurements using a light source such as, e.g., non-invasive monitoring or arterial carbon dioxide partial tension, the content of blood sugar, etc. In other words, for any kind of measuring blood properties using light emission through a human or animal tissue, the above mentioned means for improving the measurement can be used. This means that the present invention is not at all restricted to optical pulsoximetry used for non-invasive measure of pulsation and oxygen saturation in arterial human or animal blood. Carlson at [0076] The measured values can be transmitted via a wire connection or wireless, e.g. within the range of radio frequency. Well known these days is wireless transmission using “Bluetooth” technology. According to a further embodiment, the pulsoximetric sensor could be included within a hearing aid device.

’475 Patent	Carlson
	Carlson at [0077] Taking prior art into consideration, **the measured values can be monitored at a special unit worn by the person or patient**, respectively, where e.g. a signal is generated, if the measured value is not within a predetermined range. In other words, health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0078] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	Carlson discloses or renders obvious one or more biosensors adapted to be placed on the user, wherein one or more physiological parameters are measured. **Proposed is a configuration for the acquisition and/or monitoring of medical data, in particular the state of the cardiovascular and pulmonary system, blood values or blood composition, characterised by at least one measuring sensor for the acquisition of the medical data such as the state of the cardiovascular system, etc. of a person comprising at least one light source which can emit light at least at two wavelengths**, as well as at least one light receiver for determining the light transmitted and/or reflected through a tissue portion of a person or an animal further comprising means in order to increase the optical Signal-to-Noise and/or Signal-to-Background ratio. Carlson at [Abstract] **Commercially available pulsoximeter sensors are typically used in hospitals and doctor's offices where the (optical) environment and mounting of the sensor onto the patient's skin are well defined**. In the recent past pulsoximetry measuring devices and methods are also offered and used for

’475 Patent	Carlson
	mobile monitoring and surveying of human individuals, e.g. suffering of diseases, such as heart problems, diabetes, respiratory diseases, insufficient oxygen blood saturation, etc. Pulsoximetry measuring devices are also used in sports for control and survey of athletes. Respective monitoring devices are described within the international patent application WO02/089 663 which proposes in this respect to monitor in particular persons with cardio vascular disorders by means of pulsoximetry with measurements being taken by means of pulsoximetry preferably on an ear or on a finger. When using pulsoximetry in telemedicine or near patient testing applications, which means e.g. at self-controlling and self-testing of patients in non-ideal environment, standard pulsoximeter sensors suffer from signal instability and insufficient robustness versus environmental disturbances. Carlson at [0004] In addition to the above mentioned configuration or as an alternative, it is proposed to use a configuration for monitoring e.g. pulsation frequency, oxygen saturation within blood and breathing frequency which comprises at least the following components: **at least one measuring sensor to the person or the animal for the acquisition or monitoring of medically relevant data which sensor comprises at least one light source that can emit light at least at two wavelengths**, as well as at least one light receiver for determining the light transmission through a tissue portion of the person or the animal, and at least one light baffle or light trap, respectively, and/or an optical wavelength filter which is adapted to the power spectrum of the light source and the absorption spectrum of human or animal arterial blood. The basic idea of using geometric baffles or light traps, respectively, and/or optical wavelength filters is to suppress by geometric and/or optical means the parasitic contribution of environmental radiation in order to increase or stabilize the S/B (Signal/Background) ratio vs. environmental conditions. The increase of the S/B ratio is e.g. estimated to a factor 10-100. Carlson at [0015] FIG. 1 shows schematically **the arrangement of an ear sensor 1 which can be arranged in form of an ear clip. This sensor 1 can be arranged e.g. at an earlobe of ear 2**. Furthermore, the sensor or ear clip is connected via a wire 3 and the connection 5 with the main unit 7 including e.g. a power source, like a battery, and measuring and/or monitoring electronics. Carlson at [0048]

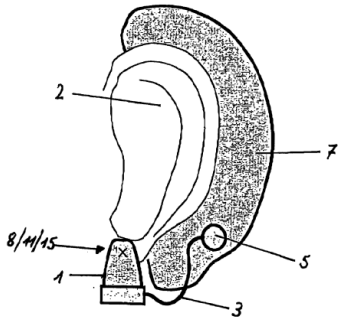
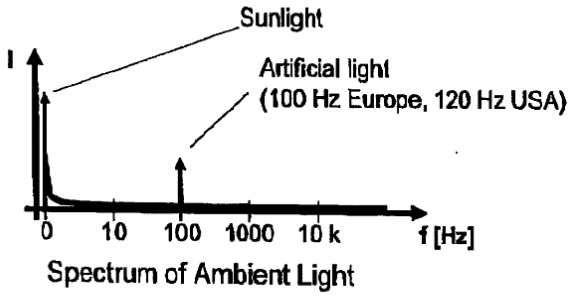
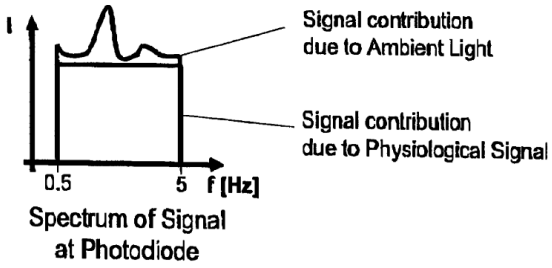
'475 Patent	Carlson
	 Figure 2 Carlson at Fig.2. In FIG. 2, the ear clip 1 is shown in cross section where it can specifically be seen that the sensor is designed in form on a clip 13. **The sensor or ear clip 13 furthermore includes a light source 15 which emits a light beam 8 to a light receiver 11**. The light is guided or emitted through the ear skin or earlobe 2. Carlson at [0049] **Of course, the sensor can also be arranged at other parts of the human body, such as e.g. at a finger or a toe. In addition, the monitoring can also be executed at animals, which means that pulsoximetric sensors can also be arranged e.g. at the ear of animals, such as e.g. cows. According to an alternative design of the sensor, it could also be possible to arrange the light receiver in such a way so that the light reflected through the earlobe is determined. Again, according to a further alternative, it could even be possible by arranging at least two light receivers to determine the light transmitted through the earlobe and the light reflected by the earlobe**. Carlson at [0052] As an alternative or in addition to using beam shaping optics, it is also possible to influence the sensor architecture of the pulsoximetric sensor. First of all, it is possible to use a light receiving or light sensitive

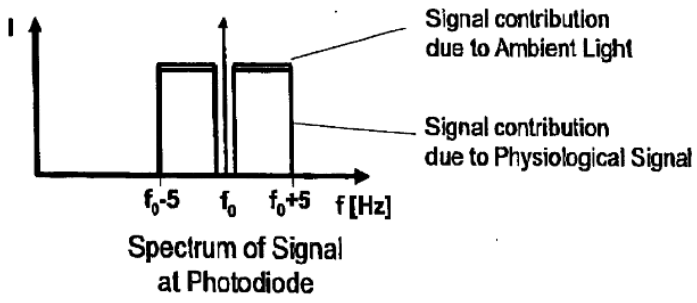
’475 Patent	Carlson
	element 11 with reduced light sensitivity outside the spectral range of the band limited light source as LEDs. FIG. 5 a shows the light absorption curves of with oxygen saturated 22 and unsaturated 23 blood. As visible from the shown diagram, the sensor architecture, which means the spectrum sensitivity, should be in the range within approximately 500 nm to approximately 1000 nm. In addition, in FIG. 5 a the two wavelengths λ1 and λ2 are indicated at which the pulsoximetric sensor is operated. Carlson at [0055] By using one of the proposed devices or methods, respectively, according to the present invention or a combination thereof, it is possible **to use pulsoximetric measurement or monitoring to survey the health condition of a person or an animal which is mobile. In other words, pulsoximetric measurement is not restricted for use in, e.g., a hospital but can also be used, if a person is travelling, is staying at home, et**c. Furthermore, it is also possible to study health conditions of animals living in nature such as e.g. cows feeding outside. Carlson at [0072]  Figure 1 Carlson at Fig.1. Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase

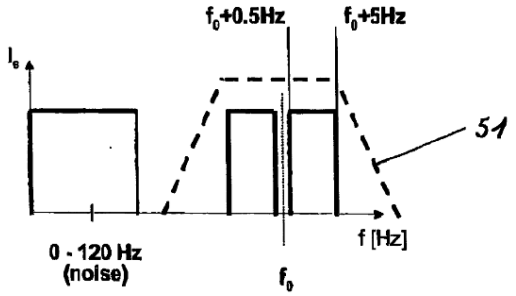
’475 Patent	Carlson
	and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Carlson at [0073] Furthermore, all the above mentioned means for improving the measurement of the oxygen saturation of blood using a light source can, of course, also be used by any further kind of measurements using a light source such as, e.g., non-invasive monitoring or arterial carbon dioxide partial tension, the content of blood sugar, etc. In other words, for any kind of measuring blood properties using light emission through a human or animal tissue, the above mentioned means for improving the measurement can be used. This means that the present invention is not at all restricted to optical pulsoximetry used for non-invasive measure of pulsation and oxygen saturation in arterial human or animal blood. Carlson at [0076] The measured values can be transmitted via a wire connection or wireless, e.g. within the range of radio frequency. Well known these days is wireless transmission using “Bluetooth” technology. According to a further embodiment, **the pulsoximetric sensor could be included within a hearing aid device**. Carlson at [0077] **Taking prior art into consideration, the measured values can be monitored at a special unit worn by the person or patient, respectively, where e.g. a signal is generated, if the measured value is not within a predetermined range**. In other words, health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0078] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	Carlson discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. Again, in addition to the above mentioned two configurations, or as an alternative, a further configuration is proposed which comprises at least the following components: **at least one measuring sensor on the person or the animal for the acquisition or the monitoring of medically relevant data, such as in particular data, which describe the cardio vascular and pulmonary function and/or contained data regarding blood values or blood composition**, which sensor comprises at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted through a tissue portion of the person, and at least one light source frequency modulating means to frequency modulate the optical radiation of the light source at a carrier frequency in order to shift the power spectrum of the pulsoximeter signals. The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the amplitude of the optical radiation of, e.g., the LED at a carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency range of, e.g. fc +/−5 Hz, increasing significantly the S/N (Signal/Noise)- and S/B ratio. Carlson at [0018] Furthermore, the above mentioned problem is solved according to the invention by means of methods according to the invention. **Proposed is a method for monitoring e.g. pulsation frequency, oxygen saturation in blood or breathing frequency, which comprises at least one of the following steps:** **measuring or monitoring medically relevant data of a person or an animal, such as in particular data, which describe the cardiovascular and pulmonary function and/or contain data regarding blood values or blood composition with the use of at least one measuring sensor, which sensor comprises at least one light source which can emit light at least at two wavelengths**:

’475 Patent	Carlson
	direct the emitted light or optical radiation, respectively, by using a beam shaping element, such as e.g. a diffractive or refractive lens to the human or animal tissue; receiving and detecting the emitted and shaped light with at least one light receiving element for determining the light transmitted through the tissue portion of the person or the animal. Carlson at [0022]-[0025] The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3. Carlson at [0065] The frequency spectrum of ambient light is schematically shown in diagram 7 b. Sunlight is at 0 Hz, while artificial light, such as e.g. electrical in-house light, is going up to approximately 120 Hz (USA). In other words, within the range of frequencies of physiological signals, we have high influence of frequencies of sunlight and ambient light. A corresponding combined frequency spectrum is shown in Fig. c, which would be detected by a photo diode without the use of any means as described above in relation to FIGS. 1 to 6. FIG. 7 c shows a basic signal contribution due to physiological signal and additional signal contribution due to ambient light. In other words, the influence of ambient light is quite substantial, and therefore the deviations of the measured values compared to the real values can be dramatic. Carlson at [0067]

’475 Patent	Carlson
	 Figure 1 Carlson at Fig.1  Figure 7b  Figure 7c Carlson at Fig. 7b & 7c As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio. FIG. 8 shows the shift spectrum of signal to a region where

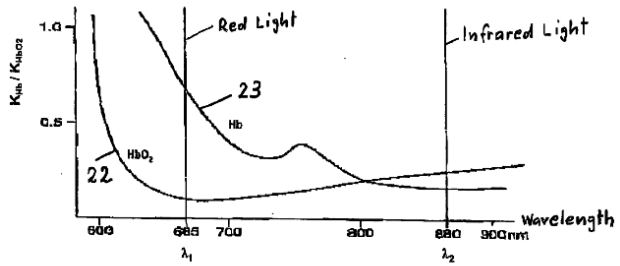
’475 Patent	Carlson
	there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069]  Figure 8

’475 Patent	Carlson
	 Figure 9 Carlson at Fig. 8 & 9 Furthermore, all the above mentioned means for improving the measurement of the oxygen saturation of blood using a light source can, of course, also be used by any further kind of measurements using a light source such as, e.g., non-invasive monitoring or arterial carbon dioxide partial tension, the content of blood sugar, etc. **In other words, for any kind of measuring blood properties using light emission through a human or animal tissue, the above mentioned means for improving the measurement can be used. This means that the present invention is not at all restricted to optical pulsoximetry used for non-invasive measure of pulsation and oxygen saturation in arterial human or animal blood**. Carlson at [0076] 1. **Configuration for the acquisition and/or monitoring of medical data, in particular the state of the cardiovascular and pulmonary system, blood values or blood composition, characterised by at least one measuring sensor for the acquisition of the medical data such as the stare of the cardiovascular system, etc. of a person comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted and/or reflected through a tissue portion of a person or an animal further comprising means in order to increase the optical Signal-to-Noise and/or Signal-to-Background ratio**.

’475 Patent	Carlson
	Carlson at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	Carlson discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. Pulsoximetry is a widely used standard optical technology for non-invasive monitoring of pulsation and oxygen saturation in arterial human or animal blood [1]. **The method consists of measuring the absorption of reduced (Hb)—and oxidized (HbO2) haemoglobin at two optical wavelengths, where the relative absorption coefficients differ significantly, e.g. 660 nm and a second wavelength in the range of 800 to 1000 nm, preferably 890 nm or 950 nm**. A concise description of the measurement method and the sensor signals is given in [2]. Carlson at [0003] The posed problem is solved by means of a configuration/method according to the invention. Proposed is a configuration for monitoring which comprises at least one of the following components: at least one measuring sensor for the acquisition of the medical data, such as the state of the cardiovascular and pulmonary system, as e.g. pulsation frequency, oxygen saturation of blood, breathing frequency, etc. of a human being or an animal, **comprising at least one light source which can emit light at least at two wavelengths**, as well as at least one light receiver for determining the light transmitted through a tissue portion of the person or the animal; at least one beam shaping optical element to direct the emitted light to a human or animal tissue and the light receiver in order to increase the optical signal power. Carlson at [0011]

'475 Patent	Carlson
	In addition to the above mentioned configuration or as an alternative, it is proposed to use a configuration for monitoring e.g. pulsation frequency, oxygen saturation within blood and breathing frequency which comprises at least the following components: **at least one measuring sensor to the person or the animal for the acquisition or monitoring of medically relevant data which sensor comprises at least one light source that can emit light at least at two wavelengths**, as well as at least one light receiver for determining the light transmission through a tissue portion of the person or the animal, and at least one light baffle or light trap, respectively, and/or an optical wavelength filter which is adapted to the power spectrum of the light source and the absorption spectrum of human or animal arterial blood. The basic idea of using geometric baffles or light traps, respectively, and/or optical wavelength filters is to suppress by geometric and/or optical means the parasitic contribution of environmental radiation in order to increase or stabilize the S/B (Signal/Background) ratio vs. environmental conditions. The increase of the S/B ratio is e.g. estimated to a factor 10-100. Carlson at [0015] Again, in addition to the above mentioned two configurations, or as an alternative, a further configuration is proposed which comprises at least the following components: **at least one measuring sensor on the person or the animal for the acquisition or the monitoring of medically relevant data, such as in particular data, which describe the cardio vascular and pulmonary function and/or contained data regarding blood values or blood composition, which sensor comprises at least one light source which can emit light at least at two wavelengths**, as well as at least one light receiver for determining the light transmitted through a tissue portion of the person, and at least one light source frequency modulating means to frequency modulate the optical radiation of the light source at a carrier frequency in order to shift the power spectrum of the pulsoximeter signals. The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to **temporarily modulate the amplitude of the optical radiation of, e.g., the LED at a carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent**. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency range of, e.g. fc +/−5 Hz, increasing significantly the S/N (Signal/Noise)- and S/B ratio. Carlson at [0018]

’475 Patent	Carlson
	In FIG. 2, the ear clip 1 is shown in cross section where it can specifically be seen that the sensor is designed in form on a clip 13. The sensor or ear clip 13 furthermore includes a light source 15 which emits a light beam 8 to a light receiver 11. The light is guided or emitted through the ear skin or earlobe 2. Carlson at [0049] As already mentioned in the introduction, the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body. **The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed**. Carlson at [0050] Of course, the sensor can also be arranged at other parts of the human body, such as e.g. at a finger or a toe. In addition, the monitoring can also be executed at animals, which means that pulsoximetric sensors can also be arranged e.g. at the ear of animals, such as e.g. cows. According to an alternative design of the sensor, it could also be possible to arrange the light receiver in such a way so that the light reflected through the earlobe is determined. Again, according to a further alternative, it could even be possible by arranging at least two light receivers to determine the light transmitted through the earlobe and the light reflected by the earlobe. Carlson at [0052] Therefore, it is proposed, as shown in FIG. 4, to use beam shaping optics 20 to direct the emitted optical radiation 8 emitted from the **two LEDs 15** to the middle of the earlobe. As it is shown clearly in FIG. 4, using the beam shaping optics 21, the two initial light beams 8 are guided in form of bundled beams 12 to a relatively small area within the middle ear 2. By using the beam shaping optics 21, of course the

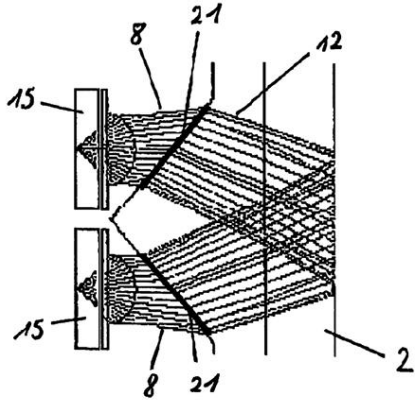
’475 Patent	Carlson
	influence of environmental light or noise, respectively, can be reduced substantially by increasing the S/B ratio. First or all, the light beam is bundled and, in addition, the optical signal power can be increased. Carlson at [0054] As an alternative or in addition to using beam shaping optics, it is also possible to influence the sensor architecture of the pulsoximetric sensor. First of all, it is possible to use a light receiving or light sensitive element 11 with reduced light sensitivity outside the spectral range of the band limited **light source as LED**s. FIG. 5 a shows the light absorption curves of with oxygen saturated 22 and unsaturated 23 blood. As visible from the shown diagram, the sensor architecture, which means the spectrum sensitivity, should be in the range within approximately 500 nm to approximately 1000 nm. In addition, in FIG. 5 a the two wavelengths λ1 and λ2 are indicated at which the pulsoximetric sensor is operated. Carlson at [0055]  Figure 5a Carlson at Fig. 5a FIG. 6 b shows the part of the sensor of FIG. 6 a in a longitudinal section. The stray light will be trapped substantially within the depressions of the baffles 31, **while the emitted light by the LEDs will reach the optical sensor 35.**

'475 Patent	Carlson
	Carlson at [0061] Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Therefore, it is preferred to further provide means for stabilizing the signal guiding and detecting and to provide means for the beam path to be co-linear with the optical axis of the LED and the photo detector. Because of that, according to FIGS. 10 a and 10 b, it is proposed to use a frame 61 which is stable and does not change its dimensions due to strong movements or an individual carrying the pulsoximetric sensor or due to swelling or contracting of the tissue to be monitored by the pulsoximetric sensor. In this case, of course, other means have to be provided, so that the distance between the LED 15 and the photo detector 11 can be adjusted or adapted to the thickness of the tissue to be monitored. Therefore, according to FIG. 10 a, it is proposed that the LED 15 is arranged within a clamping mechanism 63 and that between the clamping mechanism 63 and the LED a screw connection 65 is arranged, so that the LED 15 can be moved into the clamping mechanism or out of the clamping mechanism 63. In other words, the distance between the LED 15 and the photo detector 11 can be adjusted along the optical axis 67 which guarantees that the beam path has always been co-linear with the optical axis 67 of the LED and the photo detector. Carlson at [0073] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output	Carlson discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin.

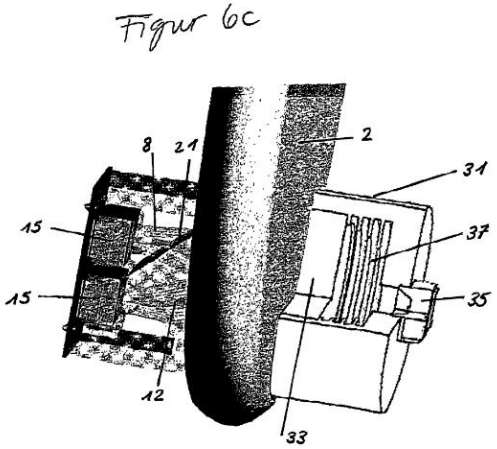
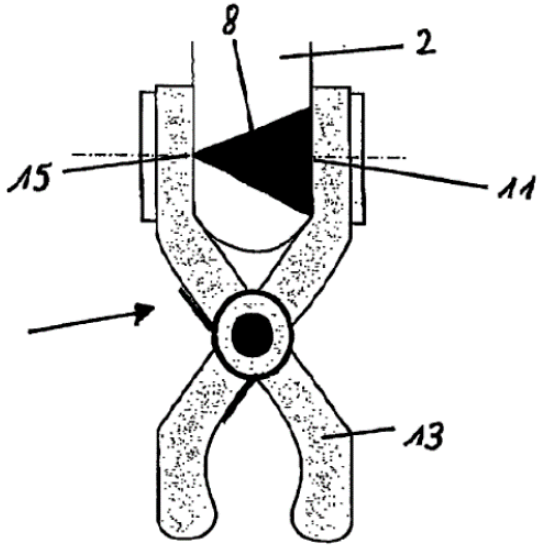
’475 Patent	Carlson
optical light and to deliver a lens output light to tissue comprising skin;	The invention relates in particular to optical pulsoximetry used for non-invasive measurement of pulsation and oxygen saturation in arterial human or animal blood, and is particularly concerned with increasing the technical performance of pulsoximetry in terms of quality and robustness of the measurement signal versus environmental disturbances and energy consumption. Carlson at [0002] Commercially available pulsoximeter sensors are typically used in hospitals and doctor's offices where the (optical) environment and mounting of the sensor onto the patient's skin are well defined. In the recent past pulsoximetry measuring devices and methods are also offered and used for mobile monitoring and surveying of human individuals, e.g. suffering of diseases, such as heart problems, diabetes, respiratory diseases, insufficient oxygen blood saturation, etc. Pulsoximetry measuring devices are also used in sports for control and survey of athletes. Respective monitoring devices are described within the international patent application WO02/089 663 which proposes in this respect to monitor in particular persons with cardio vascular disorders by means of pulsoximetry with measurements being taken by means of pulsoximetry preferably on an ear or on a finger. When using pulsoximetry in telemedicine or near patient testing applications, which means e.g. at self-controlling and self-testing of patients in non-ideal environment, standard pulsoximeter sensors suffer from signal instability and insufficient robustness versus environmental disturbances. Carlson at [0004] Critical points are: Human tissue scatters and transmits light in the visible and near infrared (NIR) wavelength range. Therefore, suppression of environmental optical radiation, e.g. sunlight, is difficult by geometric means of the architecture of the pulsoximeter sensor. The power spectrum of environmental optical radiation strongly varies as a function or time and place where the pulsoximeter is used, e.g. day versus night, indoor versus outdoor. Therefore, the background (offset) in the detected optical power varies in a large range, making difficult the analog and digital signal processing of the primary sensor signal.

’475 Patent	Carlson
	The temporal spectrum of pulsoximeter signals varies in the range of 0.5 Hz to 5 Hz where environmental optical radiation may have significant components leading to parasitic contributions which cannot be separated from the pulsoximeter signals of interest. Realization of a performing electronic band pass filter in the range of 0.5 Hz to 5 Hz, in order to suppress DC offset and high frequency contribution in the pulsoximeter signal, is technically challenging. Further, optical contributions, e.g. temporally structured day-light, and electronic noise, e.g. 1/f (1/frequency-Noise), are stronger in the low frequency range 0.5 Hz to 10 Hz than in higher frequency ranges. Carlson at [0005]-[0009] It is therefore an object of the present invention to define optical and/or electronic means for increasing the Signal-to-Noise ratio (S/N) and Signal-to-Background ratio (S/B) of a pulsoximeter sensor for robust application of pulsoximetry in telemedicine- and near patient testing applications in rough (optical) environmental conditions, e.g. at changing light influences, such as sunlight, shadow, artificial light, etc. Carlson at [0010] The posed problem is solved by means of a configuration/method according to the invention. Proposed is a configuration for monitoring which comprises at least one of the following components: at least one measuring sensor for the acquisition of the medical data, such as the state of the cardiovascular and pulmonary system, as e.g. pulsation frequency, oxygen saturation of blood, breathing frequency, etc. of a human being or an animal, comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted through a tissue portion of the person or the animal; at least one beam shaping optical element to direct the emitted light to a human or animal tissue and the light receiver in order to increase the optical signal power. Carlson at [0011]-[0013]

’475 Patent	Carlson
	The basic idea therefore is to use a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise—and signal/Background ratio. The increase of the S/B ratio is estimated e.g. to a factor 5. Carlson at [0014] Furthermore, the above mentioned problem is solved according to the invention by means of methods according to the invention. Proposed is a method for monitoring e.g. pulsation frequency, oxygen saturation in blood or breathing frequency, which comprises at least one of the following steps: measuring or monitoring medically relevant data of a person or an animal, such as in particular data, which describe the cardiovascular and pulmonary function and/or contain data regarding blood values or blood composition with the use of at least one measuring sensor, which sensor comprises at least one light source which can emit light at least at two wavelengths: direct the emitted light or optical radiation, respectively, **by using a beam shaping element, such as e.g. a diffractive or refractive lens to the human or animal tissue**; receiving and detecting the emitted and shaped light with at least one light receiving element for determining the light transmitted through the tissue portion of the person or the animal. Carlson at [0022]-[0025]

’475 Patent	Carlson
	 Figure 4 Carlson at Fig.4 FIG. 2 schematically the ear clip of FIG. 1 in cross section view; Carlson at [0033] **FIG. 6 c an oximetric sensor in perspective view, containing optical lenses**, filters and geometrical baffles Carlson at [0041] In FIG. 2, the ear clip 1 is shown in cross section where it can specifically be seen that the sensor is designed in form on a clip 13. The sensor or ear clip 13 furthermore includes a light source 15 which emits a light beam 8 to a light receiver 11. The light is guided or emitted through the ear skin or earlobe 2. Carlson at [0049] As already mentioned in the introduction, the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body. The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which

'475 Patent	Carlson
	means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed. Carlson at [0050] Therefore, it is proposed, as shown in FIG. 4, to use beam shaping optics 20 to direct the emitted optical radiation 8 emitted from the two LEDs 15 to the middle of the earlobe. As it is shown clearly in FIG. 4, using the beam shaping optics 21, the two initial light beams 8 are guided in form of bundled beams 12 to a relatively small area within the middle ear 2. By using the beam shaping optics 21, of course the influence of environmental light or noise, respectively, can be reduced substantially by increasing the S/B ratio. First or all, the light beam is bundled and, in addition, the optical signal power can be increased. Carlson at [0054] According to the preferred embodiment of the invention, the various described optical and geometric means, **such as the beam shaping element as shown in FIG. 4, the wavelength filters, the sensor architecture, and the mentioned baffles, can be combined as shown in principle and perspective view in FIG. 6 c. Again, light is emitted from the two LEDs 15 and is shaped by the two beam shaping elements or lenses 21 to be guided as beams 12 through the earlobe 2**. After the earlobe, the double pass filter 33 is arranged to guarantee that only light in the range of approximately 660 nm and in the range of approximately 890 nm is transmitted through the filter. After the filter, any stray light, entered the sensor e.g. trough the earlobe from the side, will be trapped within the baffles 37 which are arranged in circumferential direction. Finally, a photo detecting element 35 is arranged with specific spectrum sensitivity. Carlson at [0062] Besides the high influence of ambient light, also sunlight can have a dramatic influence, e.g. if a person is walking through streets with relatively quick changing conditions between sunlight and shadow. Another serious possibility is caused by a tree avenue when driving along the trees. Sunlight then is received e.g. by the pulsoximetric sensor at a certain frequency, which means that every time when passing a tree, sunlight is attenuated and between the trees sunlight is influencing the measurement of the pulsoximetric sensor.

’475 Patent	Carlson
	Carlson at [0068]  Carlson at Fig. 6c  Figure 2

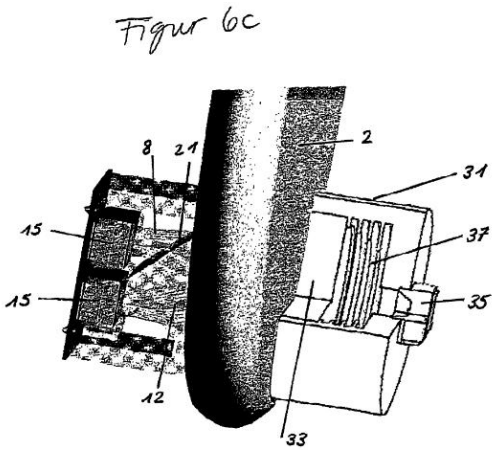
’475 Patent	Carlson
	Carlson at Fig. 2 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	Carlson discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. Proposed is a configuration for the acquisition and/or monitoring of medical data, in particular the state of the cardiovascular and pulmonary system, blood values or blood composition, characterised by at least one measuring sensor for the acquisition of the medical data such as the state of the cardiovascular system, etc. of a person comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted and/or reflected through a tissue portion of a person or an animal further **comprising means in order to increase the optical Signal-to-Noise and/or Signal-to-Background ratio**. Carlson at Abstract The invention relates in particular to optical pulsoximetry used for non-invasive measurement of pulsation and oxygen saturation in arterial human or animal blood, and is particularly concerned with increasing the technical performance of pulsoximetry in terms of quality and robustness of the measurement signal versus environmental disturbances and energy consumption. Carlson at [0002] Commercially available pulsoximeter sensors are typically used in hospitals and doctor's offices where the (optical) environment and mounting of the sensor onto the patient's skin are well defined. In the recent past pulsoximetry measuring devices and methods are also offered and used for mobile monitoring and surveying of human individuals, e.g. suffering of diseases, such as heart problems, diabetes, respiratory diseases, insufficient oxygen blood saturation, etc. Pulsoximetry measuring devices are also used in sports for control and survey of athletes. Respective monitoring devices are described within the

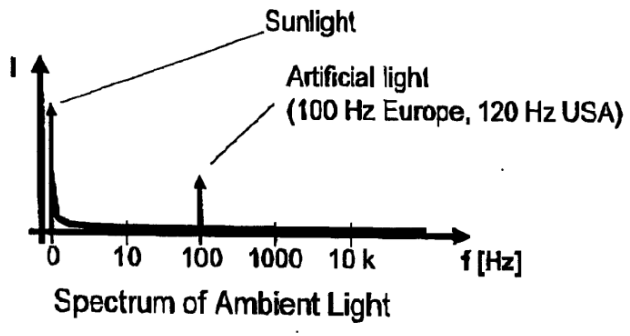
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	international patent application WO02/089 663 which proposes in this respect to monitor in particular persons with cardio vascular disorders by means of pulsoximetry with measurements being taken by means of pulsoximetry preferably on an ear or on a finger. When using pulsoximetry in telemedicine or near patient testing applications, which means e.g. at self-controlling and self-testing of patients in non-ideal environment, standard pulsoximeter sensors suffer from signal instability and insufficient robustness versus environmental disturbances. Carlson at [0004] Critical points are: Human tissue scatters and transmits light in the visible and near infrared (NIR) wavelength range. Therefore, suppression of environmental optical radiation, e.g. sunlight, is difficult by geometric means of the architecture of the pulsoximeter sensor. The power spectrum of environmental optical radiation strongly varies as a function or time and place where the pulsoximeter is used, e.g. day versus night, indoor versus outdoor. Therefore, the background (offset) in the detected optical power varies in a large range, making difficult the analog and digital signal processing of the primary sensor signal. The temporal spectrum of pulsoximeter signals varies in the range of 0.5 Hz to 5 Hz where environmental optical radiation may have significant components leading to parasitic contributions which cannot be separated from the pulsoximeter signals of interest. Realization of a performing electronic band pass filter in the range of 0.5 Hz to 5 Hz, in order to suppress DC offset and high frequency contribution in the pulsoximeter signal, is technically challenging. Further, optical contributions, e.g. temporally structured day-light, and electronic noise, e.g. 1/f (1/frequency-Noise), are stronger in the low frequency range 0.5 Hz to 10 Hz than in higher frequency ranges. Carlson at [0005]-[0009] It is therefore an object of the present invention to **define optical and/or electronic means for increasing the Signal-to-Noise ratio (S/N) and Signal-to-Background ratio (S/B) of a pulsoximeter sensor for robust application of pulsoximetry in telemedicine**- and near patient testing applications

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	in rough (optical) environmental conditions, e.g. at changing light influences, such as sunlight, shadow, artificial light, etc. Carlson at [0010] The posed problem is solved by means of a configuration/method according to the invention. Proposed is a configuration for monitoring which comprises at least one of the following components: at least one measuring sensor for the acquisition of the medical data, such as the state of the cardiovascular and pulmonary system, as e.g. pulsation frequency, oxygen saturation of blood, breathing frequency, etc. of a human being or an animal, comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted through a tissue portion of the person or the animal; at least one beam shaping optical element to direct the emitted light to a human or animal tissue and the light receiver in order to increase the optical signal power. Carlson at [0011]-[0013] The basic idea therefore is to use a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise—and signal/Background ratio. The increase of the S/B ratio is estimated e.g. to a factor 5. Carlson at [0014] The basic idea therefore is to use a **beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power**, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise—and signal/Background ratio. The increase of the S/B ratio is estimated e.g. to a factor 5. Carlson at [0014]

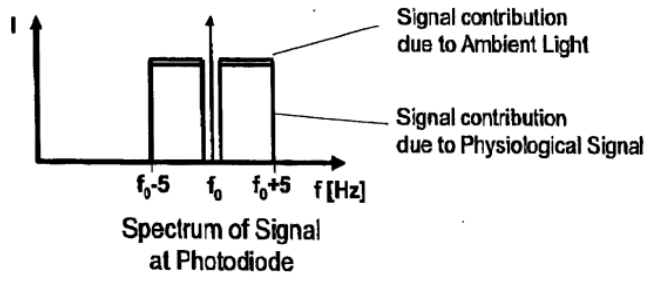
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	Furthermore, the above mentioned problem is solved according to the invention by means of methods according to the invention. Proposed is a method for monitoring e.g. pulsation frequency, oxygen saturation in blood or breathing frequency, which comprises at least one of the following steps: measuring or monitoring medically relevant data of a person or an animal, such as in particular data, which describe the cardiovascular and pulmonary function and/or contain data regarding blood values or blood composition with the use of at least one measuring sensor, which sensor comprises at least one light source which can emit light at least at two wavelengths: direct the emitted light or optical radiation, respectively, by using a beam shaping element, such as e.g. a diffractive or refractive lens to the human or animal tissue; receiving and detecting the emitted and shaped light with at least one light receiving element for determining the light transmitted through the tissue portion of the person or the animal. Carlson at [0022]-[0025] FIG. 2 schematically the ear clip of FIG. 1 in cross section view; Carlson at [0033] FIG. 4 schematically two light emitting sources for an oximetric sensor including beam shaping optics; Carlson at [0035] In FIG. 2, the ear clip 1 is shown in cross section where it can specifically be seen that the sensor is designed in form on a clip 13. The sensor or ear clip 13 furthermore includes a light source 15 which emits a light beam 8 to a light receiver 11. The light is guided or emitted through the ear skin or earlobe 2. Carlson at [0049] As already mentioned in the introduction, the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body. The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which

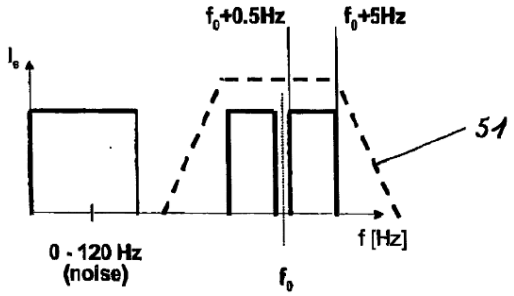
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	means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed. Carlson at [0050] Therefore, it is proposed, as shown in FIG. 4, to use beam shaping optics 20 to direct the emitted optical radiation 8 emitted from the two LEDs 15 to the middle of the earlobe. As it is shown clearly in FIG. 4, using the beam shaping optics 21, the two initial light beams 8 are guided in form of bundled beams 12 to a relatively small area within the middle ear 2**. By using the beam shaping optics 21, of course the influence of environmental light or noise, respectively, can be reduced substantially by increasing the S/B ratio.** First or all, the light beam is bundled and, in addition, the optical signal power can be increased. Carlson at [0054] According to the preferred embodiment of the invention, the various described optical and geometric means, such as the beam shaping element as shown in FIG. 4, the wavelength filters, the sensor architecture, and the mentioned baffles, can be combined as shown in principle and perspective view in FIG. 6 c. Again, **light is emitted from the two LEDs 15 and is shaped by the two beam shaping elements or lenses 21 to be guided as beams 12 through the earlobe 2.** After the earlobe, the double pass filter 33 is arranged to guarantee that only light in the range of approximately 660 nm and in the range of approximately 890 nm is transmitted through the filter. After the filter, any stray light, entered the sensor e.g. trough the earlobe from the side, will be trapped within the baffles 37 which are arranged in circumferential direction. Finally, a photo detecting element 35 is arranged with specific spectrum sensitivity. Carlson at [0062] By using sensor architecture as shown in FIG. 6 c, the Signal-to-Background ratio may be increased in a range of a factor 50 to 1000. **According to a further aspect of the present invention, it is furthermore possible to use a light source modulation to temporarily modulate the optical radiation of the LED**. Carlson at [0063]

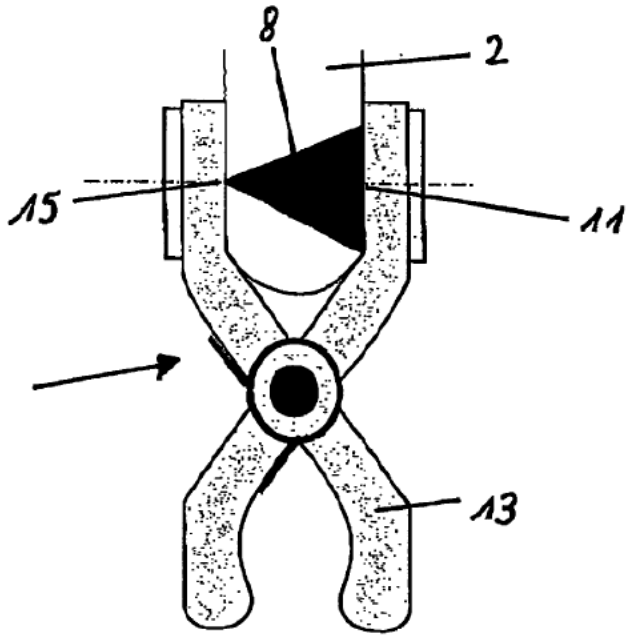
’475 Patent	Carlson
	 Carlson at Fig. 6c **The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range** where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3. Carlson at [0065]

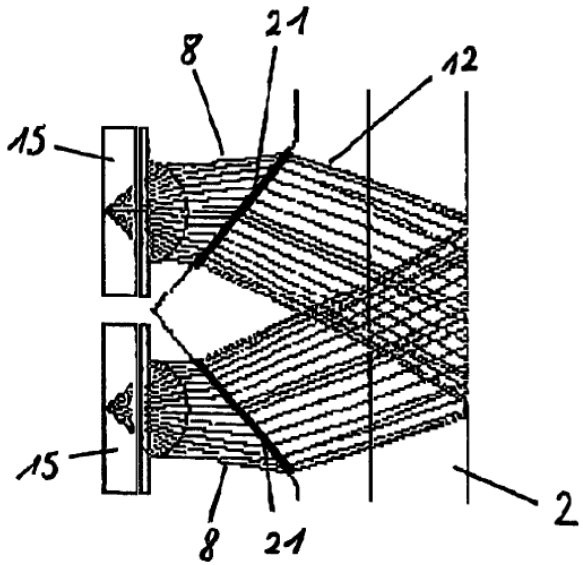
’475 Patent	Carlson
	 Figure 7b Carlson at Fig.7b. The frequency spectrum of ambient light is schematically shown in diagram 7 b. Sunlight is at 0 Hz, while artificial light, such as e.g. electrical in-house light, is going up to approximately 120 Hz (USA). In other words, within the range of frequencies of physiological signals, we have high influence of frequencies of sunlight and ambient light. **A corresponding combined frequency spectrum is shown in Fig. c, which would be detected by a photo diode without the use of any means as described above in relation to FIGS. 1 to 6. FIG. 7 c shows a basic signal contribution due to physiological signal and additional signal contribution due to ambient light**. In other words, the influence of ambient light is quite substantial, and therefore the deviations of the measured values compared to the real values can be dramatic. Carlson at [0067] Besides the high influence of ambient light, also sunlight can have a dramatic influence, e.g. if a person is walking through streets with relatively quick changing conditions between sunlight and shadow. Another serious possibility is caused by a tree avenue when driving along the trees. Sunlight then is received e.g. by the pulsoximetric sensor at a certain frequency, which means that every time when passing a tree, sunlight is attenuated and between the trees sunlight is influencing the measurement of the pulsoximetric sensor. Carlson at [0068]

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	As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069] Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Therefore, it is preferred to further provide means for stabilizing the signal guiding and detecting and to provide means for the beam path to be co-linear with the optical axis of the LED and the photo detector. Because of that, according to FIGS. 10 a and 10 b, it is proposed to use a frame 61 which is stable and does not change its dimensions due to strong movements or an individual carrying the pulsoximetric sensor or due to swelling or contracting of the tissue to be monitored by the

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	pulsoximetric sensor. In this case, of course, other means have to be provided, so that the distance between the LED 15 and the photo detector 11 can be adjusted or adapted to the thickness of the tissue to be monitored. Therefore, according to FIG. 10 a, it is proposed that the LED 15 is arranged within a clamping mechanism 63 and that between the clamping mechanism 63 and the LED a screw connection 65 is arranged, so that the LED 15 can be moved into the clamping mechanism or out of the clamping mechanism 63. In other words, the distance between the LED 15 and the photo detector 11 can be adjusted along the optical axis 67 which guarantees that the beam path has always been co-linear with the optical axis 67 of the LED and the photo detector. Carlson at [0073] The invention, as described with reference to FIG. 1 to 10, is of course not limited to the examples as shown in FIG. 1 to 9, but can be differently designed combined with other features, etc. E.g. pulsoximetric measurements can also be done at other parts of the body like e.g. fingers or toes. In addition, not only one light source can be used for the measurement, but also two or even more light emitting sources. It is understood that also one, two, or more light receiving detectors can be used. All the various above mentioned and proposed means for improving the pulsoximetric monitoring to survey the health condition are not restricted to the measurement of transmitted light through a human or animal tissue. All the proposed means according to the present invention can be used, of course, also by measuring reflected light or as a combination of measuring reflected and transmitted light through a human or animal tissue. Carlson at [0075]  Figure 8

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	 Figure 9 Carlson at Figs. 8 & 9

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	 Figure 2 Carlson at Fig. 2

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	 Figure 4 Carlson at Fig. 4 1. Configuration for the acquisition and/or monitoring of medical data, in particular the state of the cardiovascular and pulmonary system, blood values or blood composition, characterised by at least one measuring sensor for the acquisition of the medical data such as the stare of the cardiovascular system, etc. of a person comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted and/or reflected through a tissue portion of a person or an animal further comprising means in order to increase the optical Signal-to-Noise and/or Signal-to-Background ratio. Carlson at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Carlson discloses or renders obvious, the detection system is configured to be synchronized to the light source. Proposed is a configuration for the acquisition and/or monitoring of medical data, in particular the state of the cardiovascular and pulmonary system, blood values or blood composition, characterised by at least one measuring sensor for the acquisition of the medical data such as the state of the cardiovascular system, etc. of a person comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted and/or reflected through a tissue portion of a person or an animal further comprising means in order to increase the optical Signal-to-Noise and/or Signal-to-Background ratio. Carlson at Abstract It is therefore an object of the present invention to define optical and/or electronic means for increasing the Signal-to-Noise ratio (S/N) and Signal-to-Background ratio (S/B) of a pulsoximeter sensor for robust application of pulsoximetry in telemedicine- and near patient testing applications in rough (optical) environmental conditions, e.g. at changing light influences, such as sunlight, shadow, artificial light, etc. Carlson at [0010 Again, in addition to the above mentioned two configurations, or as an alternative, a further configuration is proposed which comprises at least the following components: at least one measuring sensor on the person or the animal for the acquisition or the monitoring of medically relevant data, such as in particular data, which describe the cardio vascular and pulmonary function and/or contained data regarding blood values or blood composition, which sensor comprises at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted through a tissue portion of the person, **and at least one light source frequency modulating means to frequency modulate the optical radiation of the light source at a carrier frequency in order to shift the power spectrum of the pulsoximeter signals**. **The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the amplitude of the optical radiation of, e.g., the LED at a carrier frequency fc in order**

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	to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency range of, e.g. fc +/−5 Hz, increasing significantly the S/N (Signal/Noise)- and S/B ratio. Carlson at [0018] Furthermore, the above mentioned problem is solved according to the invention by means of methods according to the invention. Proposed is a method for monitoring e.g. pulsation frequency, oxygen saturation in blood or breathing frequency, which comprises at least one of the following steps: measuring or monitoring medically relevant data of a person or an animal, such as in particular data, which describe the cardiovascular and pulmonary function and/or contain data regarding blood values or blood composition with the use of at least one measuring sensor, which sensor comprises at least one light source which can emit light at least at two wavelengths: direct the emitted light or optical radiation, respectively, by using a beam shaping element, such as e.g. a diffractive or refractive lens to the human or animal tissue; receiving and detecting the emitted and shaped light with at least one light receiving element for determining the light transmitted through the tissue portion of the person or the animal. Carlson at [0022]-[0025] Therefore, it is proposed, as shown in FIG. 4, to use beam shaping optics 20 to direct the emitted optical radiation 8 emitted from the two LEDs 15 to the middle of the earlobe. As it is shown clearly in FIG. 4, using the beam shaping optics 21, the two initial light beams 8 are guided in form of bundled beams 12 to a relatively small area within the middle ear 2**.** By using the beam shaping optics 21, of course the influence of environmental light or noise, respectively, can be reduced substantially by increasing the S/B ratio. First or all, the light beam is bundled and, in addition, the optical signal power can be increased. Carlson at [0054] According to the preferred embodiment of the invention, the various described optical and geometric means, such as the beam shaping element as shown in FIG. 4, the wavelength filters, the sensor

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	architecture, and the mentioned baffles, can be combined as shown in principle and perspective view in FIG. 6 c. Again, light is emitted from the two LEDs 15 and is shaped by the two beam shaping elements or lenses 21 to be guided as beams 12 through the earlobe 2. After the earlobe, the double pass filter 33 is arranged to guarantee that only light in the range of approximately 660 nm and in the range of approximately 890 nm is transmitted through the filter. After the filter, any stray light, entered the sensor e.g. trough the earlobe from the side, will be trapped within the baffles 37 which are arranged in circumferential direction. Finally, a photo detecting element 35 is arranged with specific spectrum sensitivity. Carlson at [0062] **The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent**. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3. Carlson at [0065] The frequency spectrum of ambient light is schematically shown in diagram 7 b. Sunlight is at 0 Hz, while artificial light, such as e.g. electrical in-house light, is going up to approximately 120 Hz (USA). In other words, within the range of frequencies of physiological signals, we have high influence of frequencies of sunlight and ambient light. **A corresponding combined frequency spectrum is shown in Fig. c, which would be detected by a photo diode without the use of any means as described above in relation to FIGS. 1 to 6. FIG. 7 c shows a basic signal contribution due to physiological signal and additional signal contribution due to ambient light**. In other words, the influence of ambient light is quite substantial, and therefore the deviations of the measured values compared to the real values can be dramatic. Carlson at [0067] Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during

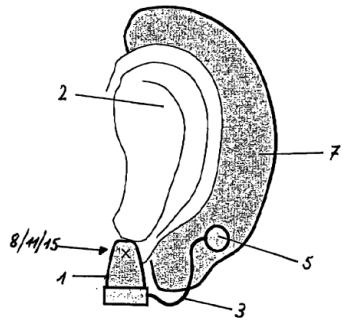
’475 Patent	Carlson
	the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Therefore, it is preferred to further provide means for stabilizing the signal guiding and detecting and to provide means for the beam path to be co-linear with the optical axis of the LED and the photo detector. Because of that, according to FIGS. 10 a and 10 b, it is proposed to use a frame 61 which is stable and does not change its dimensions due to strong movements or an individual carrying the pulsoximetric sensor or due to swelling or contracting of the tissue to be monitored by the pulsoximetric sensor. In this case, of course, other means have to be provided, so that the distance between the LED 15 and the photo detector 11 can be adjusted or adapted to the thickness of the tissue to be monitored. Therefore, according to FIG. 10 a, it is proposed that the LED 15 is arranged within a clamping mechanism 63 and that between the clamping mechanism 63 and the LED a screw connection 65 is arranged, so that the LED 15 can be moved into the clamping mechanism or out of the clamping mechanism 63. In other words, the distance between the LED 15 and the photo detector 11 can be adjusted along the optical axis 67 which guarantees that the beam path has always been co-linear with the optical axis 67 of the LED and the photo detector. Carlson at [0073] The invention, as described with reference to FIG. 1 to 10, is of course not limited to the examples as shown in FIG. 1 to 9, but can be differently designed combined with other features, etc. E.g. pulsoximetric measurements can also be done at other parts of the body like e.g. fingers or toes. In addition, not only one light source can be used for the measurement, but also two or even more light emitting sources. It is understood that also one, two, or more light receiving detectors can be used. All the various above mentioned and proposed means for improving the pulsoximetric monitoring to survey the health condition are not restricted to the measurement of transmitted light through a human or animal tissue. All the proposed means according to the present invention can be used, of course, also by measuring reflected light or as a combination of measuring reflected and transmitted light through a human or animal tissue. Carlson at [0075] 1. Configuration for the acquisition and/or monitoring of medical data, in particular the state of the cardiovascular and pulmonary system, blood values or blood composition, characterised by at least one measuring sensor for the acquisition of the medical data such as the stare of the cardiovascular system,

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	etc. of a person comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted and/or reflected through a tissue portion of a person or an animal further comprising means in order to increase the optical Signal-to-Noise and/or Signal-to-Background ratio. Carlson at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	Carlson discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. Critical points are: Human tissue scatters and transmits light in the visible and near infrared (NIR) wavelength range. Therefore, suppression of environmental optical radiation, e.g. sunlight, is difficult by geometric means of the architecture of the pulsoximeter sensor. The power spectrum of environmental optical radiation strongly varies as a function or time and place where the pulsoximeter is used, e.g. day versus night, indoor versus outdoor. Therefore, the background (offset) in the detected optical power varies in a large range, making difficult the analog and digital signal processing of the primary sensor signal. The temporal spectrum of pulsoximeter signals varies in the range of 0.5 Hz to 5 Hz where environmental optical radiation may have significant components leading to parasitic contributions which cannot be separated from the pulsoximeter signals of interest. Realization of a performing electronic band pass filter in the range of 0.5 Hz to 5 Hz, in order to suppress DC offset and high frequency contribution in the pulsoximeter signal, is technically challenging. Further, optical contributions, e.g. temporally structured day-light, and electronic noise, e.g. 1/f (1/frequency-Noise), are stronger in the low frequency range 0.5 Hz to 10 Hz than in higher frequency ranges. Carlson at [0005]

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	The power spectrum of environmental optical radiation strongly varies as a function or time and place where the pulsoximeter is used, e.g. day versus night, indoor versus outdoor. Therefore, the background (offset) in the detected optical power varies in a large range, **making difficult the analog and digital signal processing of the primary sensor signal**. Carlson at [0006] The basic idea therefore is to use a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise—and signal/Background ratio. The increase of the S/B ratio is estimated e.g. to a factor 5. Carlson at [0014] Furthermore, the above mentioned problem is solved according to the invention by means of methods according to the invention. Proposed is a method for monitoring e.g. pulsation frequency, oxygen saturation in blood or breathing frequency, which comprises at least one of the following steps: measuring or monitoring medically relevant data of a person or an animal, such as in particular data, which describe the cardiovascular and pulmonary function and/or contain data regarding blood values or blood composition with the use of at least one measuring sensor, which sensor comprises at least one light source which can emit light at least at two wavelengths: direct the emitted light or optical radiation, respectively, by using a beam shaping element, such as e.g. a diffractive or refractive lens to the human or animal tissue; receiving and detecting the emitted and shaped light with at least one light receiving element for determining the light transmitted through the tissue portion of the person or the animal. Carlson at [0022]-[0025] The invention, as described with reference to FIG. 1 to 10, is of course not limited to the examples as shown in FIG. 1 to 9, but can be differently designed combined with other features, etc. E.g. pulsoximetric measurements can also be done at other parts of the body like e.g. fingers or toes. In

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	addition, not only one light source can be used for the measurement, but also two or even more light emitting sources. **It is understood that also one, two, or more light receiving detectors can be used.** All the various above mentioned and proposed means for improving the pulsoximetric monitoring to survey the health condition are not restricted to the measurement of transmitted light through a human or animal tissue. All the proposed means according to the present invention can be used, of course, also by measuring reflected light or as a combination of measuring reflected and transmitted light through a human or animal tissue. Carlson at [0075] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	Carlson discloses or renders obvious the output signal is indicative of the one or more physiological parameters. Proposed is a configuration for the acquisition and/or monitoring of medical data, in particular the state of the cardiovascular and pulmonary system, blood values or blood composition, characterised by at least one measuring sensor for the acquisition of the medical data such as the state of the cardiovascular system, etc. of a person comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted and/or reflected through a tissue portion of a person or an animal further comprising means in order to increase the optical Signal-to-Noise and/or Signal-to-Background ratio. Carlson at [Abstract] In FIG. 2, the ear clip 1 is shown in cross section where it can specifically be seen that the sensor is designed in form on a clip 13. The sensor or ear clip 13 furthermore includes a light source 15 which emits a light beam 8 to a light receiver 11. The light is guided or emitted through the ear skin or earlobe 2.

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	Carlson at [0049] As already mentioned in the introduction**, the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body.** The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed. Carlson at [0050] Of course, the sensor can also be arranged at other parts of the human body, such as e.g. at a finger or a toe. In addition, the monitoring can also be executed at animals, which means that pulsoximetric sensors can also be arranged e.g. at the ear of animals, such as e.g. cows. According to an alternative design of the sensor, it could also be possible to arrange the light receiver in such a way so that the light reflected through the earlobe is determined. Again, according to a further alternative, it could even be possible by arranging at least two light receivers to determine the light transmitted through the earlobe and the light reflected by the earlobe. Carlson at [0052] As an alternative or in addition to using beam shaping optics, it is also possible to influence the sensor architecture of the pulsoximetric sensor. First of all, it is possible to use a light receiving or light sensitive element 11 with reduced light sensitivity outside the spectral range of the band limited light source as LEDs. **FIG. 5 a shows the light absorption curves of with oxygen saturated 22 and unsaturated 23 blood**. As visible from the shown diagram, the sensor architecture, which means the spectrum sensitivity, should be in the range within approximately 500 nm to approximately 1000 nm. In addition, in FIG. 5 a the two wavelengths λ1 and λ2 are indicated at which the pulsoximetric sensor is operated. Carlson at [0055] **FIG. 7 a shows a spectrum of physiological signals, such as pulsation frequency, breathing frequency, etc.** The frequency of physiological events is within the range of approximately 0.5 Hz (30

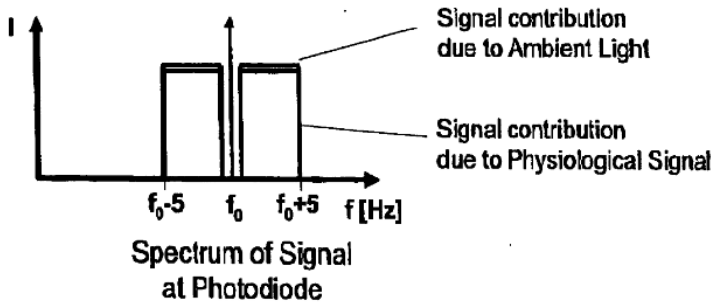
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	heartbeats in one minute) up to approximately 3 Hz (180 heartbeats in one minute) that can be even higher and therefore is supposed to go up to 5 Hz. Carlson at [0066] By using one of the proposed devices or methods, respectively, according to the present invention or a combination thereof, it is possible to use pulsoximetric measurement or monitoring to survey the health condition of a person or an animal which is mobile. In other words, pulsoximetric measurement is not restricted for use in, e.g., a hospital but can also be used, if a person is travelling, is staying at home, etc. Furthermore, it is also possible to study health conditions of animals living in nature such as e.g. cows feeding outside. Carlson at [0072]  Figure 1 Carlson at Fig.1 Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector.

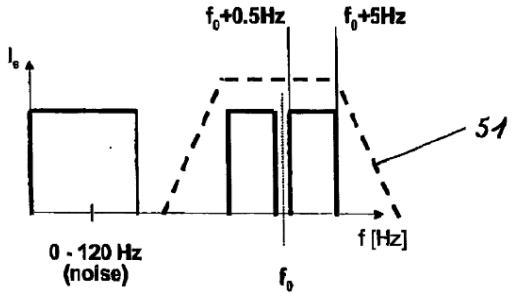
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	Carlson at [0073] Furthermore, all the above mentioned means for improving the measurement of the oxygen saturation of blood using a light source can, of course, also be used by any further kind of measurements using a light source such as, e.g., non-invasive monitoring or arterial carbon dioxide partial tension, the content of blood sugar, etc. **In other words, for any kind of measuring blood properties using light emission through a human or animal tissue, the above mentioned means for improving the measurement can be used. This means that the present invention is not at all restricted to optical pulsoximetry used for non-invasive measure of pulsation and oxygen saturation in arterial human or animal blood**. Carlson at [0076] The measured values can be transmitted via a wire connection or wireless, e.g. within the range of radio frequency. Well known these days is wireless transmission using “Bluetooth” technology. According to a further embodiment, the pulsoximetric sensor could be included within a hearing aid device. Carlson at [0077] Taking prior art into consideration, the measured values can be monitored at a special unit worn by the person or patient, respectively, where e.g. a signal is generated, if the measured value is not within a predetermined range. In other words, health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0078] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Carlson discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. **The basic idea therefore is to use a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter sensor, and thus increasing the Signal/Noise—and signal/Background ratio**. The increase of the S/B ratio is estimated e.g. to a factor 5. Carlson at [0014] Again, in addition to the above mentioned two configurations, or as an alternative, a further configuration is proposed which comprises at least the following components: at least one measuring sensor on the person or the animal for the acquisition or the monitoring of medically relevant data, such as in particular data, which describe the cardio vascular and pulmonary function and/or contained data regarding blood values or blood composition, which sensor comprises at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted through a tissue portion of the person, and at least one light source frequency modulating means to frequency modulate the optical radiation of the light source at a carrier frequency in order to shift the power spectrum of the pulsoximeter signals. The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the amplitude of the optical radiation of, e.g., the LED at a carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency range of, e.g. fc +/−5 Hz, increasing significantly the S/N (Signal/Noise)- and S/B ratio. Carlson at [0018] Therefore, it is proposed, as shown in FIG. 4, to use beam shaping optics 20 to direct the emitted optical radiation 8 emitted from the two LEDs 15 to the middle of the earlobe. As it is shown clearly in FIG. 4, using the beam shaping optics 21, the two initial light beams 8 are guided in form of bundled beams 12 to a relatively small area within the middle ear 2. **By using the beam shaping optics 21, of course the**

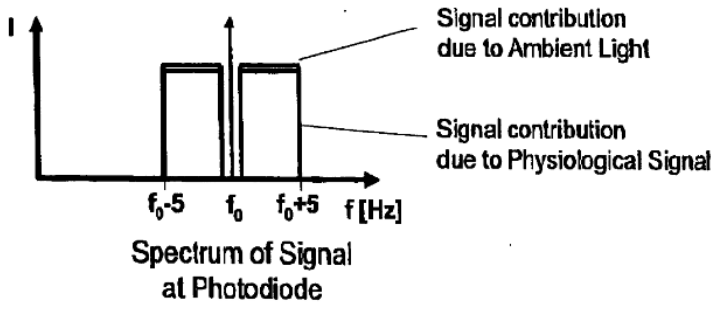
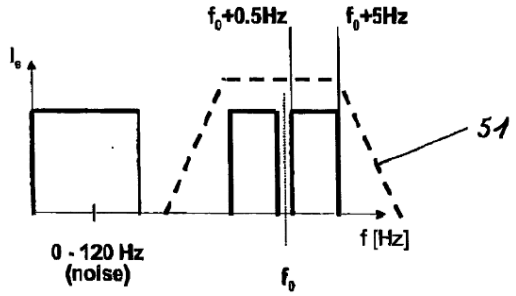
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	influence of environmental light or noise, respectively, can be reduced substantially by increasing the S/B ratio. First or all, the light beam is bundled and, in addition, the optical signal power can be increased. Carlson at [0054] The frequency spectrum of ambient light is schematically shown in diagram 7 b. Sunlight is at 0 Hz, while artificial light, such as e.g. electrical in-house light, is going up to approximately 120 Hz (USA). In other words, within the range of frequencies of physiological signals, we have high influence of frequencies of sunlight and ambient light. A corresponding combined frequency spectrum is shown in Fig. c, which would be detected by a photo diode without the use of any means as described above in relation to FIGS. 1 to 6. FIG. 7 c shows a basic signal contribution due to physiological signal and additional signal contribution due to ambient light. In other words, the influence of ambient light is quite substantial, and therefore the deviations of the measured values compared to the real values can be dramatic. Carlson at [0067] As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even

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	possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069] 1**. Configuration for the acquisition and/or monitoring of medical data, in particular the state of the cardiovascular and pulmonary system, blood values or blood composition, characterised by at least one measuring sensor for the acquisition of the medical data such as the stare of the cardiovascular system, etc. of a person comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted and/or reflected through a tissue portion of a person or an animal further comprising means in order to increase the optical Signal-to-Noise and/or Signal-to-Background ratio**. Carlson at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Carlson discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off. **As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio**. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and

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	f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069]  Figure 8

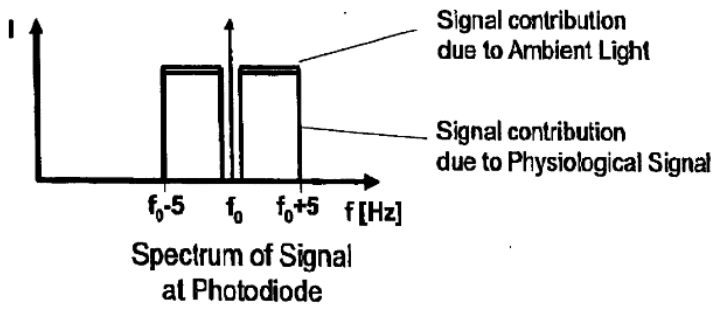
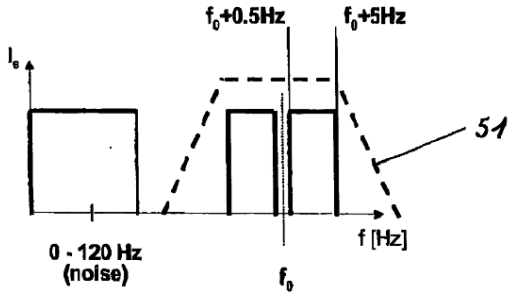
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	 Figure 9 Carlson at Fig. 8 & 9 Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Therefore, it is preferred to further provide means for stabilizing the signal guiding and detecting and to provide means for the beam path to be co-linear with the optical axis of the LED and the photo detector. Because of that, according to FIGS. 10 a and 10 b, it is proposed to use a frame 61 which is stable and does not change its dimensions due to strong movements or an individual carrying the pulsoximetric sensor or due to swelling or contracting of the tissue to be monitored by the pulsoximetric sensor. In this case, of course, other means have to be provided, so that the distance between the LED 15 and the photo detector 11 can be adjusted or adapted to the thickness of the tissue to be monitored. Therefore, according to FIG. 10 a, it is proposed that the LED 15 is arranged within a clamping mechanism 63 and that between the clamping mechanism 63 and the LED a screw connection 65 is arranged, so that the LED 15 can be moved into the clamping mechanism or out of the clamping mechanism 63. In other words, the distance between the LED 15 and the photo detector 11 can be

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	adjusted along the optical axis 67 which guarantees that the beam path has always been co-linear with the optical axis 67 of the LED and the photo detector. Carlson at [0073] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Carlson discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. **As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio**. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As

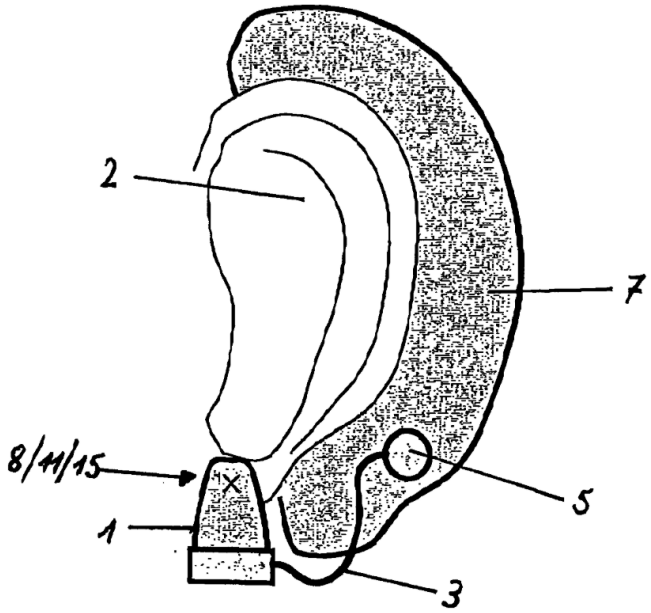
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	a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069]  Figure 8  Figure 9 Carlson at Fig. 8 & 9

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	Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Therefore, it is preferred to further provide means for stabilizing the signal guiding and detecting and to provide means for the beam path to be co-linear with the optical axis of the LED and the photo detector. Because of that, according to FIGS. 10 a and 10 b, it is proposed to use a frame 61 which is stable and does not change its dimensions due to strong movements or an individual carrying the pulsoximetric sensor or due to swelling or contracting of the tissue to be monitored by the pulsoximetric sensor. In this case, of course, other means have to be provided, so that the distance between the LED 15 and the photo detector 11 can be adjusted or adapted to the thickness of the tissue to be monitored. Therefore, according to FIG. 10 a, it is proposed that the LED 15 is arranged within a clamping mechanism 63 and that between the clamping mechanism 63 and the LED a screw connection 65 is arranged, so that the LED 15 can be moved into the clamping mechanism or out of the clamping mechanism 63. In other words, the distance between the LED 15 and the photo detector 11 can be adjusted along the optical axis 67 which guarantees that the beam path has always been co-linear with the optical axis 67 of the LED and the photo detector. Carlson at [0073] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Carlson discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. The basic idea therefore is to use a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct the emitted optical radiation of, e.g., the LED light source into the human or animal tissue and the photon detecting element in order to increase the optical signal power, detected by the pulsoximeter

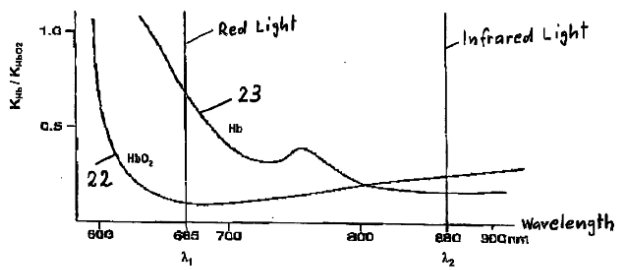
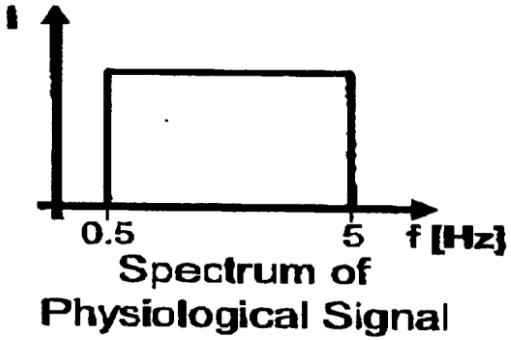
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	sensor, and thus increasing the Signal/Noise—and signal/Background ratio. The increase of the S/B ratio is estimated e.g. to a factor 5. Carlson at [0014] **As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio**. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. **The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor**. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. By using light source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069]

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	 Figure 8  Figure 9 Carlson at Fig. 8 & 9 Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase

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	and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Therefore, it is preferred to further provide means for stabilizing the signal guiding and detecting and to provide means for the beam path to be co-linear with the optical axis of the LED and the photo detector. Because of that, according to FIGS. 10 a and 10 b, it is proposed to use a frame 61 which is stable and does not change its dimensions due to strong movements or an individual carrying the pulsoximetric sensor or due to swelling or contracting of the tissue to be monitored by the pulsoximetric sensor. In this case, of course, other means have to be provided, so that the distance between the LED 15 and the photo detector 11 can be adjusted or adapted to the thickness of the tissue to be monitored. Therefore, according to FIG. 10 a, it is proposed that the LED 15 is arranged within a clamping mechanism 63 and that between the clamping mechanism 63 and the LED a screw connection 65 is arranged, so that the LED 15 can be moved into the clamping mechanism or out of the clamping mechanism 63. In other words, the distance between the LED 15 and the photo detector 11 can be adjusted along the optical axis 67 which guarantees that the beam path has always been co-linear with the optical axis 67 of the LED and the photo detector. Carlson at [0073] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Carlson discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. Proposed is a configuration for the acquisition and/or monitoring of medical data, in particular the state of the cardiovascular and pulmonary system, blood values or blood composition, characterised by at least one measuring sensor for the acquisition of the medical data such as the state of the cardiovascular system, etc. of a person comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted and/or reflected through a tissue portion of a person or an animal further comprising means in order to increase the optical Signal-to-Noise and/or Signal-to-Background ratio.

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	Carlson at [Abstract]  Figure 1 Carlson at Fig. 1 FIG. 1 shows schematically the arrangement of an ear sensor 1 which can be arranged in form of an ear clip. This sensor 1 can be arranged e.g. at an earlobe of ear 2**.** Furthermore, the sensor or ear clip is connected via a wire 3 and the connection 5 with the main unit 7 including e.g. a power source, like a battery, and measuring and/or monitoring electronics. Carlson at [0048] In FIG. 2, the ear clip 1 is shown in cross section where it can specifically be seen that the sensor is designed in form on a clip 13. The sensor or ear clip 13 furthermore includes a light source 15 which

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	emits a light beam 8 to a light receiver 11. The light is guided or emitted through the ear skin or earlobe 2. Carlson at [0049] As already mentioned in the introduction**,** the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body**.** The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed. Carlson at [0050] Of course, the sensor can also be arranged at other parts of the human body, such as e.g. at a finger or a toe. In addition, the monitoring can also be executed at animals, which means that pulsoximetric sensors can also be arranged e.g. at the ear of animals, such as e.g. cows. According to an alternative design of the sensor, it could also be possible to arrange the light receiver in such a way so that the light reflected through the earlobe is determined. Again, according to a further alternative, it could even be possible by arranging at least two light receivers to determine the light transmitted through the earlobe and the light reflected by the earlobe. Carlson at [0052] As an alternative or in addition to using beam shaping optics, it is also possible to influence the sensor architecture of the pulsoximetric sensor. First of all, it is possible to use a light receiving or light sensitive element 11 with reduced light sensitivity outside the spectral range of the band limited light source as LEDs. FIG. 5 a shows the light absorption curves of with oxygen saturated 22 and unsaturated 23 blood. As visible from the shown diagram, the sensor architecture, which means the spectrum sensitivity, should be in the range within approximately 500 nm to approximately 1000 nm. In addition, in FIG. 5 a the two wavelengths $\lambda 1$ and $\lambda 2$ are indicated at which the pulsoximetric sensor is operated. Carlson at [0055]

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	 Figure 5a Carlson at Fig. 5a FIG. 7 a shows a spectrum of physiological signals, such as pulsation frequency, breathing frequency, etc. The frequency of physiological events is within the range of approximately 0.5 Hz (30 heartbeats in one minute) up to approximately 3 Hz (180 heartbeats in one minute) that can be even higher and therefore is supposed to go up to 5 Hz. Carlson at [0066]  Figure 7a

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	Carlson at Fig. 7a By using one of the proposed devices or methods, respectively, according to the present invention or a combination thereof, it is possible to use pulsoximetric measurement or monitoring to survey the health condition of a person or an animal which is mobile. In other words, pulsoximetric measurement is not restricted for use in, e.g., a hospital but can also be used, if a person is travelling, is staying at home, etc. Furthermore, it is also possible to study health conditions of animals living in nature such as e.g. cows feeding outside. Carlson at [0072] Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Carlson at [0073] The invention, as described with reference to FIG. 1 to 10, is of course not limited to the examples as shown in FIG. 1 to 9, but can be differently designed combined with other features, etc. E.g. pulsoximetric measurements can also be done at other parts of the body like e.g. fingers or toes**.** In addition, not only one light source can be used for the measurement, but also two or even more light emitting sources. It is understood that also one, two, or more light receiving detectors can be used. All the various above mentioned and proposed means for improving the pulsoximetric monitoring to survey the health condition are not restricted to the measurement of transmitted light through a human or animal tissue. All the proposed means according to the present invention can be used, of course, also by measuring reflected light or as a combination of measuring reflected and transmitted light through a human or animal tissue. Carlson at [0075]

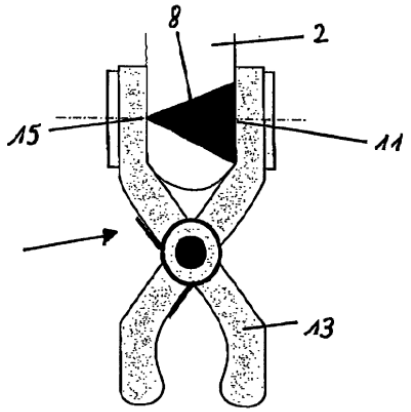
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	Furthermore, all the above mentioned means for improving the measurement of the oxygen saturation of blood using a light source can, of course, also be used by any further kind of measurements using a light source such as, e.g., non-invasive monitoring or arterial carbon dioxide partial tension, the content of blood sugar, etc. In other words, for any kind of measuring blood properties using light emission through a human or animal tissue, the above mentioned means for improving the measurement can be used. This means that the present invention is not at all restricted to optical pulsoximetry used for non-invasive measure of pulsation and oxygen saturation in arterial human or animal blood. Carlson at [0076] The measured values can be transmitted via a wire connection or wireless, e.g. within the range of radio frequency. Well known these days is wireless transmission using “Bluetooth” technology. According to a further embodiment, the pulsoximetric sensor could be included within a hearing aid device. Carlson at [0077] **Taking prior art into consideration, the measured values can be monitored at a special unit worn by the person or patient, respectively, where e.g. a signal is generated, if the measured value is not within a predetermined range**. In other words, health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0078] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus	See claim 1 above.

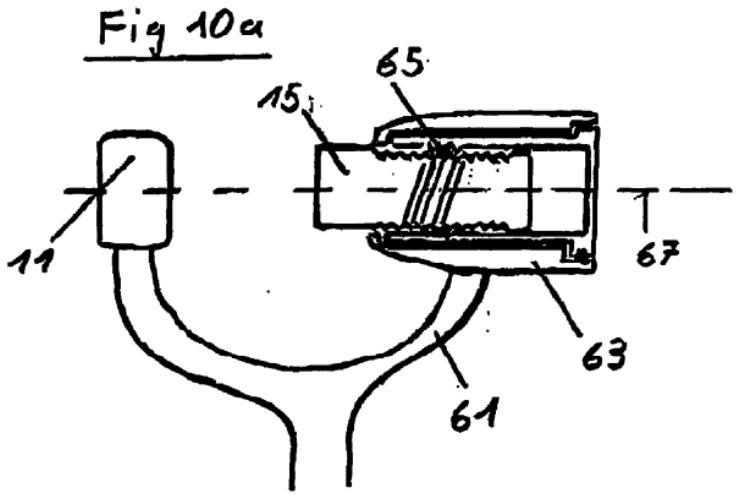
’475 Patent	Carlson
further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.	Carlson discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal. Commercially available pulsoximeter sensors are typically used in hospitals and doctor's offices where the (optical) environment and mounting of the sensor onto the patient's skin are well defined. In the recent past pulsoximetry measuring devices and methods are also offered and used for mobile monitoring and surveying of human individuals, e.g. suffering of diseases, such as heart problems, diabetes, respiratory diseases, insufficient oxygen blood saturation, etc. Pulsoximetry measuring devices are also used in sports for control and survey of athletes. Respective monitoring devices are described within the international patent application WO02/089 663 which proposes in this respect to monitor in particular persons with cardio vascular disorders by means of pulsoximetry with measurements being taken by means of pulsoximetry preferably on an ear or on a finger. When using pulsoximetry in telemedicine or near patient testing applications, which means e.g. at self-controlling and self-testing of patients in non-ideal environment, standard pulsoximeter sensors suffer from signal instability and insufficient robustness versus environmental disturbances. Carlson at [0004] Critical points are: Human tissue scatters and transmits light in the visible and near infrared (NIR) wavelength range. Therefore, suppression of environmental optical radiation, e.g. sunlight, is difficult by geometric means of the architecture of the pulsoximeter sensor. The power spectrum of environmental optical radiation strongly varies as a function or time and place where the pulsoximeter is used, e.g. day versus night, indoor versus outdoor. Therefore, the background (offset) in the detected optical power varies in a large range, making difficult the analog and digital signal processing of the primary sensor signal. The temporal spectrum of pulsoximeter signals varies in the range of 0.5 Hz to 5 Hz where environmental optical radiation may have significant components leading to parasitic contributions which cannot be separated from the pulsoximeter signals of interest. Realization of a performing electronic band pass filter in the range of 0.5 Hz to 5 Hz, in order to suppress DC offset and high frequency contribution in the pulsoximeter signal, is technically challenging. Further, optical contributions, e.g. temporally structured day-light, and electronic noise, e.g. 1/f (1/frequency-Noise), are stronger in the low frequency range 0.5 Hz to 10 Hz than in higher frequency ranges.

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	Carlson at [0005-0009] The measured values can be transmitted via a wire connection or wireless, e.g. within the range of radio frequency. Well known these days is wireless transmission using “Bluetooth” technology. According to a further embodiment, the pulsoximetric sensor could be included within a hearing aid device. Carlson at [0077] Taking prior art into consideration, the measured values can be monitored at a special unit worn by the person or patient, respectively, where e.g. a signal is generated, if the measured value is not within a predetermined range. In other words, health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0078] 1. Configuration for the acquisition and/or monitoring of medical data, in particular the state of the cardiovascular and pulmonary system, blood values or blood composition, characterised by at least one measuring sensor for the acquisition of the medical data such as the stare of the cardiovascular system, etc. of a person comprising at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted and/or reflected through a tissue portion of a person or an animal further comprising means in order to increase the optical Signal-to-Noise and/or Signal-to-Background ratio. Carlson at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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Claim 6	
6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	See claim 1 above. Carlson discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. As already mentioned in the introduction, the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body. The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed. Carlson at [0050] Of course, the sensor can also be arranged at other parts of the human body, such as e.g. at a finger or a toe. In addition, the monitoring can also be executed at animals, which means that pulsoximetric sensors can also be arranged e.g. at the ear of animals, such as e.g. cows. According to an alternative design of the sensor, it could also be possible to arrange the light receiver in such a way so that the light reflected through the earlobe is determined. Again, according to a further alternative, it could even be possible by arranging at least two light receivers to determine the light transmitted through the earlobe and the light reflected by the earlobe. Carlson at [0052] As a consequence, FIG. 5 b shows the spectrum sensitivity of a silicon photo detecting element which is suitable for the use in a pulsoximetric sensor according to the present invention. As shown, the detection sensitivity is within a range of approximately 500 to 1000 nm. In other words, any light below or above this range would not be detected by the light receiving element with a sensitivity as shown in FIG. 5 b. In addition, it is possible to arrange an optical wavelength filter or double pass filter which is e.g. light permeable at the wavelength of approximately 660 nm and in the range of approximately 850 nm to 910 nm. A corresponding transmission spectrum of such a double band pass filter will be suitably used in a pulsoximetric sensor as shown in FIG. 5 c.

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	Carlson at [0056] Of course, it is furthermore possible to combine wavelength filters, wavelength sensitive receivers like photodiodes, with beam shaping optics as described with reference to FIG. 4. Carlson at [0058] Coming back to the fixing system, which means a clip as shown in FIGS. 1 and 2, it has to be mentioned that when using a clip for fixing a pulsoximetric sensor, problems could occur due to strong movements of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance between the LED 15 and the photo detector 11 would increase and, what is even more critical, the beam path could divert substantially from the optical axis of the LED and the photo detector. Therefore, it is preferred to further provide means for stabilizing the signal guiding and detecting and to provide means for the beam path to be co-linear with the optical axis of the LED and the photo detector. Because of that, according to FIGS. 10 a and 10 b, it is proposed to use a frame 61 which is stable and does not change its dimensions due to strong movements or an individual carrying the pulsoximetric sensor or due to swelling or contracting of the tissue to be monitored by the pulsoximetric sensor. In this case, of course, other means have to be provided, so that the distance between the LED 15 and the photo detector 11 can be adjusted or adapted to the thickness of the tissue to be monitored. Therefore, according to FIG. 10 a, it is proposed that the LED 15 is arranged within a clamping mechanism 63 and that between the clamping mechanism 63 and the LED a screw connection 65 is arranged, so that the LED 15 can be moved into the clamping mechanism or out of the clamping mechanism 63. In other words, the distance between the LED 15 and the photo detector 11 can be adjusted along the optical axis 67 which guarantees that the beam path has always been co-linear with the optical axis 67 of the LED and the photo detector. Carlson at [0073]

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	 Figure 2 Carlson at Fig.2 The invention, as described with reference to FIG. 1 to 10, is of course not limited to the examples as shown in FIG. 1 to 9, but can be differently designed combined with other features, etc. E.g. pulsoximetric measurements can also be done at other parts of the body like e.g. fingers or toes**. In addition, not only one light source can be used for the measurement, but also two or even more light emitting sources. It is understood that also one, two, or more light receiving detectors can be used**. All the various above mentioned and proposed means for improving the pulsoximetric monitoring to survey the health condition are not restricted to the measurement of transmitted light through a human or animal tissue. All the proposed means according to the present invention can be used, of course, also by measuring reflected light or as a combination of measuring reflected and transmitted light through a human or animal tissue. Carlson at [0075]

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	 Carlson at Fig. 10a. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons	See claim 6 above. Carlson discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. Commercially available pulsoximeter sensors are typically used in hospitals and doctor's offices where the (optical) environment and mounting of the sensor onto the patient's skin are well defined. In the recent past pulsoximetry measuring devices and methods are also offered and used for mobile monitoring and surveying of human individuals, e.g. suffering of diseases, such as heart problems, diabetes,

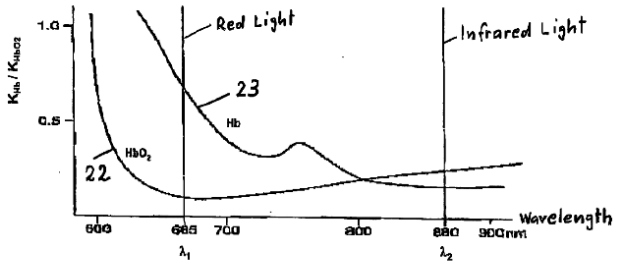
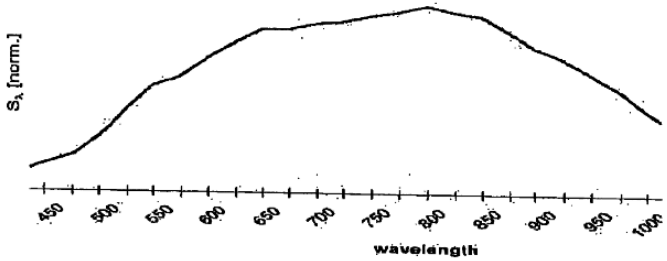
'475 Patent	Carlson
or knobs, a microprocessor, and a touch screen.	respiratory diseases, insufficient oxygen blood saturation, etc. Pulsoximetry measuring devices are also used in sports for control and survey of athletes. Respective monitoring devices are described within the international patent application WO02/089 663 which proposes in this respect to monitor in particular persons with cardio vascular disorders by means of pulsoximetry with measurements being taken by means of pulsoximetry preferably on an ear or on a finger. When using pulsoximetry in telemedicine or near patient testing applications, which means e.g. at self-controlling and self-testing of patients in non-ideal environment, standard pulsoximeter sensors suffer from signal instability and insufficient robustness versus environmental disturbances. Carlson at [0004] By using one of the proposed devices or methods, respectively, according to the present invention or a combination thereof, it is possible to use pulsoximetric measurement or monitoring to survey the health condition of a person or an animal which is mobile. In other words, pulsoximetric measurement is not restricted for use in, e.g., a hospital but can also be used, if a person is travelling, is staying at home, etc. Furthermore, it is also possible to study health conditions of animals living in nature such as e.g. cows feeding outside. Carlson at [0072] The measured values can be transmitted via a wire connection or wireless, e.g. within the range of radio frequency. Well known these days is wireless transmission using "Bluetooth" technology. According to a further embodiment, the pulsoximetric sensor could be included within a hearing aid device. Carlson at [0077] Taking prior art into consideration, the measured values can be monitored at a special unit worn by the person or patient, respectively, where e.g. a signal is generated, if the measured value is not within a predetermined range. In other words, health problems could be detected and an alarm signal could be generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0078]

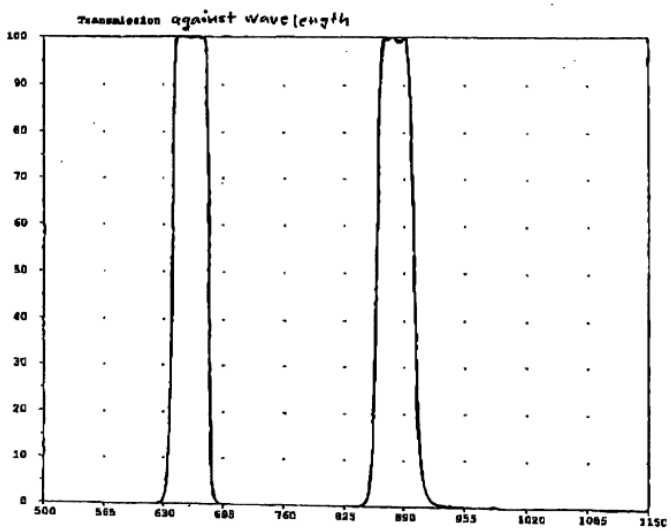
’475 Patent	Carlson
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Carlson discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. *See* claim 1[pre], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Carlson discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;. *See* claim 1[c], 1[j], 1[k], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Carlson discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. *See* claim 1[d], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Carlson discloses or renders obvious a detector. *See* claim 1[e], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Carlson discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. *See* claim 1[k], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Carlson discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. *See* claim 1[j], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	Carlson discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. *See* claim 1[e], 1[h], 1[l], above. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.	Carlson discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user. *See* claim 1[m], above.

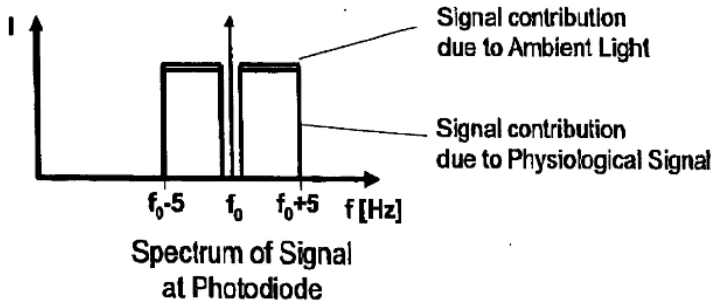
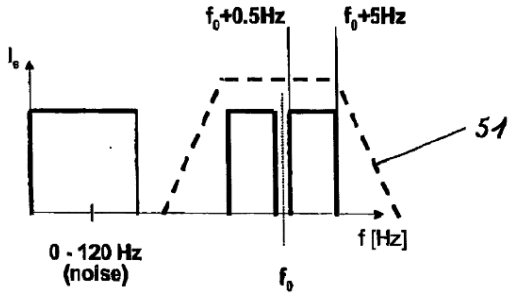
’475 Patent	Carlson
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. Carlson discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. Pulsoximetry is a widely used standard optical technology for non-invasive monitoring of pulsation and oxygen saturation in arterial human or animal blood [1]. Th**e method consists of measuring the absorption of reduced (Hb)—and oxidized (HbO2) haemoglobin at two optical wavelengths, where the relative absorption coefficients differ significantly, e.g. 660 nm and a second wavelength in the range of 800 to 1000 nm, preferably 890 nm or 950 nm**. A concise description of the measurement method and the sensor signals is given in [2]. Carlson at [0003] As already mentioned in the introduction, the sensor is working according to the oximetric principal which is known best out of the state of the art. Optical pulsoximetry is used for non-invasive measurement, e.g. for pulsation and oxygen saturation in the human body. **The light source is emitting light at two wavelengths, at 660 nm and a second wavelength within the range of 800 to 1000 nm, which means in the present case at 890 nm. Therefore, it is of course also possible to have two light emitting sources arranged, which means two LEDs. The light receiver is determining the light transmitted through the earlobe, which means through the tissue portion of a person to be surveyed**. Carlson at [0050] As an alternative or in addition to using beam shaping optics, it is also possible to influence the sensor architecture of the pulsoximetric sensor. First of all, it is possible to use a light receiving or light sensitive

’475 Patent	Carlson
	element 11 with reduced light sensitivity outside the spectral range of the band limited light source as LEDs. FIG. 5 a shows the light absorption curves of with oxygen saturated 22 and unsaturated 23 blood. **As visible from the shown diagram, the sensor architecture, which means the spectrum sensitivity, should be in the range within approximately 500 nm to approximately 1000 nm. In addition, in FIG. 5 a the two wavelengths λ1 and λ2 are indicated at which the pulsoximetric sensor is operated**. Carlson at [0055] As a consequence, FIG. 5 b shows the spectrum sensitivity of a silicon photo detecting element which is suitable for the use in a pulsoximetric sensor according to the present invention. As shown, the detection sensitivity is within a range of approximately 500 to 1000 nm. In other words, any light below or above this range would not be detected by the light receiving element with a sensitivity as shown in FIG. 5 b. In addition, it is possible to arrange an optical wavelength filter or double pass filter which is e.g. light permeable at the wavelength of approximately 660 nm and in the range of approximately 850 nm to 910 nm. A corresponding transmission spectrum of such a double band pass filter will be suitably used in a pulsoximetric sensor as shown in FIG. 5 c. Carlson at [0056]  Figure 5a  Figure 5b

’475 Patent	Carlson
	 Figure 5c Carlson at Fig. 5a,5b & 5c One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a	See claim 8 above. *See* claim 1[b], above.

’475 Patent	Carlson
blood constituent or a blood flow of the user.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	See claim 8 above. Carlson discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency. Again, in addition to the above mentioned two configurations, or as an alternative, a further configuration is proposed which comprises at least the following components: at least one measuring sensor on the person or the animal for the acquisition or the monitoring of medically relevant data, such as in particular data, which describe the cardio vascular and pulmonary function and/or contained data regarding blood values or blood composition, which sensor comprises at least one light source which can emit light at least at two wavelengths, as well as at least one light receiver for determining the light transmitted through a tissue portion of the person, **and at least one light source frequency modulating means to frequency modulate the optical radiation of the light source at a carrier frequency in order to shift the power spectrum of the pulsoximeter signals. The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the amplitude of the optical radiation of, e.g., the LED at a carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency range of, e.g. fc +/−5 Hz, increasing significantly the S/N (Signal/Noise)- and S/B ratio**. Carlson at [0018] Again, in addition to the above mentioned two methods or as an alternative, **it is further proposed to temporarily modulate the amplitude of the optical radiation of the light source by using e.g. AC-Coupling or Lock-In Amplification detection means. The basic idea of using AC-Coupling or**

’475 Patent	Carlson
	Lock-In Amplification detection means is to temporarily modulate the optical radiation of, e.g., the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where an environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. Carlson at [0027] According to a further aspect of the present invention, i**t is furthermore possible to use a light source modulation to temporarily modulate the optical radiation of the LED.** **The basic idea of using AC-Coupling or Lock-In Amplification (synchronous detection), is to temporarily modulate the optical radiation of the LED at the carrier frequency fc in order to shift the power spectrum of the pulsoximeter signals into a higher frequency range where environmental optical radiation is unlikely and electronic band pass filtering is technologically less stringent. AC-Coupling or Lock-In Amplification is well known out of the state of the art and is described in literature 3**. Carlson at [0064-0065] As a consequence, it is therefore proposed to emit light by the LEDs not as current or continuous light but as pulsed light. **The frequency is chosen in such a way that it is outside the frequency spectrum of sunlight and of ambient light which, according to FIG. 7 b, is in the range of above approximately 1000 Hz**. Thus, the pulsoximeter signals are readily discriminated from electronic and parasitic contributions of environmental optical radiation outside the frequency fc+/−5 Hz increasing significantly the Signal-to-Noise and Signal-to-Background ratio. FIG. 8 shows the shift spectrum of signal to a region where there is little influence, e.g. of ambient light. F0 is the chosen frequency of the emitted light to operate the pulsoximeter sensor and the range between f0−5 Hz and f0+5 Hz is the consequence of the influence of the frequency due to physiological signal. Therefore, as shown in FIG. 8, the frequency spectrum of signal at the photo diode does have a basic signal contribution due to physiological signal. The signal contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, while the light beam for the pulsoximetric measurement is within the range of approximately f0−5 Hz to f0+5 Hz, will not influence the measurement of the pulsoximetric sensor. F0 could be e.g., as mentioned, 1000 Hz which of course is a frequency far outside of any indoor light source, as e.g. halogen light, conventional light, etc. f0 of course can be chosen at any other frequency, as e.g. 2000 Hz or even higher. **By using light**

’475 Patent	Carlson
	source modulation, it is even possible to use an additional filter removing a certain frequency spectrum. Looking e.g. at FIG. 9, it is possible to arrange a filter band pass 51 which is e.g. removing any frequencies in the range of 0 to 120 Hz. The respective filter is shown in form of the dashed line 51. As a result, we end up by a diagram according to FIG. 9 b only showing any measurements in the range of f0−5 Hz to f0+5 Hz. Carlson at [0069]  Figure 8  Figure 9 Carlson at Fig. 8 & 9

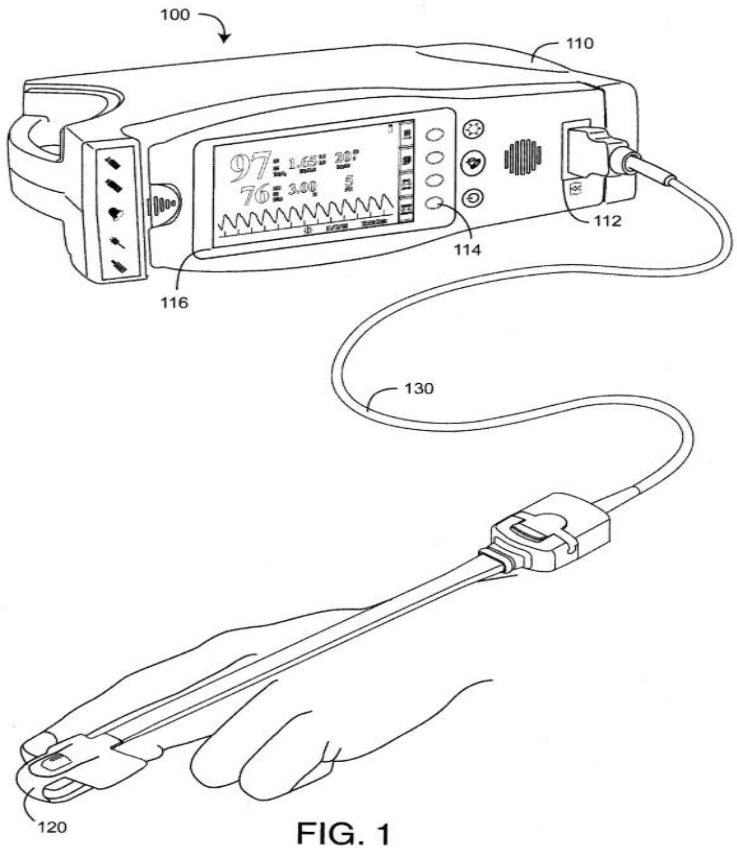
’475 Patent	Carlson
	Finally, after the measurements with pulse light have been executed, of course a reversed phase shifting or modulation has to be executed to calculate the real values of the Pulsoximetric measurement. Again, this reverse face shifting on modulation according to Lock-In technique is known out of the state of the art. **Again, it is of course possible to combine the light source modulation as described with reference to FIGS. 8 and 9 with any of the prior means such as the sensor architecture, as shown with respect to FIGS. 5 and 6 and with beam shaping optics, as described in FIG. 4**. Carlson at [0070-0071] 10. Configuration according to claims 1 to 9, comprising **light source amplitude modulating or light source modulating means to shift the frequency of the emitted light**. Carlson at Claim 10 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Carlson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

U.S. Pat. No. 12,268,475 in view of US Patent Publication No. 20080242958 to Ammar Al-Ali ("Al-Ali")

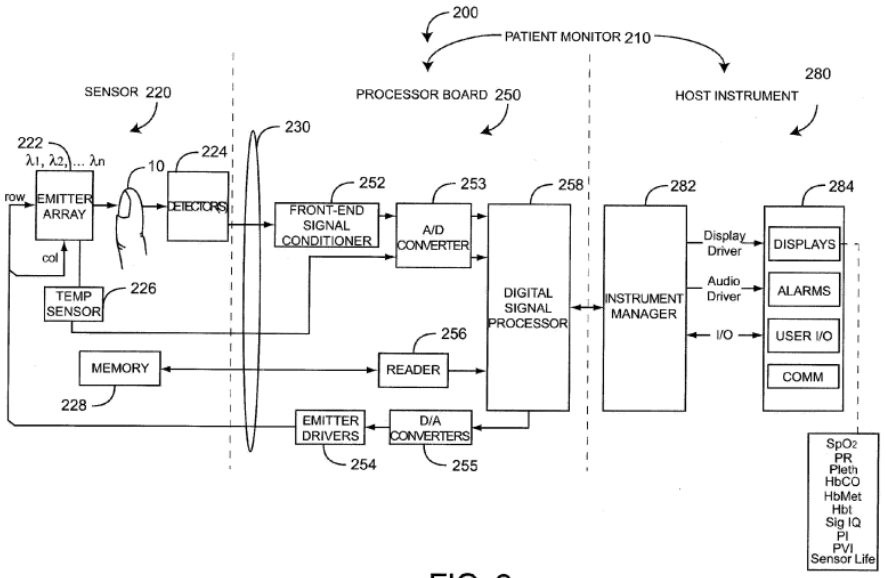
As described in detail below, Al-Ali (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Al-Ali. The cited portions of Al-Ali are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Al-Ali. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Al-Ali "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Al-Ali does not expressly disclose certain limitations in the Asserted Claims, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Al-Ali (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Al-Ali anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

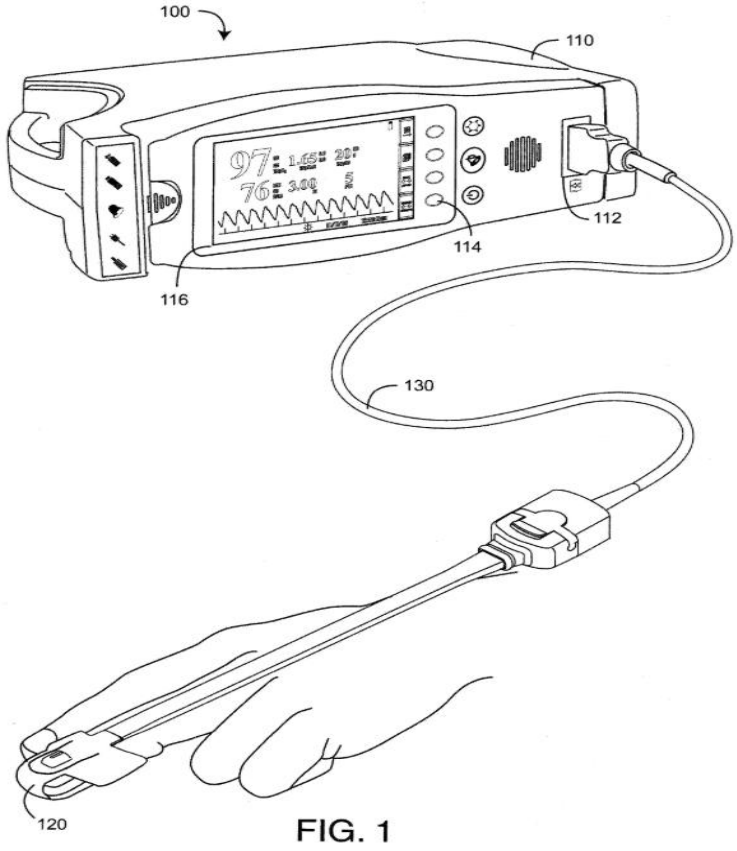
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

’475 Patent	Al-Ali
Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Al-Ali discloses or renders obvious An apparatus adapted to be worn by a user comprising.  FIG. 1 Al-Ali at Fig. 1 FIG. 1 illustrates a physiological measurement system 100 having a monitor 110 and a multiple wavelength optical sensor 120 with enhanced measurement capabilities as compared with conventional pulse oximetry. In particular, the multiple wavelength optical sensor 120 allows the measurement of various blood constituents and related parameters in addition to oxygen saturation and pulse rate.

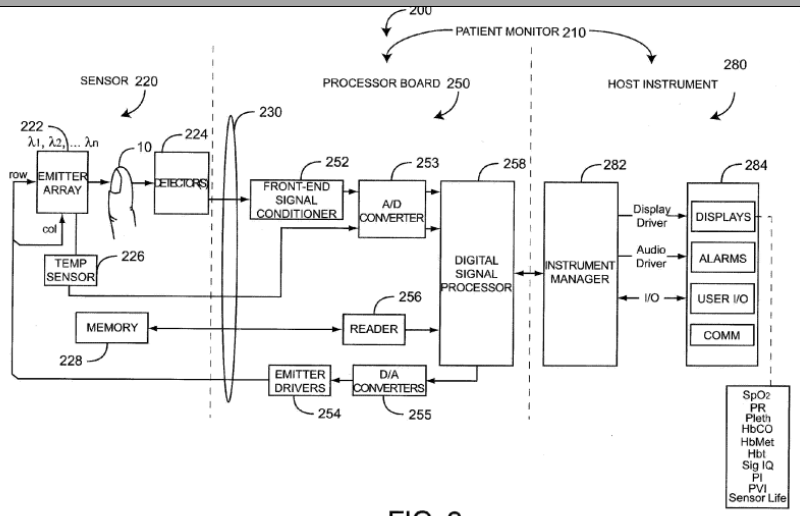
’475 Patent	Al-Ali
	Alternatively, the multiple wavelength optical sensor 120 allows the measurement of oxygen saturation and pulse rate with increased accuracy or robustness as compared with conventional pulse oximetry. Al-Ali at [0039] In one embodiment, the optical sensor 120 is configured to plug into a monitor sensor port 112 via a patient cable 130. Monitor keys 114 provide control over operating modes and alarms, to name a few. A display 116 provides readouts of measured parameters, such as oxygen saturation, pulse rate, HbCO, HbMet and Hbt to name a few. Other blood parameters that may be measured to provide important clinical information are fractional oxygen saturation, bilirubin and blood glucose, to name a few. Al-Ali at [0040] In this application, reference is made to many blood parameters. Some references that have common shorthand designations are referenced through such shorthand designations. For example, as used herein, HbCO designates carboxyhemoglobin, HbMet designates methemoglobin, and Hbt designates total hemoglobin. Other shorthand designations such as COHb, MetHb, and tHb are also common in the art for these same constituents. These constituents are generally reported in terms of a percentage, often referred to as saturation, relative concentration or fractional saturation. Total hemoglobin is generally reported as a concentration in g/dL. The use of the particular shorthand designators presented in this application does not restrict the term to any particular manner in which the designated constituent is reported. Al-Ali at [0041]

’475 Patent	Al-Ali
	 FIG. 2 Al-Ali at Fig. 2 FIG. 2 illustrates a block diagram a physiological measurement system 200. This measurement system includes a monitor 210 and an optical sensor 220 communicating via a patient cable 230. The monitor 210 has one or more processor boards 250 communicating with a host instrument 280. Generally, the processor board 250 communicates with the sensor 220 so as to control the emission of light into a tissue site 10. Also the processor board 250 receives and processes a corresponding sensor signal responsive to the emitted light after scattering and absorption by tissue site constituents. Accordingly, the processor board 250 derives physiological parameters relating to pulsatile blood flow within the tissue site and communicates values for those parameters to the host instrument 280. Generally, the host instrument 280 provides user I/O and communications with external devices so as to define operating conditions and communicate those conditions to the processor board 250. The host instrument 280 also transfers parameter values from the processor board for display and for triggering alarms. Al-Ali at [0042] In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple

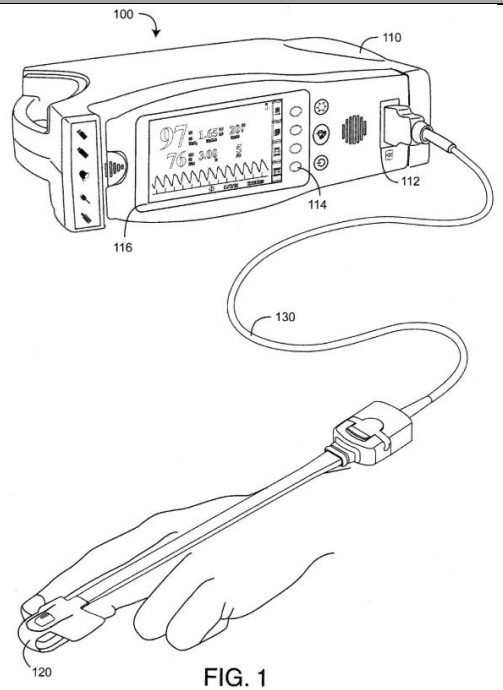
'475 Patent	Al-Ali
	wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters. Al-Ali at [0043] Although described herein with respect to various disposable sensor embodiments, a sensor may be reusable, resposable (partially reusable/partially disposable), adhesive or non-adhesive, or a transmittance, reflectance or transflectance sensor. Further, a sensor may be configured for a variety of tissue sites such as a finger, hand, foot, forehead or ear or for attachment to multiple tissue sites, including multiple-head sensors capable of simultaneous multi-site measurements. Al-Ali at [0044] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	Al-Ali discloses or renders obvious one or more biosensors adapted to be placed on the user, wherein one or more physiological parameters are measured.

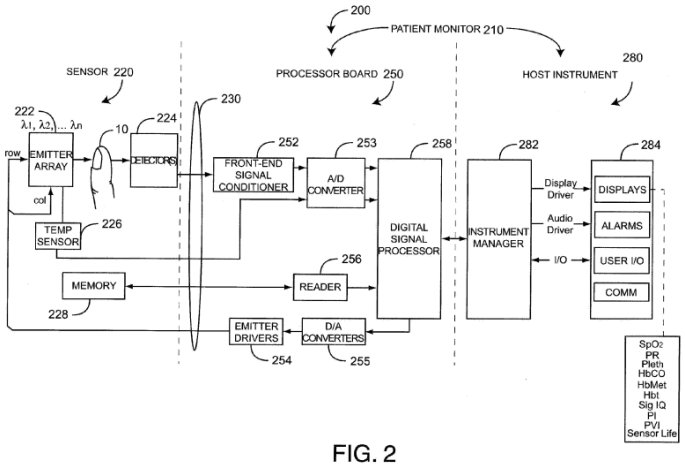
’475 Patent	Al-Ali
	 FIG. 1 Al-Ali at Fig. 1 FIG. 1 illustrates a physiological measurement system 100 having a monitor 110 and a multiple wavelength optical sensor 120 with enhanced measurement capabilities as compared with conventional pulse oximetry. In particular, the multiple wavelength optical sensor 120 allows the measurement of various blood constituents and related parameters in addition to oxygen saturation and pulse rate. Alternatively, the multiple wavelength optical sensor 120 allows the measurement of oxygen saturation and pulse rate with increased accuracy or robustness as compared with conventional pulse oximetry. Al-Ali at [0039]

’475 Patent	Al-Ali
	In one embodiment, the optical sensor 120 is configured to plug into a monitor sensor port 112 via a patient cable 130. Monitor keys 114 provide control over operating modes and alarms, to name a few. A display 116 provides readouts of measured parameters, such as oxygen saturation, pulse rate, HbCO, HbMet and Hbt to name a few. Other blood parameters that may be measured to provide important clinical information are fractional oxygen saturation, bilirubin and blood glucose, to name a few. Al-Ali at [0040] Although described herein with respect to various disposable sensor embodiments, a sensor may be reusable, resposable (partially reusable/partially disposable), adhesive or non-adhesive, or a transmittance, reflectance or transflectance sensor. Further, a sensor may be configured for a variety of tissue sites such as a finger, hand, foot, forehead or ear or for attachment to multiple tissue sites, including multiple-head sensors capable of simultaneous multi-site measurements. Al-Ali at [0044] Also shown in FIG. 2, the host instrument 280 communicates with the processor board 250 to receive signals indicative of the physiological parameter information calculated by the DSP 258. The host instrument 280 preferably includes one or more display devices, alarms, user I/O and communication ports 284. The alarms may be audible or visual indicators or both. The user I/O may be, as examples, keypads, touch screens, pointing devices or voice recognition devices. The displays may be indicators, numerics or graphics for displaying one or more of a pulse rate, plethysmograph data, signal quality, perfusion index and blood constituents values, such as SpO2, carboxyhemoglobin (HbCO), methemoglobin (HbMet) and total hemoglobin (Hbt), or the like. The host instrument 280 may also be capable of storing or displaying historical or trending data related to one or more of the measured values or combinations of the measured values. A patient monitor is disclosed in U.S. App. No. 11,367,033, filed on Mar. 1, 2006, titled Noninvasive Multi-Parameter Patient Monitor, which is assigned to Masimo and incorporated by reference herein. Al-Ali at [0047]

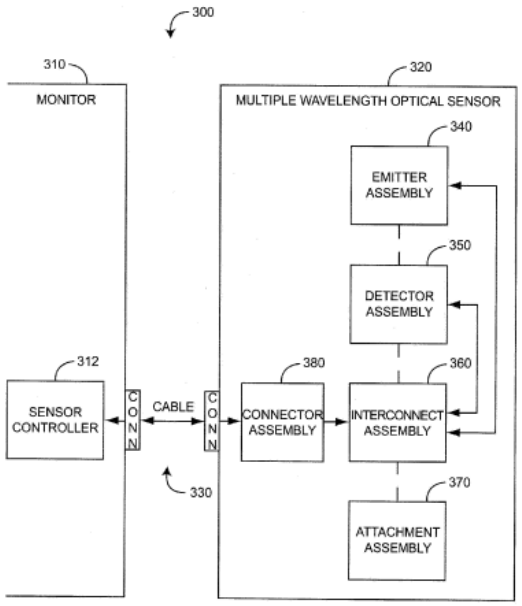
’475 Patent	Al-Ali
	 FIG. 2 Al-Ali at Fig. 2 FIGS. 21A-B illustrate additional embodiments of a multiple wavelength optical sensor 2100. In particular, disposable sensors include an adult/pediatric sensor 2101 and an infant/pediatric sensor 2102. Each sensor 2100 has a tape end 2110 and an opposite connector end 2120 electrically and mechanically interconnected via a cable 2130. The tape end 2110 attaches an emitter and detector to a tissue site. An emitter, described below, emits transmits light into the tissue site and a detector, also described below, generates a sensor signal responsive to the emitted light after tissue absorption. The sensor signal is communicated via the cable 2130 to the connector 2120. The connector 2120 mates with a patient cable (not shown) that communicates the sensor signal to a monitor (not shown). The relative spacing between the emitter and detector are selected to obtain a desired alignment of the emitter and detector when the sensor is attached to the body tissue of a patient. Al-Ali at [0073] A multiple wavelength sensor has been disclosed in detail in connection with various embodiments. These embodiments are disclosed by way of examples only and are not to limit the scope of the claims that follow. Although a multiple wavelength sensor has been disclosed with respect to various disposable sensor embodiments, other embodiments incorporate other tissue site attachment technologies including reusable and resposable sensors configured to attach to various tissue sites including fingers, hands, feet,

'475 Patent	Al-Ali
	toes, ears to name a few. Further, although a multiple wavelength sensor has been disclosed with respect to light transmission with respect to emitters, tissue site and detectors, other embodiments incorporate reflectance and transflectance configurations. A reusable sensor is disclosed in U.S. patent application Ser. No. 11/366,833, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Attachment, incorporated by reference herein. One of ordinary skill in art will appreciate many variations and modifications. Al-Ali at [0084] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	Al-Ali discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. There is a need to noninvasively measure multiple physiological parameters, other than, or in addition to, oxygen saturation and pulse rate. For example, hemoglobin parameters that are also significant are total hemoglobin (Hbt) and the percentage of carboxyhemoglobin and methemoglobin. Other blood parameters that may be amenable to noninvasive optical sensor measurement are fractional oxygen saturation, bilirubin and blood glucose, to name a few. Al-Ali at [0007]

’475 Patent	Al-Ali
	 FIG. 1 Al-Ali at Fig. 1 FIG. 1 illustrates a physiological measurement system 100 having a monitor 110 and a multiple wavelength optical sensor 120 with enhanced measurement capabilities as compared with conventional pulse oximetry. In particular, the multiple wavelength optical sensor 120 allows the measurement of various blood constituents and related parameters in addition to oxygen saturation and pulse rate. Alternatively, the multiple wavelength optical sensor 120 allows the measurement of oxygen saturation and pulse rate with increased accuracy or robustness as compared with conventional pulse oximetry. Al-Ali at [0039] In one embodiment, the optical sensor 120 is configured to plug into a monitor sensor port 112 via a patient cable 130. Monitor keys 114 provide control over operating modes and alarms, to name a few. A display 116 provides readouts of measured parameters, such as oxygen saturation, pulse rate, HbCO, HbMet and Hbt to name a few. Other blood parameters that may be measured to provide important clinical information are fractional oxygen saturation, bilirubin and blood glucose, to name a few.

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	Al-Ali at [0040]  FIG. 2 Al-Ali at Fig. 2 FIG. 2 illustrates a block diagram a physiological measurement system 200. This measurement system includes a monitor 210 and an optical sensor 220 communicating via a patient cable 230. The monitor 210 has one or more processor boards 250 communicating with a host instrument 280. Generally, the processor board 250 communicates with the sensor 220 so as to control the emission of light into a tissue site 10. Also the processor board 250 receives and processes a corresponding sensor signal responsive to the emitted light after scattering and absorption by tissue site constituents. Accordingly, the processor board 250 derives physiological parameters relating to pulsatile blood flow within the tissue site and communicates values for those parameters to the host instrument 280. Generally, the host instrument 280 provides user I/O and communications with external devices so as to define operating conditions and communicate those conditions to the processor board 250. The host instrument 280 also transfers parameter values from the processor board for display and for triggering alarms. Al-Ali at [0042] According to an embodiment, the DSP 258 comprises a processing device based on the Super Harvard ARChitecture (“SHARC”), such as those commercially available from Analog Devices. However, the

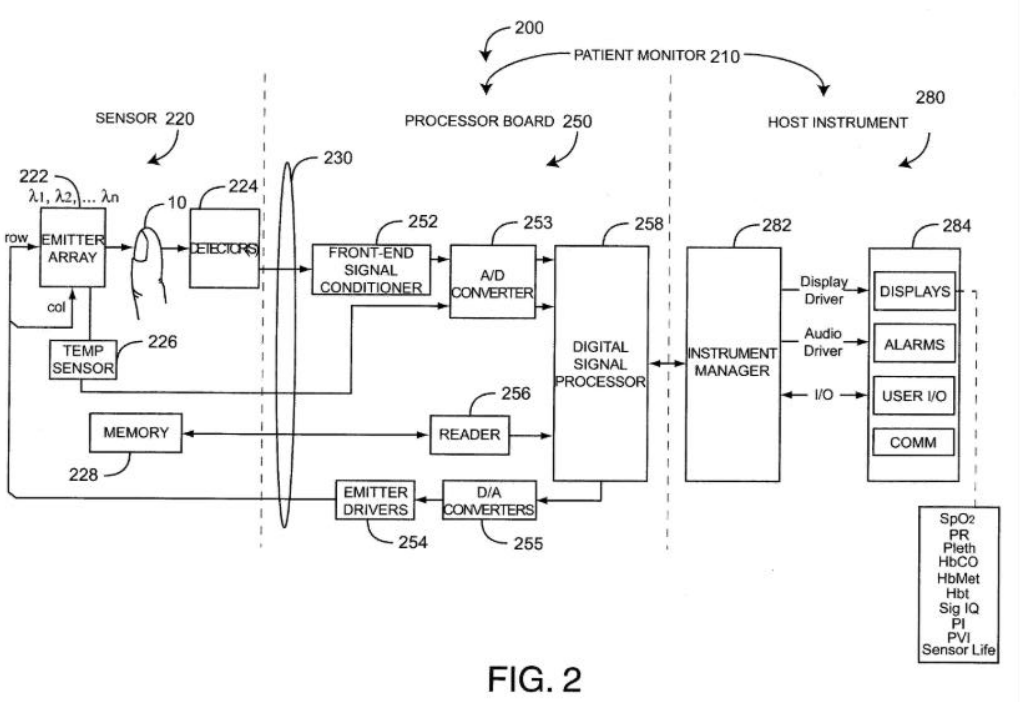
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	DSP 258 can comprise a wide variety of data and/or signal processors capable of executing programs for determining physiological parameters from input data. According to an embodiment, the processor board 250 may comprise one or more microcontrollers (not shown) for board management, including, for example, communications of calculated parameter data and the like to the host instrument 280. Al-Ali at [0046] Also shown in FIG. 2, the host instrument 280 communicates with the processor board 250 to receive signals indicative of the physiological parameter information calculated by the DSP 258. The host instrument 280 preferably includes one or more display devices, alarms, user I/O and communication ports 284. The alarms may be audible or visual indicators or both. The user I/O may be, as examples, keypads, touch screens, pointing devices or voice recognition devices. The displays may be indicators, numerics or graphics for displaying one or more of a pulse rate, plethysmograph data, signal quality, perfusion index and blood constituents values, such as SpO2, carboxyhemoglobin (HbCO), methemoglobin (HbMet) and total hemoglobin (Hbt), or the like. The host instrument 280 may also be capable of storing or displaying historical or trending data related to one or more of the measured values or combinations of the measured values. A patient monitor is disclosed in U.S. App. No. 11,367,033, filed on Mar. 1, 2006, titled Noninvasive Multi-Parameter Patient Monitor, which is assigned to Masimo and incorporated by reference herein. Al-Ali at [0047]

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	 FIG. 3 Al-Ali at Fig. 3 As shown in FIG. 3, the emitter assembly 340 responds to drive signals received from the sensor controller 312 so as to emit light having a plurality of wavelengths. The detector assembly 350 provides a sensor signal to the sensor controller 312 in response to the emitted light after absorption by a tissue site. The interconnect assembly 360 mechanically mounts the emitter assembly 340 and the detector assembly 350 and provides electrical communication between the cable 330 and these assemblies 340, 350. The attachment assembly 370 attaches the emitter assembly 340 and detector assembly 350 to a tissue site. The connector assembly 380 provides a mechanical and electrical interface to the connector at one end of the cable 330. A tape assembly example of an attachment assembly is described with respect to FIGS. 11A-B, below. A contact assembly example of a connector assembly is described with respect to FIGS. 13-14, below. Al-Ali at [0049]

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	FIGS. 9A-B illustrate embodiments of a multiple wavelength optical sensor. In particular, illustrated are a disposable sensor 900 including an adult/pediatric sensor 901 configured for finger placement and an infant/neonate sensor 902 configured for toe, foot or hand placement. Each sensor 900 has a tape end 910 and an opposite connector end 920 electrically and mechanically interconnected via a flexible coupling 930. The tape end 910 attaches an emitter and detector to a tissue site, as described below. The emitter illuminates the tissue site and the detector generates a sensor signal responsive to the light after tissue absorption, such as absorption by pulsatle arterial blood flow within the tissue site. The sensor signal is communicated via the flexible coupling 930 to the connector end 920. The connector mates with a cable (not shown) that communicates the sensor signal to a monitor (not shown). The monitor calculates a variety of physiological parameters from the detector signal, such as pulse rate (PR), oxygen saturation (SpO2), carboxyhemoglobin (HbCO), methemoglobin (HbMet) and total hemoglobin (Hbt), to name a few. A sensor configured for measurement of at least some of the above-mentioned physiological parameters is described in U.S. Provisional Application Ser. No. 60/920,474, filed Mar. 27, 2007, titled Disposable Multiple Wavelength Optical Sensor; and U.S. Provisional Application Ser. No. 60/923,630, filed Apr. 14, 2007, titled Disposable Multiple Wavelength Optical Sensor, both applications incorporated by reference herein. Al-Ali at [0057] As shown in FIGS. 15A-B, an LED array 1520 is connected within an electrical grid of n rows and m columns totaling n+m LED drive lines where n and m are integers greater than one. The electrical grid advantageously minimizes the number of drive lines required to activate the LEDs 1520 while preserving flexibility to selectively activate individual LEDs 1520 in any sequence and multiple LEDs 1520 simultaneously. The electrical grid also facilitates setting LED currents so as to control intensity at each LED wavelength, determining operating wavelengths and monitoring total grid current so as to limit power dissipation. The LED array 1520 is physically configured in rows, which facilitates clustering LEDs according to wavelength so as to minimize pathlength variations and which facilitates equalization of LED intensities. In an embodiment the LED array 1520 comprises up to sixteen LEDs configured in an electrical grid of four rows and four columns. Each of four row drive lines provide a common anode connection to four LEDs, and each of four column drive lines provide a common cathode connection to four LEDs. Thus, sixteen LEDs are advantageously driven with only eight wires, including four anode drive lines and four cathode drive lines. In an embodiment, an LED array is partially populated with eight LEDs having nominal wavelengths as shown in TABLE 1. In an embodiment, the LED array is partially populated with thirteen LEDs having nominal wavelengths as shown in TABLE 2.

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	Advantageously, LED array and the corresponding LED wavelengths are adapted to measure total hemoglobin (Hbt) in addition to SpO2, pulse rate, HbCO and HbMet, among other physiological parameters. In an embodiment, LEDs D1-D5 are encapsulated with an attenuating epoxy 1660 (FIGS. 16B, F) so as to equalize LED intensities. In an embodiment, a clear fill epoxy 1670 (FIGS. 16B, F) mixed with 1-20 μm microspheres is dispersed and cured over the LEDs. An LED array and corresponding drivers for an electrical grid are disclosed in U.S. patent application Ser. No. 11/367,013, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Emitters, incorporated by reference herein. Al-Ali at [0067] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	Al-Ali discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. A multiple wavelength optical sensor has an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs configured in an array and connected within an electrical grid. A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive oxygen saturation, carboxyhemoglobin, methemoglobin and total hemoglobin. Al-Ali at [Abstract] One aspect of a physiological sensor is an emitter that emits light having a plurality of wavelengths. A detector generates an output signal responsive to the emitted light after absorption by tissue. An attachment assembly removably attaches the emitter and the detector to tissue. A spacer provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue. A light scattering medium is disposed in a optical path between the emitter and tissue. The spacer and the light scattering medium provide at least a substantially uniform illumination of tissue by the emitted light for each of the

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	wavelengths. In various embodiments, the light scattering medium comprises glass beads mixed with an encapsulant disposed proximate the spacer. The light scattering medium comprises microspheres mixed with an epoxy disposed proximate the emitter. The emitter comprises an array of at least eight light emitting diodes emitting light generally centered around eight unique wavelengths. The emitter comprises an array of at least thirteen light emitting diodes emitting light generally centered around at least twelve unique wavelengths. The detector comprises at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The detector comprises two Si photodiodes and four InGaAs photodiodes all connected in parallel. The light emitting diodes emit light within a first range of about 620-905 nm and within a second range of about 1040-1270 nm. Al-Ali at [0008] Another aspect of a physiological sensor comprising an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs disposed within an emitter ceramic substrate. A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive total hemoglobin (Hbt). The detector comprises a plurality of photodiodes disposed within a detector ceramic substrate. A first set of the photodiodes is responsive to a first set of the wavelengths and a second set of the photodiodes is responsive to a second set of the wavelengths. In various embodiments a diffuser scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths**.** A first encapsulate containing glass beads is mounted in a spacer proximate the emitter ceramic substrate. A second encapsulate mixed with microspheres is disposed on the LEDs within the emitter ceramic substrate. The photodiodes comprise at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The LEDs radiate light generally centered around at least twelve unique wavelengths. The LEDs are mounted in an array of at least thirteen LEDs connected within an electrical grid. The twelve unique wavelengths comprise eight wavelengths within a first range of about 620-905 nm. and four wavelengths within a second range of about 1040-1270 nm. Al-Ali at [0009]

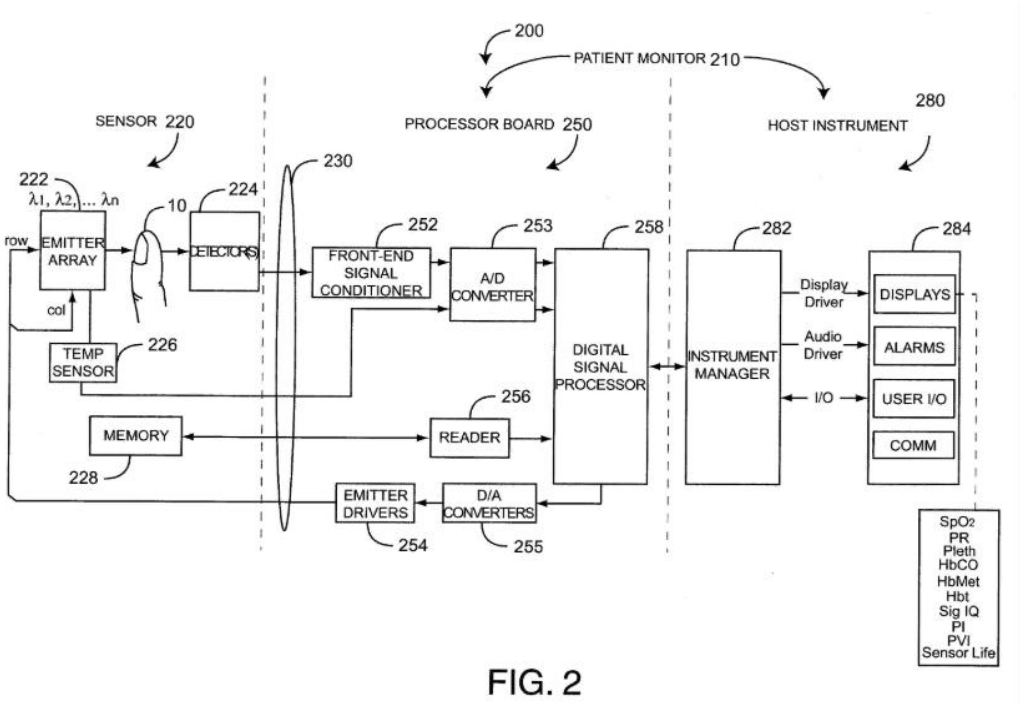
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	 FIG. 2 Al-Ali at Fig. 2 In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters.

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	Al-Ali at [0043] As shown in FIG. 3, the emitter assembly 340 responds to drive signals received from the sensor controller 312 so as to emit light having a plurality of wavelengths. The detector assembly 350 provides a sensor signal to the sensor controller 312 in response to the emitted light after absorption by a tissue site. The interconnect assembly 360 mechanically mounts the emitter assembly 340 and the detector assembly 350 and provides electrical communication between the cable 330 and these assemblies 340, 350. The attachment assembly 370 attaches the emitter assembly 340 and detector assembly 350 to a tissue site. The connector assembly 380 provides a mechanical and electrical interface to the connector at one end of the cable 330. A tape assembly example of an attachment assembly is described with respect to FIGS. 11A-B, below. A contact assembly example of a connector assembly is described with respect to FIGS. 13-14, below. Al-Ali at [0049] FIG. 4 illustrates an emitter assembly 400 having a substrate 410, an emitter array 420, an equalization 430 and a diffusion 440. The emitter array 420 has multiple light emitting sources, each activated by drive signals 422. The light emitting sources are capable of generating light 442 having multiple wavelengths. The equalization 430 accounts for differences in emitter intensity and tissue absorption of the light across the multiple wavelengths so as to at least partially equalize wavelength-dependent variations in intensity at the detector. The substrate 410 provides a physical mount for the emitter array and emitter-related equalization and an electrical connection between the emitter array and an interconnect assembly, such as described above. Advantageously, the substrate 410 also maintains a uniform bulk temperature measurement so as to calculate the operating wavelengths for the light emitting sources. One example of an emitter array embodiment 420 is described with respect to FIG. 6, below. One example of equalization 430 is described with respect to encapsulants, below. Examples of substrates 410 are described with respect to ceramic and board substrates, below. Al-Ali at [0050] FIG. 6 illustrates an emitter array 600 having multiple light emitters (LE) 610 capable of emitting light having multiple wavelengths. Row drivers 670 and column drivers 690 are electrically connected to the light emitters 610 and activate one or more light emitters 610 by addressing at least one row 620 and at least one column 640 of an electrical grid. In one embodiment, the light emitters 610 each include a first contact 612 and a second contact 614. The first contact 612 of a first subset 630 of light emitters is in

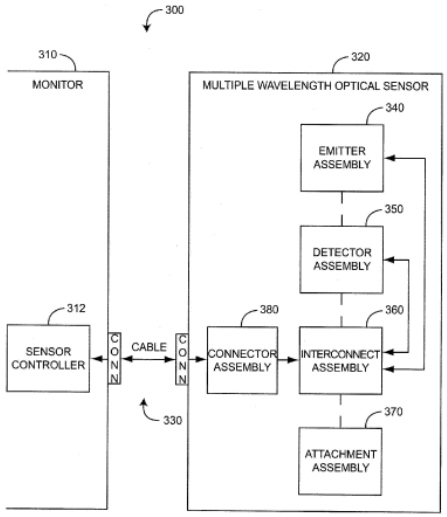
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	communication with a first conductor 620 of the electrical grid. The second contact 614 of a second subset 650 of light emitters is in communication with a second conductor 640. Al-Ali at [0052] FIGS. 12A-C further illustrate optical components 1200 having emitter components 1220 and a detector 1250 mounted to a flex circuit 1210. The emitter components 1220 include a cover 1222, a light block 1224, an emitter 1280, a spacer 1226 and an encapsulant 1228. Advantageously, the spacer 1226 and encapsulant 1228 provide a relatively uniform illumination of a tissue site across all emitted wavelengths. In particular, the spacer 1226 provides a gap between the emitter 1280 and a tissue site, allowing emitted light from, say, individual LEDs of the emitter 1280 to spread as the multiple wavelength light propagates to a tissue site. Further, the encapsulant 1228 can be configured to diffuse or scatter emitted light as the light propagates to a tissue site. In an embodiment, the spacer 1226 gap is 70 mm. In an embodiment, the encapsulant 1228 contains 0.1 mm glass beads, 25% by weight, in a clear silicon RTV. In an embodiment, the emitter has an epoxy fill over LEDs incorporated within the emitter that contain microspheres so as to diffuse or scatter LED transmitted light, as described below. In an embodiment, an attenuation epoxy is dispersed over selected emitter LEDs so as to equalize intensities of the various LEDs, also as described, below. LED intensity equalization is disclosed in U.S. patent application Ser. No. 11/366,995, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Equalization, incorporated by reference herein. In an embodiment, the encapsulant or LED fill or both provide notch filter characteristics according to emitted wavelengths so as to substantially attenuate secondary emissions from one or more LEDs. Al-Ali at [0060] As shown in FIGS. 15A-B, an LED array 1520 is connected within an electrical grid of n rows and m columns totaling n+m LED drive lines where n and m are integers greater than one. The electrical grid advantageously minimizes the number of drive lines required to activate the LEDs 1520 while preserving flexibility to selectively activate individual LEDs 1520 in any sequence and multiple LEDs 1520 simultaneously. The electrical grid also facilitates setting LED currents so as to control intensity at each LED wavelength, determining operating wavelengths and monitoring total grid current so as to limit power dissipation. The LED array 1520 is physically configured in rows, which facilitates clustering LEDs according to wavelength so as to minimize pathlength variations and which facilitates equalization of LED intensities. In an embodiment the LED array 1520 comprises up to sixteen LEDs configured in an electrical grid of four rows and four columns. Each of four row drive lines provide a common anode

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	connection to four LEDs, and each of four column drive lines provide a common cathode connection to four LEDs. Thus, sixteen LEDs are advantageously driven with only eight wires, including four anode drive lines and four cathode drive lines. In an embodiment, an LED array is partially populated with eight LEDs having nominal wavelengths as shown in TABLE 1. In an embodiment, the LED array is partially populated with thirteen LEDs having nominal wavelengths as shown in TABLE 2. Advantageously, LED array and the corresponding LED wavelengths are adapted to measure total hemoglobin (Hbt) in addition to SpO2, pulse rate, HbCO and HbMet, among other physiological parameters. In an embodiment, LEDs D1-D5 are encapsulated with an attenuating epoxy 1660 (FIGS. 16B, F) so as to equalize LED intensities. In an embodiment, a clear fill epoxy 1670 (FIGS. 16B, F) mixed with 1-20 μm microspheres is dispersed and cured over the LEDs. An LED array and corresponding drivers for an electrical grid are disclosed in U.S. patent application Ser. No. 11/367,013, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Emitters, incorporated by reference herein. Al-Ali at [0067] FIG. 22 illustrates an emitter 2200 embodiment having a board substrate 2210, an LED array 2220 and one or more encapsulants 2230. The LED array 2220 emits optical radiation having multiple wavelengths of predetermined nominal values, advantageously allowing multiple parameter measurements. In particular, the LED array 2220 has multiple light emitting diodes (LEDs) that are physically arranged and electrically connected in an electrical grid to facilitate drive control, equalization, and minimization of optical pathlength differences at particular wavelengths. The LEDs are each activated by addressing at least one row and at least one column of the electrical grid, as described above. At least a portion of the encapsulants 2230 are advantageously configured to provide intensity equalization across a specific LED subset. In an embodiment, the LEDs emit light having wavelengths generally centered around the values shown in TABLE 3. Al-Ali at [0074] 1.A physiological sensor comprising: an emitter that emits light having a plurality of wavelengths; a detector that generates an output signal responsive to the emitted light after absorption by tissue; an attachment assembly that removably attaches the emitter and the detector to tissue; a spacer that provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue; and a light scattering medium disposed in a optical path between the emitter and tissue;

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	the spacer and the light scattering medium providing at least a substantially uniform illumination of tissue by the emitted light for each of the wavelengths. Al-Ali at Claim 1 4. The physiological sensor according to claim 3 wherein the emitter comprises an array of at least eight light emitting diodes emitting light generally centered around eight unique wavelengths. Al-Ali at Claim 4 5. The physiological sensor according to claim 4 wherein the emitter comprises an array of at least thirteen light emitting diodes emitting light generally centered around at least twelve unique wavelengths. Al-Ali at Claim 5 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	Al-Ali discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin. Another aspect of a physiological sensor comprising an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs disposed within an emitter ceramic substrate**.** A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive total hemoglobin (Hbt). The detector comprises a plurality of photodiodes disposed within a detector ceramic substrate. A first set of the photodiodes is responsive to a first set of the wavelengths and a second set of the photodiodes is responsive to a second set of the wavelengths. In various embodiments a diffuser scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths. A first encapsulate containing glass beads is mounted in a spacer proximate

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	the emitter ceramic substrate. A second encapsulate mixed with microspheres is disposed on the LEDs within the emitter ceramic substrate. The photodiodes comprise at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The LEDs radiate light generally centered around at least twelve unique wavelengths. The LEDs are mounted in an array of at least thirteen LEDs connected within an electrical grid. The twelve unique wavelengths comprise eight wavelengths within a first range of about 620-905 nm. and four wavelengths within a second range of about 1040-1270 nm. Al-Ali at [0009]  FIG. 2 Al-Ali at Fig. 2 FIG. 2 illustrates a block diagram a physiological measurement system 200. This measurement system includes a monitor 210 and an optical sensor 220 communicating via a patient cable 230. The monitor 210 has one or more processor boards 250 communicating with a host instrument 280. Generally, the processor board 250 communicates with the sensor 220 so as to control the emission of light into a tissue site 10. Also the processor board 250 receives and processes a corresponding sensor signal responsive to

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	the emitted light after scattering and absorption by tissue site constituents. Accordingly, the processor board 250 derives physiological parameters relating to pulsatile blood flow within the tissue site and communicates values for those parameters to the host instrument 280. Generally, the host instrument 280 provides user I/O and communications with external devices so as to define operating conditions and communicate those conditions to the processor board 250. The host instrument 280 also transfers parameter values from the processor board for display and for triggering alarms. Al-Ali at [0042] In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters. Al-Ali at [0043] Although described herein with respect to various disposable sensor embodiments, a sensor may be reusable, resposable (partially reusable/partially disposable), adhesive or non-adhesive, or a transmittance, reflectance or transflectance sensor. Further, a sensor may be configured for a variety of tissue sites such as a finger, hand, foot, forehead or ear or for attachment to multiple tissue sites, including multiple-head sensors capable of simultaneous multi-site measurements. Al-Ali at [0044]

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	 FIG. 3 Al-Ali at Fig. 3 As shown in FIG. 3, the emitter assembly 340 responds to drive signals received from the sensor controller 312 so as to emit light having a plurality of wavelengths. The detector assembly 350 provides a sensor signal to the sensor controller 312 in response to the emitted light after absorption by a tissue site. The interconnect assembly 360 mechanically mounts the emitter assembly 340 and the detector assembly 350 and provides electrical communication between the cable 330 and these assemblies 340, 350. The attachment assembly 370 attaches the emitter assembly 340 and detector assembly 350 to a tissue site. The connector assembly 380 provides a mechanical and electrical interface to the connector at one end of the cable 330. A tape assembly example of an attachment assembly is described with respect to FIGS. 11A-B, below. A contact assembly example of a connector assembly is described with respect to FIGS. 13-14, below. Al-Ali at [0049] FIG. 4 illustrates an emitter assembly 400 having a substrate 410, an emitter array 420, an equalization 430 and a diffusion 440. The emitter array 420 has multiple light emitting sources, each activated by drive signals 422. The light emitting sources are capable of generating light 442 having multiple

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	wavelengths. The equalization 430 accounts for differences in emitter intensity and tissue absorption of the light across the multiple wavelengths so as to at least partially equalize wavelength-dependent variations in intensity at the detector. The substrate 410 provides a physical mount for the emitter array and emitter-related equalization and an electrical connection between the emitter array and an interconnect assembly, such as described above. Advantageously, the substrate 410 also maintains a uniform bulk temperature measurement so as to calculate the operating wavelengths for the light emitting sources. One example of an emitter array embodiment 420 is described with respect to FIG. 6, below. One example of equalization 430 is described with respect to encapsulants, below. Examples of substrates 410 are described with respect to ceramic and board substrates, below. Al-Ali at [0050] FIGS. 9A-B illustrate embodiments of a multiple wavelength optical sensor. In particular, illustrated are a disposable sensor 900 including an adult/pediatric sensor 901 configured for finger placement and an infant/neonate sensor 902 configured for toe, foot or hand placement. Each sensor 900 has a tape end 910 and an opposite connector end 920 electrically and mechanically interconnected via a flexible coupling 930. The tape end 910 attaches an emitter and detector to a tissue site, as described below. The emitter illuminates the tissue site and the detector generates a sensor signal responsive to the light after tissue absorption, such as absorption by pulsatle arterial blood flow within the tissue site. The sensor signal is communicated via the flexible coupling 930 to the connector end 920. The connector mates with a cable (not shown) that communicates the sensor signal to a monitor (not shown). The monitor calculates a variety of physiological parameters from the detector signal, such as pulse rate (PR), oxygen saturation (SpO_2), carboxyhemoglobin (HbCO), methemoglobin (HbMet) and total hemoglobin (Hbt), to name a few. A sensor configured for measurement of at least some of the above-mentioned physiological parameters is described in U.S. Provisional Application Ser. No. 60/920,474, filed Mar. 27, 2007, titled Disposable Multiple Wavelength Optical Sensor; and U.S. Provisional Application Ser. No. 60/923,630, filed Apr. 14, 2007, titled Disposable Multiple Wavelength Optical Sensor, both applications incorporated by reference herein. Al-Ali at [0057] FIGS. 12A-C further illustrate optical components 1200 having emitter components 1220 and a detector 1250 mounted to a flex circuit 1210. The emitter components 1220 include a cover 1222, a light block 1224, an emitter 1280, a spacer 1226 and an encapsulant 1228. Advantageously, the spacer 1226 and encapsulant 1228 provide a relatively uniform illumination of a tissue site across all emitted wavelengths.

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	In particular, the spacer 1226 provides a gap between the emitter 1280 and a tissue site, allowing emitted light from, say, individual LEDs of the emitter 1280 to spread as the multiple wavelength light propagates to a tissue site. Further, the encapsulant 1228 can be configured to diffuse or scatter emitted light as the light propagates to a tissue site. In an embodiment, the spacer 1226 gap is 70 mm. In an embodiment, the encapsulant 1228 contains 0.1 mm glass beads, 25% by weight, in a clear silicon RTV. In an embodiment, the emitter has an epoxy fill over LEDs incorporated within the emitter that contain microspheres so as to diffuse or scatter LED transmitted light, as described below. In an embodiment, an attenuation epoxy is dispersed over selected emitter LEDs so as to equalize intensities of the various LEDs, also as described, below. LED intensity equalization is disclosed in U.S. patent application Ser. No. 11/366,995, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Equalization, incorporated by reference herein. In an embodiment, the encapsulant or LED fill or both provide notch filter characteristics according to emitted wavelengths so as to substantially attenuate secondary emissions from one or more LEDs. Al-Ali at [0060] FIGS. 19A-B illustrate a detector 1900 having a detector component 1700 and a shield 1910. The shield 1910 has a conductive surface 1920 defining windows 1930. The windows 1930 can be any shape appropriate to the passage of light and the blocking of electromagnetic noise. In an embodiment, the windows 1930 are large rectangles with minimal interconnect so as to allow for a substantial passage of emitted light to the photodiodes 1720. In an embodiment, the shield 1910 is soldered to the ceramic substrate 1710 on at least the four corners, electrically and mechanically coupling the shield 1910 to the ceramic substrate 1710 and allowing the shield to form one side of a Faraday cage. Mechanical coupling can be, for example, gluing, welding, soldering, screwing, snap fitting, or other suitable fastening. Electrical coupling can be, for example, soldering, wire bonding, die bonding, or other suitable forms of electrical connection. In an embodiment, the ceramic substrate 1710 is printed with shielding material to complete the Faraday cage. Additional shielding material can be attached to or plated on the ceramic substrate 1710. Al-Ali at [0071] FIGS. 21A-B illustrate additional embodiments of a multiple wavelength optical sensor 2100. In particular, disposable sensors include an adult/pediatric sensor 2101 and an infant/pediatric sensor 2102. Each sensor 2100 has a tape end 2110 and an opposite connector end 2120 electrically and mechanically interconnected via a cable 2130. The tape end 2110 attaches an emitter and detector to a tissue site. An

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	emitter, described below, emits transmits light into the tissue site and a detector, also described below, generates a sensor signal responsive to the emitted light after tissue absorption. The sensor signal is communicated via the cable 2130 to the connector 2120. The connector 2120 mates with a patient cable (not shown) that communicates the sensor signal to a monitor (not shown). The relative spacing between the emitter and detector are selected to obtain a desired alignment of the emitter and detector when the sensor is attached to the body tissue of a patient. Al-Ali at [0073] A physiological sensor comprising: an emitter that emits light having a plurality of wavelengths; a detector that generates an output signal responsive to the emitted light after absorption by tissue; an attachment assembly that removably attaches the emitter and the detector to tissue; a spacer that provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue; and a light scattering medium disposed in a optical path between the emitter and tissue; the spacer and the light scattering medium providing at least a substantially uniform illumination of tissue by the emitted light for each of the wavelengths. Al-Ali at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	Al-Ali discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. Pulse oximeters capable of reading through motion induced noise are disclosed in at least U.S. Pat. Nos. 6,770,028, 6,658,276, 6,650,917, 6,157,850, 6,002,952, 5,769,785, and 5,758,644; low noise pulse oximetry sensors are disclosed in at least U.S. Pat. Nos. 6,088,607 and 5,782,757; all of which are assigned to Masimo Corporation, Irvine, Calif. ("Masimo") and are incorporated by reference herein.

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	Al-Ali at [0004] Another aspect of a physiological sensor comprising an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs disposed within an emitter ceramic substrate. A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive total hemoglobin (Hbt). The detector comprises a plurality of photodiodes disposed within a detector ceramic substrate. A first set of the photodiodes is responsive to a first set of the wavelengths and a second set of the photodiodes is responsive to a second set of the wavelengths. In various embodiments a diffuser scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths**.** A first encapsulate containing glass beads is mounted in a spacer proximate the emitter ceramic substrate. A second encapsulate mixed with microspheres is disposed on the LEDs within the emitter ceramic substrate. The photodiodes comprise at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The LEDs radiate light generally centered around at least twelve unique wavelengths. The LEDs are mounted in an array of at least thirteen LEDs connected within an electrical grid. The twelve unique wavelengths comprise eight wavelengths within a first range of about 620-905 nm. and four wavelengths within a second range of about 1040-1270 nm. Al-Ali at [0009] In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters.

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	Al-Ali at [0043] FIGS. 19A-B illustrate a detector 1900 having a detector component 1700 and a shield 1910. The shield 1910 has a conductive surface 1920 defining windows 1930. The windows 1930 can be any shape appropriate to the passage of light and the blocking of electromagnetic noise. In an embodiment, the windows 1930 are large rectangles with minimal interconnect so as to allow for a substantial passage of emitted light to the photodiodes 1720. In an embodiment, the shield 1910 is soldered to the ceramic substrate 1710 on at least the four corners, electrically and mechanically coupling the shield 1910 to the ceramic substrate 1710 and allowing the shield to form one side of a Faraday cage. Mechanical coupling can be, for example, gluing, welding, soldering, screwing, snap fitting, or other suitable fastening. Electrical coupling can be, for example, soldering, wire bonding, die bonding, or other suitable forms of electrical connection. In an embodiment, the ceramic substrate 1710 is printed with shielding material to complete the Faraday cage. Additional shielding material can be attached to or plated on the ceramic substrate 1710. Al-Ali at [0071] 1. A physiological sensor comprising: an emitter that emits light having a plurality of wavelengths; a detector that generates an output signal responsive to the emitted light after absorption by tissue; an attachment assembly that removably attaches the emitter and the detector to tissue; a spacer that provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue; and a light scattering medium disposed in a optical path between the emitter and tissue; the spacer and the light scattering medium providing at least a substantially uniform illumination of tissue by the emitted light for each of the wavelengths. Al-Ali at claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would

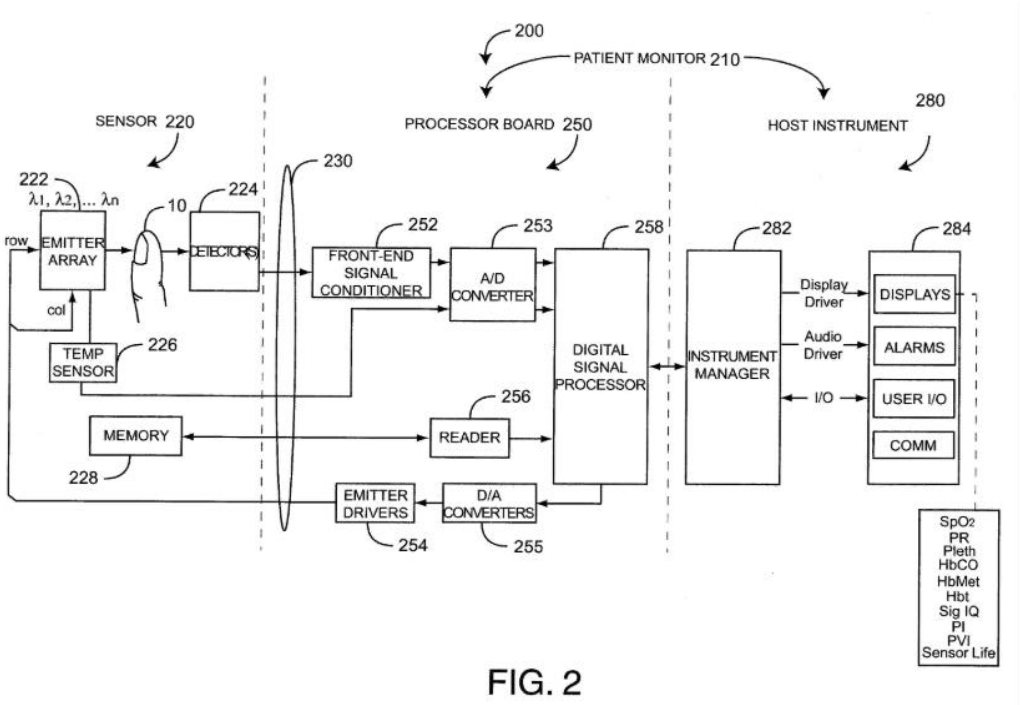
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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Al-Ali discloses or renders obvious, the detection system is configured to be synchronized to the light source. A multiple wavelength optical sensor has an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs configured in an array and connected within an electrical grid. A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive oxygen saturation, carboxyhemoglobin, methemoglobin and total hemoglobin. Al-Ali at [Abstract] Another aspect of a physiological sensor comprising an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs disposed within an emitter ceramic substrate. A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive total hemoglobin (Hbt). The detector comprises a plurality of photodiodes disposed within a detector ceramic substrate. A first set of the photodiodes is responsive to a first set of the wavelengths and a second set of the photodiodes is responsive to a second set of the wavelengths. In various embodiments a diffuser scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths. A first encapsulate containing glass beads is mounted in a spacer proximate the emitter ceramic substrate. A second encapsulate mixed with microspheres is disposed on the LEDs within the emitter ceramic substrate. The photodiodes comprise at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The LEDs radiate light generally centered around at least twelve unique wavelengths. The LEDs are mounted in an array of at least thirteen LEDs connected within an electrical grid. The twelve unique wavelengths comprise eight wavelengths within a first range of about 620-905 nm. and four wavelengths within a second range of about 1040-1270 nm. Al-Ali at [0009] A further aspect of a physiological sensor comprises a light source that radiates light having a plurality of wavelengths, a diffuser that scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths, and at least one detector that generates a sensor signal responsive to the

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	radiated light after tissue attenuation. In an embodiment, the light source comprises a ceramic substrate having conductors arranged as an electrical grid and a plurality of LEDs mounted within the ceramic substrate in an array. In other embodiments, the diffuser comprises a first encapsulant having microspheres disposed over the LEDs; and a second encapsulant having glass beads disposed proximate the ceramic substrate. A spacer is disposed proximate the ceramic substrate so as to form a gap between the LEDs and the tissue site. A connector connects to a patient cable so as to communicate the sensor signal to a monitor. A flexible coupling has an optical end proximate the light source and the detector and a connector end proximate the connector. The flexible coupling has conductors that communicate the sensor signal from the optical end to the connector end. Al-Ali at [0010] In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters. Al-Ali at [0043] FIG. 7 illustrates an example of an emitter assembly 700 having light emitting diodes 710, a temperature sensor 720 and a substrate 730. The substrate 730 provides a thermal mass so as to stabilize a bulk temperature for the LEDs 710. A temperature sensor 720 is thermally coupled to the substrate 730 so as to output, say, a current responsive to the bulk temperature Tb. The LED wavelengths 712 are determinable as a function of the drive currents 740 and the temperature sensor output 722. In an

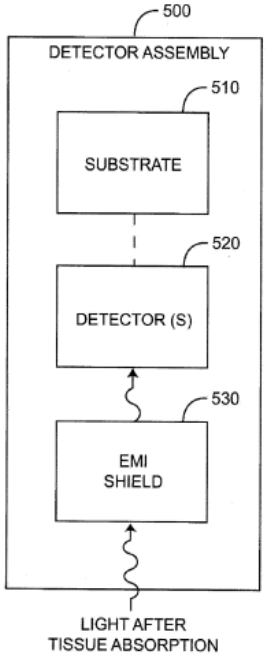
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	embodiment, the substrate 730 is a ceramic material or, alternatively, a circuit board material having multiple materialization layers for thermal mass. Al-Ali at [0053] In yet another embodiment, an operating wavelength for each LED is determined by measuring the junction voltage for each LED 710. In a further embodiment, the temperature of each LED 710 is controlled, such as by one or more Peltier cells coupled to each LED 710, and an operating wavelength for each LED 710 is determined as a function of the resulting controlled temperature or temperatures. In other embodiments, the operating wavelength for each LED 710 is determined directly, for example by attaching a charge coupled device (CCD) to each light emitter or by attaching a fiberoptic to each light emitter and coupling the fiberoptics to a wavelength measuring device, to name a few. Al-Ali at [0055] FIGS. 12A-C further illustrate optical components 1200 having emitter components 1220 and a detector 1250 mounted to a flex circuit 1210. The emitter components 1220 include a cover 1222, a light block 1224, an emitter 1280, a spacer 1226 and an encapsulant 1228. Advantageously, the spacer 1226 and encapsulant 1228 provide a relatively uniform illumination of a tissue site across all emitted wavelengths. In particular, the spacer 1226 provides a gap between the emitter 1280 and a tissue site, allowing emitted light from, say, individual LEDs of the emitter 1280 to spread as the multiple wavelength light propagates to a tissue site. Further, the encapsulant 1228 can be configured to diffuse or scatter emitted light as the light propagates to a tissue site. In an embodiment, the spacer 1226 gap is 70 mm. In an embodiment, the encapsulant 1228 contains 0.1 mm glass beads, 25% by weight, in a clear silicon RTV. In an embodiment, the emitter has an epoxy fill over LEDs incorporated within the emitter that contain microspheres so as to diffuse or scatter LED transmitted light, as described below. In an embodiment, an attenuation epoxy is dispersed over selected emitter LEDs so as to equalize intensities of the various LEDs, also as described, below. LED intensity equalization is disclosed in U.S. patent application Ser. No. 11/366,995, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Equalization, incorporated by reference herein. In an embodiment, the encapsulant or LED fill or both provide notch filter characteristics according to emitted wavelengths so as to substantially attenuate secondary emissions from one or more LEDs. Al-Ali at [0060]

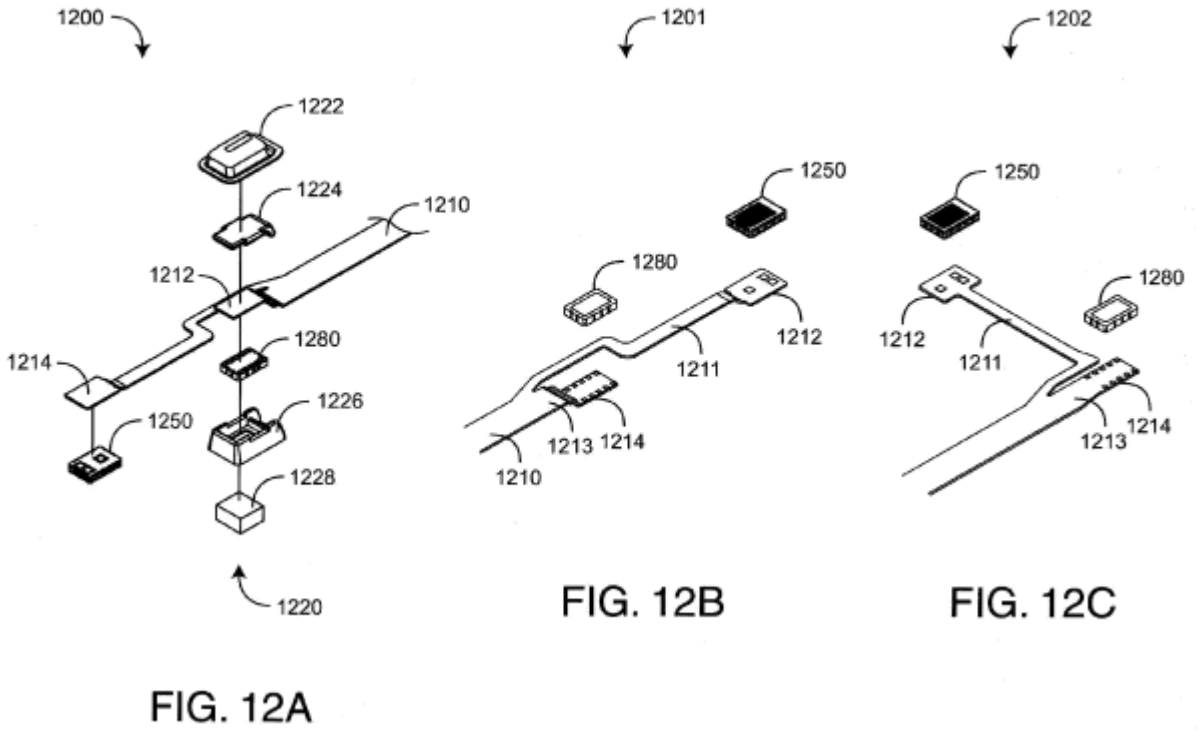
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	FIGS. 19A-B illustrate a detector 1900 having a detector component 1700 and a shield 1910. The shield 1910 has a conductive surface 1920 defining windows 1930. The windows 1930 can be any shape appropriate to the passage of light and the blocking of electromagnetic noise. In an embodiment, the windows 1930 are large rectangles with minimal interconnect so as to allow for a substantial passage of emitted light to the photodiodes 1720. In an embodiment, the shield 1910 is soldered to the ceramic substrate 1710 on at least the four corners, electrically and mechanically coupling the shield 1910 to the ceramic substrate 1710 and allowing the shield to form one side of a Faraday cage. Mechanical coupling can be, for example, gluing, welding, soldering, screwing, snap fitting, or other suitable fastening. Electrical coupling can be, for example, soldering, wire bonding, die bonding, or other suitable forms of electrical connection. In an embodiment, the ceramic substrate 1710 is printed with shielding material to complete the Faraday cage. Additional shielding material can be attached to or plated on the ceramic substrate 1710. Al-Ali at [0071] 1. A physiological sensor comprising: an emitter that emits light having a plurality of wavelengths; a detector that generates an output signal responsive to the emitted light after absorption by tissue; an attachment assembly that removably attaches the emitter and the detector to tissue; a spacer that provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue; and a light scattering medium disposed in a optical path between the emitter and tissue; the spacer and the light scattering medium providing at least a substantially uniform illumination of tissue by the emitted light for each of the wavelengths. Al-Ali at claim 1 16. A physiological sensor comprising: a light source that radiates light having a plurality of wavelengths; a diffuser that scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths; and at least one detector that generates a sensor signal responsive to the radiated light after tissue attenuation. Al-Ali at Claim 16

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	17. The physiological sensor according to claim 16 wherein the light source comprises: a ceramic substrate having conductors arranged as an electrical grid; a plurality of LEDs mounted within the ceramic substrate in an array. Al-Ali at Claim 17 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	Al-Ali discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. A multiple wavelength optical sensor has an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs configured in an array and connected within an electrical grid. A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive oxygen saturation, carboxyhemoglobin, methemoglobin and total hemoglobin. Al-Ali at [Abstract] One aspect of a physiological sensor is an emitter that emits light having a plurality of wavelengths. A detector generates an output signal responsive to the emitted light after absorption by tissue. An attachment assembly removably attaches the emitter and the detector to tissue. A spacer provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue. A light scattering medium is disposed in a optical path between the emitter and tissue. The spacer and the light scattering medium provide at least a substantially uniform illumination of tissue by the emitted light for each of the wavelengths. In various embodiments, the light scattering medium comprises glass beads mixed with an encapsulant disposed proximate the spacer. The light scattering medium comprises microspheres mixed with an epoxy disposed proximate the emitter. The emitter comprises an array of at least eight light

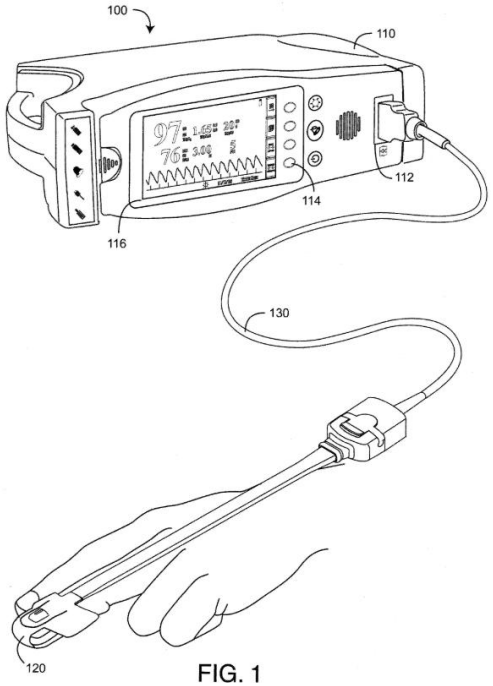
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	emitting diodes emitting light generally centered around eight unique wavelengths. The emitter comprises an array of at least thirteen light emitting diodes emitting light generally centered around at least twelve unique wavelengths. The detector comprises at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The detector comprises two Si photodiodes and four InGaAs photodiodes all connected in parallel. The light emitting diodes emit light within a first range of about 620-905 nm and within a second range of about 1040-1270 nm. Al-Ali at [0008]  FIG. 2 Al-Ali at Fig. 2 In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can

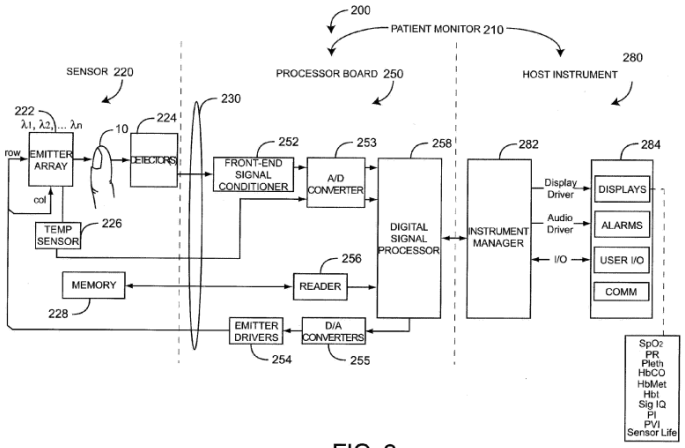
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	include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters. Al-Ali at [0043] As shown in FIG. 2, the processor board 250 includes a front end signal conditioner 252, an analog-to-digital (A/D) converter 253, a digital signal processor (DSP) 258, a memory reader 256, emitter drivers 254 and digital-to-analog (D/A) converters 255. In general, the drivers 254 convert digital control signals into analog drive signals capable of activating the emitter array 222. The front-end 252 and A/D converter 253 transform composite analog intensity signal(s) from light sensitive detector(s) 224 into digital data input to the DSP 258. In an embodiment, the DSP 258 is adapted to communicate via a reader 256 with one or more information elements such as the memory 228. Al-Ali at [0045] FIG. 3 illustrates a physiological measurement system 300 having a monitor 310 and a multiple wavelength sensor 320. The sensor 320 has an emitter assembly 340, a detector assembly 350, an interconnect assembly 360, an attachment assembly 370 and a connector assembly 380. The monitor 310 has a sensor controller 312 that communicates with the sensor 320 via a cable 330. As but one example, the sensor controller 312 may include emitter drivers, detector signal conditioning circuitry, A/D and D/A connectors, and a DSP incorporated onto a processor board, such as described with respect to FIG. 2, above. Al-Ali at [0048] As shown in FIG. 3, the emitter assembly 340 responds to drive signals received from the sensor controller 312 so as to emit light having a plurality of wavelengths. The detector assembly 350 provides a sensor signal to the sensor controller 312 in response to the emitted light after absorption by a tissue site. The interconnect assembly 360 mechanically mounts the emitter assembly 340 and the detector

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	assembly 350 and provides electrical communication between the cable 330 and these assemblies 340, 350. The attachment assembly 370 attaches the emitter assembly 340 and detector assembly 350 to a tissue site. The connector assembly 380 provides a mechanical and electrical interface to the connector at one end of the cable 330. A tape assembly example of an attachment assembly is described with respect to FIGS. 11A-B, below. A contact assembly example of a connector assembly is described with respect to FIGS. 13-14, below. Al-Ali at [0049]  FIG. 5 Al-Ali at Fig. 5

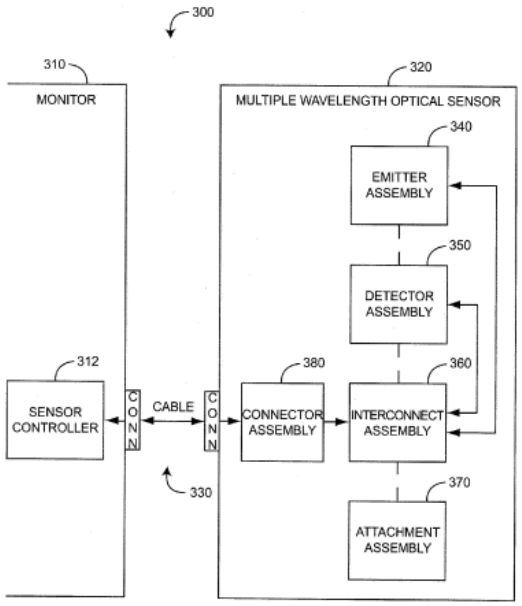
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	FIG. 5 illustrates a detector assembly 500 including a substrate 510, detector(s) 520 and an EMI shield 530. The substrate 510 acts as a mechanical support for, and provides electrical contacts to, the detector(s) 520. In an embodiment, the substrate 510 acts as an electrical insulator allowing the detector(s) 520 to be electrically isolated from EMI shielding 530 applied to a detector component. In an embodiment, the substrate 510 is a ceramic material. Al-Ali at [0051]  FIG. 12A FIG. 12B FIG. 12C Al-Ali at Fig. 12A-12C FIGS. 12A-C further illustrate optical components 1200 having emitter components 1220 and a detector 1250 mounted to a flex circuit 1210. The emitter components 1220 include a cover 1222, a light block 1224, an emitter 1280, a spacer 1226 and an encapsulant 1228. Advantageously, the spacer 1226 and

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	encapsulant 1228 provide a relatively uniform illumination of a tissue site across all emitted wavelengths. In particular, the spacer 1226 provides a gap between the emitter 1280 and a tissue site, allowing emitted light from, say, individual LEDs of the emitter 1280 to spread as the multiple wavelength light propagates to a tissue site. Further, the encapsulant 1228 can be configured to diffuse or scatter emitted light as the light propagates to a tissue site. In an embodiment, the spacer 1226 gap is 70 mm. In an embodiment, the encapsulant 1228 contains 0.1 mm glass beads, 25% by weight, in a clear silicon RTV. In an embodiment, the emitter has an epoxy fill over LEDs incorporated within the emitter that contain microspheres so as to diffuse or scatter LED transmitted light, as described below. In an embodiment, an attenuation epoxy is dispersed over selected emitter LEDs so as to equalize intensities of the various LEDs, also as described, below. LED intensity equalization is disclosed in U.S. patent application Ser. No. 11/366,995, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Equalization, incorporated by reference herein. In an embodiment, the encapsulant or LED fill or both provide notch filter characteristics according to emitted wavelengths so as to substantially attenuate secondary emissions from one or more LEDs. Al-Ali at [0060] 1. A physiological sensor comprising: an emitter that emits light having a plurality of wavelengths; a detector that generates an output signal responsive to the emitted light after absorption by tissue; an attachment assembly that removably attaches the emitter and the detector to tissue; a spacer that provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue; and a light scattering medium disposed in a optical path between the emitter and tissue; the spacer and the light scattering medium providing at least a substantially uniform illumination of tissue by the emitted light for each of the wavelengths. Al-Ali at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	Al-Ali discloses or renders obvious the output signal is indicative of the one or more physiological parameters. There is a need to noninvasively measure multiple physiological parameters, other than, or in addition to, oxygen saturation and pulse rate. For example, hemoglobin parameters that are also significant are total hemoglobin (Hbt) and the percentage of carboxyhemoglobin and methemoglobin. Other blood parameters that may be amenable to noninvasive optical sensor measurement are fractional oxygen saturation, bilirubin and blood glucose, to name a few. Al-Ali at [0007]  FIG. 1 Al-Ali at Fig. 1 FIG. 1 illustrates a physiological measurement system 100 having a monitor 110 and a multiple wavelength optical sensor 120 with enhanced measurement capabilities as compared with conventional

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	pulse oximetry. In particular, the multiple wavelength optical sensor 120 allows the measurement of various blood constituents and related parameters in addition to oxygen saturation and pulse rate. Alternatively, the multiple wavelength optical sensor 120 allows the measurement of oxygen saturation and pulse rate with increased accuracy or robustness as compared with conventional pulse oximetry. Al-Ali at [0039] In one embodiment, the optical sensor 120 is configured to plug into a monitor sensor port 112 via a patient cable 130. Monitor keys 114 provide control over operating modes and alarms, to name a few. A display 116 provides readouts of measured parameters, such as oxygen saturation, pulse rate, HbCO, HbMet and Hbt to name a few. Other blood parameters that may be measured to provide important clinical information are fractional oxygen saturation, bilirubin and blood glucose, to name a few. Al-Ali at [0040]  FIG. 2 Al-Ali at Fig. 2 FIG. 2 illustrates a block diagram a physiological measurement system 200. This measurement system includes a monitor 210 and an optical sensor 220 communicating via a patient cable 230. The monitor 210 has one or more processor boards 250 communicating with a host instrument 280. Generally, the processor board 250 communicates with the sensor 220 so as to control the emission of light into a tissue

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	site 10. Also the processor board 250 receives and processes a corresponding sensor signal responsive to the emitted light after scattering and absorption by tissue site constituents. Accordingly, the processor board 250 derives physiological parameters relating to pulsatile blood flow within the tissue site and communicates values for those parameters to the host instrument 280. Generally, the host instrument 280 provides user I/O and communications with external devices so as to define operating conditions and communicate those conditions to the processor board 250. The host instrument 280 also transfers parameter values from the processor board for display and for triggering alarms. Al-Ali at [0042] According to an embodiment, the DSP 258 comprises a processing device based on the Super Harvard ARChitecture (“SHARC”), such as those commercially available from Analog Devices. However, the DSP 258 can comprise a wide variety of data and/or signal processors capable of executing programs for determining physiological parameters from input data. According to an embodiment, the processor board 250 may comprise one or more microcontrollers (not shown) for board management, including, for example, communications of calculated parameter data and the like to the host instrument 280. Al-Ali at [0046] Also shown in FIG. 2, the host instrument 280 communicates with the processor board 250 to receive signals indicative of the physiological parameter information calculated by the DSP 258. The host instrument 280 preferably includes one or more display devices, alarms, user I/O and communication ports 284. The alarms may be audible or visual indicators or both. The user I/O may be, as examples, keypads, touch screens, pointing devices or voice recognition devices. The displays may be indicators, numerics or graphics for displaying one or more of a pulse rate, plethysmograph data, signal quality, perfusion index and blood constituents values, such as SpO2, carboxyhemoglobin (HbCO), methemoglobin (HbMet) and total hemoglobin (Hbt), or the like. The host instrument 280 may also be capable of storing or displaying historical or trending data related to one or more of the measured values or combinations of the measured values. A patient monitor is disclosed in U.S. App. No. 11,367,033, filed on Mar. 1, 2006, titled Noninvasive Multi-Parameter Patient Monitor, which is assigned to Masimo and incorporated by reference herein. Al-Ali at [0047]

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	 FIG. 3 Al-Ali at Fig. 3 As shown in FIG. 3, the emitter assembly 340 responds to drive signals received from the sensor controller 312 so as to emit light having a plurality of wavelengths. The detector assembly 350 provides a sensor signal to the sensor controller 312 in response to the emitted light after absorption by a tissue site. The interconnect assembly 360 mechanically mounts the emitter assembly 340 and the detector assembly 350 and provides electrical communication between the cable 330 and these assemblies 340, 350. The attachment assembly 370 attaches the emitter assembly 340 and detector assembly 350 to a tissue site. The connector assembly 380 provides a mechanical and electrical interface to the connector at one end of the cable 330. A tape assembly example of an attachment assembly is described with respect to FIGS. 11A-B, below. A contact assembly example of a connector assembly is described with respect to FIGS. 13-14, below. Al-Ali at [0049]

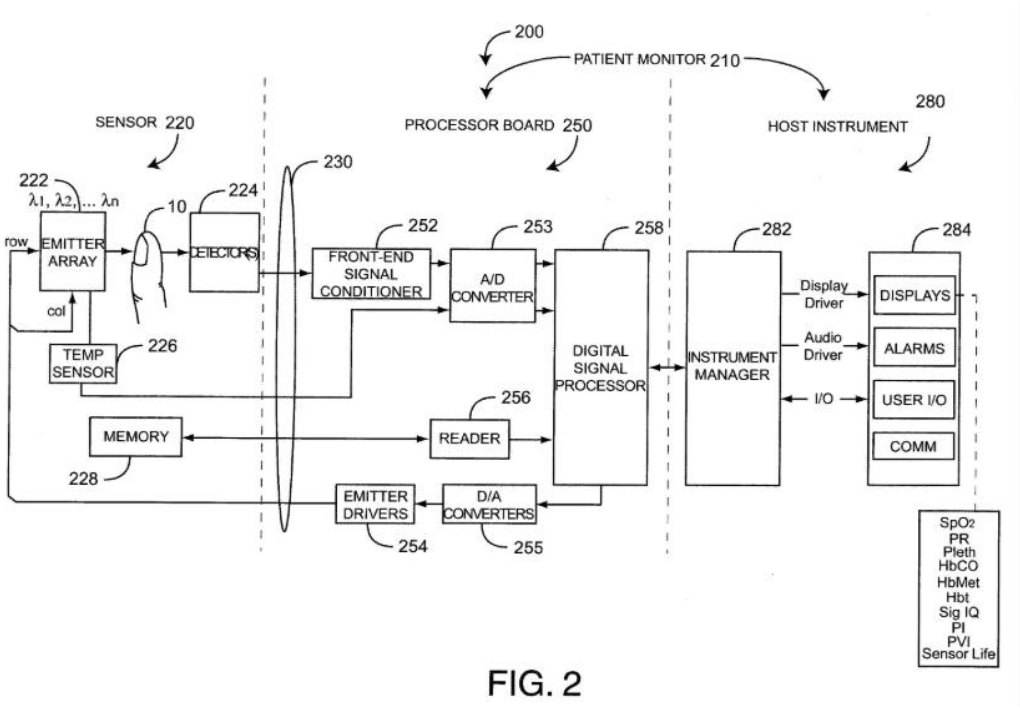
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	FIGS. 9A-B illustrate embodiments of a multiple wavelength optical sensor. In particular, illustrated are a disposable sensor 900 including an adult/pediatric sensor 901 configured for finger placement and an infant/neonate sensor 902 configured for toe, foot or hand placement. Each sensor 900 has a tape end 910 and an opposite connector end 920 electrically and mechanically interconnected via a flexible coupling 930. The tape end 910 attaches an emitter and detector to a tissue site, as described below. The emitter illuminates the tissue site and the detector generates a sensor signal responsive to the light after tissue absorption, such as absorption by pulsatle arterial blood flow within the tissue site. The sensor signal is communicated via the flexible coupling 930 to the connector end 920. The connector mates with a cable (not shown) that communicates the sensor signal to a monitor (not shown). The monitor calculates a variety of physiological parameters from the detector signal, such as pulse rate (PR), oxygen saturation (SpO2), carboxyhemoglobin (HbCO), methemoglobin (HbMet) and total hemoglobin (Hbt), to name a few. A sensor configured for measurement of at least some of the above-mentioned physiological parameters is described in U.S. Provisional Application Ser. No. 60/920,474, filed Mar. 27, 2007, titled Disposable Multiple Wavelength Optical Sensor; and U.S. Provisional Application Ser. No. 60/923,630, filed Apr. 14, 2007, titled Disposable Multiple Wavelength Optical Sensor, both applications incorporated by reference herein. Al-Ali at [0057] As shown in FIGS. 15A-B, an LED array 1520 is connected within an electrical grid of n rows and m columns totaling n+m LED drive lines where n and m are integers greater than one. The electrical grid advantageously minimizes the number of drive lines required to activate the LEDs 1520 while preserving flexibility to selectively activate individual LEDs 1520 in any sequence and multiple LEDs 1520 simultaneously. The electrical grid also facilitates setting LED currents so as to control intensity at each LED wavelength, determining operating wavelengths and monitoring total grid current so as to limit power dissipation. The LED array 1520 is physically configured in rows, which facilitates clustering LEDs according to wavelength so as to minimize pathlength variations and which facilitates equalization of LED intensities. In an embodiment the LED array 1520 comprises up to sixteen LEDs configured in an electrical grid of four rows and four columns. Each of four row drive lines provide a common anode connection to four LEDs, and each of four column drive lines provide a common cathode connection to four LEDs. Thus, sixteen LEDs are advantageously driven with only eight wires, including four anode drive lines and four cathode drive lines. In an embodiment, an LED array is partially populated with eight LEDs having nominal wavelengths as shown in TABLE 1. In an embodiment, the LED array is partially populated with thirteen LEDs having nominal wavelengths as shown in TABLE 2.

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	Advantageously, LED array and the corresponding LED wavelengths are adapted to measure total hemoglobin (Hbt) in addition to SpO2, pulse rate, HbCO and HbMet, among other physiological parameters. In an embodiment, LEDs D1-D5 are encapsulated with an attenuating epoxy 1660 (FIGS. 16B, F) so as to equalize LED intensities. In an embodiment, a clear fill epoxy 1670 (FIGS. 16B, F) mixed with 1-20 μm microspheres is dispersed and cured over the LEDs. An LED array and corresponding drivers for an electrical grid are disclosed in U.S. patent application Ser. No. 11/367,013, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Emitters, incorporated by reference herein. Al-Ali at [0067] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Al-Ali discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. Pulse oximeters capable of reading through motion induced noise are disclosed in at least U.S. Pat. Nos. 6,770,028, 6,658,276, 6,650,917, 6,157,850, 6,002,952, 5,769,785, and 5,758,644; low noise pulse oximetry sensors are disclosed in at least U.S. Pat. Nos. 6,088,607 and 5,782,757; all of which are assigned to Masimo Corporation, Irvine, Calif. (“Masimo”) and are incorporated by reference herein. Al-Ali at [0004] As shown in FIGS. 15A-B, an LED array 1520 is connected within an electrical grid of n rows and m columns totaling n+m LED drive lines where n and m are integers greater than one. The electrical grid advantageously minimizes the number of drive lines required to activate the LEDs 1520 while preserving flexibility to selectively activate individual LEDs 1520 in any sequence and multiple LEDs 1520 simultaneously. The electrical grid also facilitates setting LED currents so as to control intensity at each LED wavelength, determining operating wavelengths and monitoring total grid current so as to limit power dissipation. The LED array 1520 is physically configured in rows, which facilitates clustering

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	LEDs according to wavelength so as to minimize pathlength variations and which facilitates equalization of LED intensities. In an embodiment the LED array 1520 comprises up to sixteen LEDs configured in an electrical grid of four rows and four columns. Each of four row drive lines provide a common anode connection to four LEDs, and each of four column drive lines provide a common cathode connection to four LEDs. Thus, sixteen LEDs are advantageously driven with only eight wires, including four anode drive lines and four cathode drive lines. In an embodiment, an LED array is partially populated with eight LEDs having nominal wavelengths as shown in TABLE 1. In an embodiment, the LED array is partially populated with thirteen LEDs having nominal wavelengths as shown in TABLE 2. Advantageously, LED array and the corresponding LED wavelengths are adapted to measure total hemoglobin (Hbt) in addition to SpO2, pulse rate, HbCO and HbMet, among other physiological parameters. In an embodiment, LEDs D1-D5 are encapsulated with an attenuating epoxy 1660 (FIGS. 16B, F) so as to equalize LED intensities. In an embodiment, a clear fill epoxy 1670 (FIGS. 16B, F) mixed with 1-20 μm microspheres is dispersed and cured over the LEDs. An LED array and corresponding drivers for an electrical grid are disclosed in U.S. patent application Ser. No. 11/367,013, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Emitters, incorporated by reference herein. Al-Ali at [0067] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Al-Ali discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off. The current meter 2870 outputs a current measure 2872 that indicates the total LED current driving the LED array. The current limiter 2880 is responsive to the current measure 2872 and limits specified by the command register 2810 so as to prevent excessive power dissipation by the LED array. The current limiter 2880 provides an enable 2882 output to the anode selector 2820. A Hi Limit 2812 input specifies the higher of two preset current limits. The current limiter 2880 latches the enable 2882 output in an off condition when the current limit is exceeded, disabling the anode selector 2820. A trip reset 2814 input resets the enable 2882 output to re-enable the anode selector 2820.

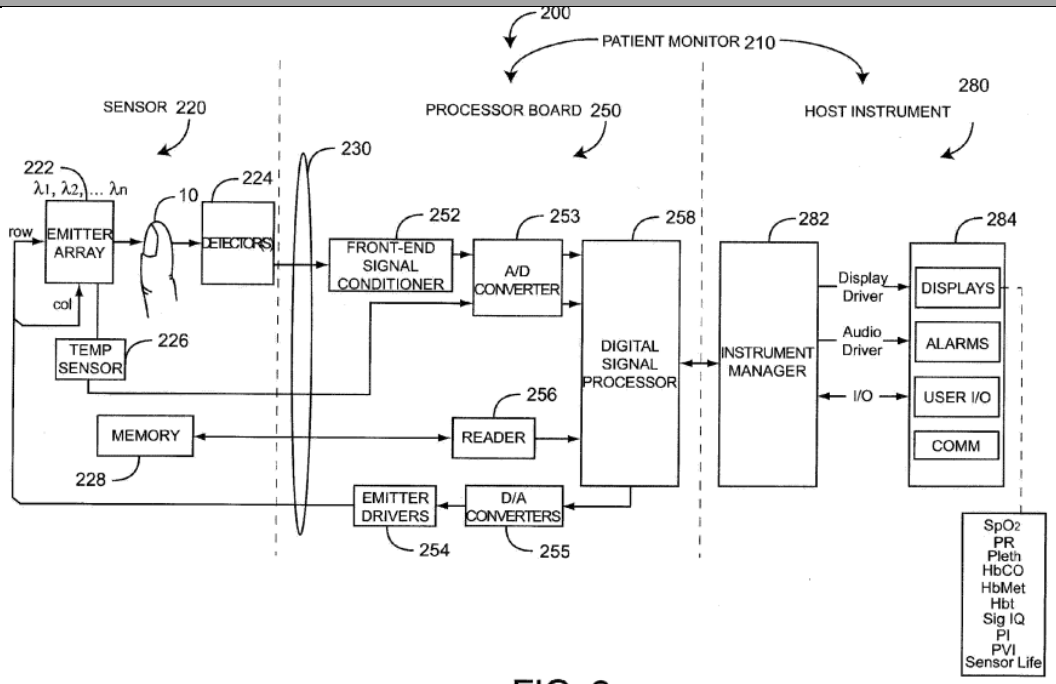
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	Al-Ali at [0083] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Al-Ali discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. FIGS. 21A-B illustrate additional embodiments of a multiple wavelength optical sensor 2100. In particular, disposable sensors include an adult/pediatric sensor 2101 and an infant/pediatric sensor 2102. Each sensor 2100 has a tape end 2110 and an opposite connector end 2120 electrically and mechanically interconnected via a cable 2130. The tape end 2110 attaches an emitter and detector to a tissue site**.** An emitter, described below, emits transmits light into the tissue site and a detector, also described below, generates a sensor signal responsive to the emitted light after tissue absorption. The sensor signal is communicated via the cable 2130 to the connector 2120. The connector 2120 mates with a patient cable (not shown) that communicates the sensor signal to a monitor (not shown). The relative spacing between the emitter and detector are selected to obtain a desired alignment of the emitter and detector when the sensor is attached to the body tissue of a patient. Al-Ali at [0073] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the	Al-Ali discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal.

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first signal and the second signal; and	Pulse oximeters capable of reading through motion induced noise are disclosed in at least U.S. Pat. Nos. 6,770,028, 6,658,276, 6,650,917, 6,157,850, 6,002,952, 5,769,785, and 5,758,644; low noise pulse oximetry sensors are disclosed in at least U.S. Pat. Nos. 6,088,607 and 5,782,757; all of which are assigned to Masimo Corporation, Irvine, Calif. (“Masimo”) and are incorporated by reference herein. Al-Ali at [0004] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Al-Ali discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. Another aspect of a physiological sensor comprising an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs disposed within an emitter ceramic substrate**.** A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive total hemoglobin (Hbt). The detector comprises a plurality of photodiodes disposed within a detector ceramic substrate. A first set of the photodiodes is responsive to a first set of the wavelengths and a second set of the photodiodes is responsive to a second set of the wavelengths. In various embodiments a diffuser scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths. A first encapsulate containing glass beads is mounted in a spacer proximate the emitter ceramic substrate. A second encapsulate mixed with microspheres is disposed on the LEDs within the emitter ceramic substrate. The photodiodes comprise at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The LEDs radiate light generally centered around at least twelve unique wavelengths. The LEDs are mounted in an array of at least thirteen LEDs connected within an electrical grid. The twelve unique wavelengths comprise eight wavelengths within a first range of about 620-905 nm. and four wavelengths within a second range of about 1040-1270 nm. Al-Ali at [0009]

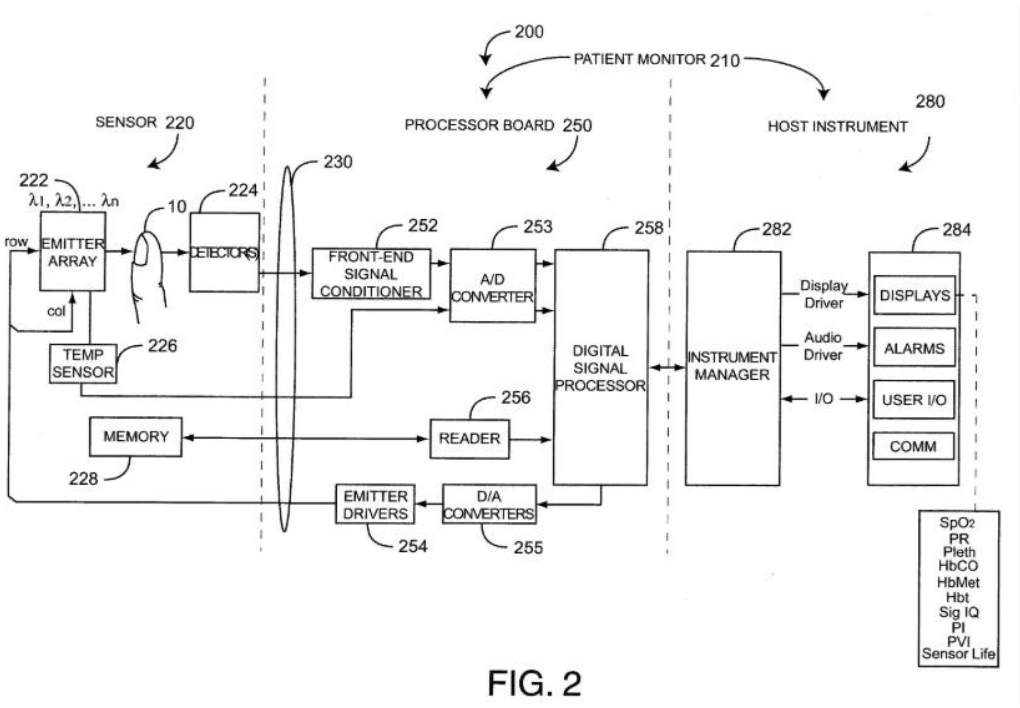
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	 FIG. 2 Al-Ali at Fig. 2 FIG. 1 illustrates a physiological measurement system 100 having a monitor 110 and a multiple wavelength optical sensor 120 with enhanced measurement capabilities as compared with conventional pulse oximetry. In particular, the multiple wavelength optical sensor 120 allows the measurement of various blood constituents and related parameters in addition to oxygen saturation and pulse rate. Alternatively, the multiple wavelength optical sensor 120 allows the measurement of oxygen saturation and pulse rate with increased accuracy or robustness as compared with conventional pulse oximetry. Al-Ali at [0039] In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter

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	array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters. Al-Ali at [0043] Although described herein with respect to various disposable sensor embodiments, a sensor may be reusable, resposable (partially reusable/partially disposable), adhesive or non-adhesive, or a transmittance, reflectance or transflectance sensor. Further, a sensor may be configured for a variety of tissue sites such as a finger, hand, foot, forehead or ear or for attachment to multiple tissue sites, including multiple-head sensors capable of simultaneous multi-site measurements. Al-Ali at [0044] FIGS. 19A-B illustrate a detector 1900 having a detector component 1700 and a shield 1910. The shield 1910 has a conductive surface 1920 defining windows 1930. The windows 1930 can be any shape appropriate to the passage of light and the blocking of electromagnetic noise. In an embodiment, the windows 1930 are large rectangles with minimal interconnect so as to allow for a substantial passage of emitted light to the photodiodes 1720. In an embodiment, the shield 1910 is soldered to the ceramic substrate 1710 on at least the four corners, electrically and mechanically coupling the shield 1910 to the ceramic substrate 1710 and allowing the shield to form one side of a Faraday cage. Mechanical coupling can be, for example, gluing, welding, soldering, screwing, snap fitting, or other suitable fastening. Electrical coupling can be, for example, soldering, wire bonding, die bonding, or other suitable forms of electrical connection. In an embodiment, the ceramic substrate 1710 is printed with shielding material to complete the Faraday cage. Additional shielding material can be attached to or plated on the ceramic substrate 1710. Al-Ali at [0071]

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.	See claim 1 above. Al-Ali discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non-Al-Alisitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal. FIG. 2 illustrates a block diagram a physiological measurement system 200. This measurement system includes a monitor 210 and an optical sensor 220 communicating via a patient cable 230. The monitor 210 has one or more processor boards 250 communicating with a host instrument 280. Generally, the processor board 250 communicates with the sensor 220 so as to control the emission of light into a tissue site 10. Also the processor board 250 receives and processes a corresponding sensor signal responsive to the emitted light after scattering and absorption by tissue site constituents. Accordingly, the processor board 250 derives physiological parameters relating to pulsatile blood flow within the tissue site and communicates values for those parameters to the host instrument 280. Generally, the host instrument 280 provides user I/O and communications with external devices so as to define operating conditions and communicate those conditions to the processor board 250. The host instrument 280 also transfers parameter values from the processor board for display and for triggering alarms. Al-Ali at [0042]

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	 FIG. 2 Al-Ali at [Fig.2] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	
6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of	See claim 1 above. Al-Ali discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.

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detectors arranged along an arc.	One aspect of a physiological sensor is an emitter that emits light having a plurality of wavelengths. A detector generates an output signal responsive to the emitted light after absorption by tissue. An attachment assembly removably attaches the emitter and the detector to tissue. A spacer provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue. A light scattering medium is disposed in a optical path between the emitter and tissue. The spacer and the light scattering medium provide at least a substantially uniform illumination of tissue by the emitted light for each of the wavelengths. In various embodiments, the light scattering medium comprises glass beads mixed with an encapsulant disposed proximate the spacer. The light scattering medium comprises microspheres mixed with an epoxy disposed proximate the emitter. The emitter comprises an array of at least eight light emitting diodes emitting light generally centered around eight unique wavelengths. The emitter comprises an array of at least thirteen light emitting diodes emitting light generally centered around at least twelve unique wavelengths. The detector comprises at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The detector comprises two Si photodiodes and four InGaAs photodiodes all connected in parallel. The light emitting diodes emit light within a first range of about 620-905 nm and within a second range of about 1040-1270 nm. Al-Ali at [0008] Another aspect of a physiological sensor comprising an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs disposed within an emitter ceramic substrate. A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive total hemoglobin (Hbt). The detector comprises a plurality of photodiodes disposed within a detector ceramic substrate. A first set of the photodiodes is responsive to a first set of the wavelengths and a second set of the photodiodes is responsive to a second set of the wavelengths. In various embodiments a diffuser scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths. A first encapsulate containing glass beads is mounted in a spacer proximate the emitter ceramic substrate. A second encapsulate mixed with microspheres is disposed on the LEDs within the emitter ceramic substrate. The photodiodes comprise at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The LEDs radiate light generally centered around at least twelve unique wavelengths. The LEDs are mounted in an array of at least thirteen LEDs connected within an electrical grid. The twelve unique wavelengths comprise eight wavelengths within a first range of about 620-905 nm. and four wavelengths within a second range of about 1040-1270 nm. Al-Ali at [0009]

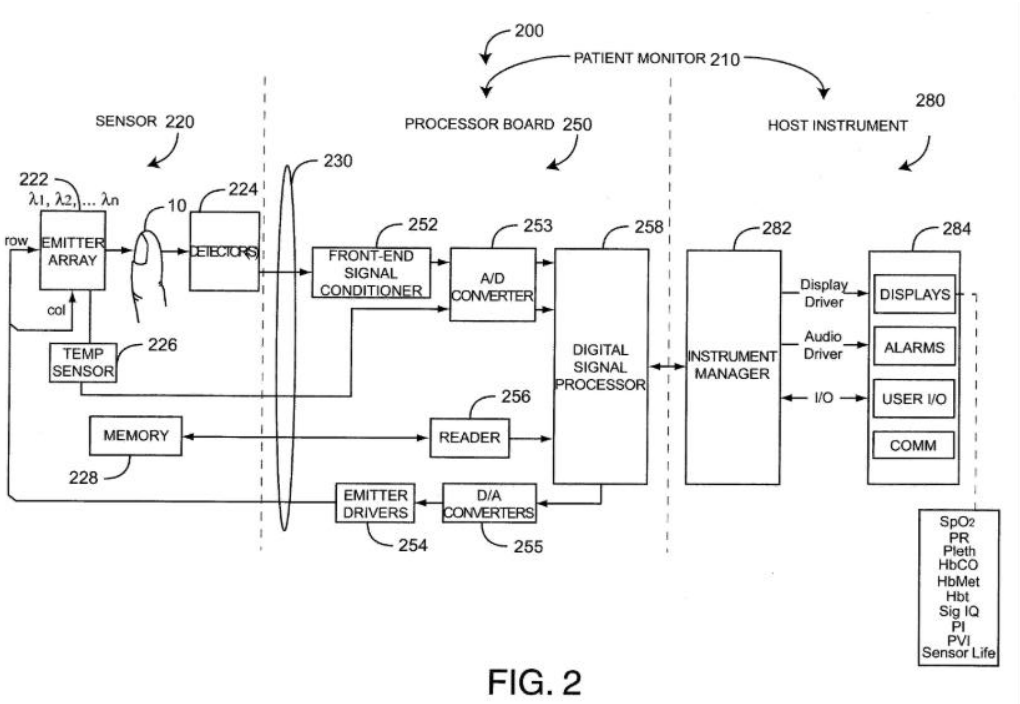
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	 FIG. 2 Al-Ali at Fig. 2 In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters.

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	Al-Ali at [0043] As shown in FIG. 2, the processor board 250 includes a front end signal conditioner 252, an analog-to-digital (A/D) converter 253, a digital signal processor (DSP) 258, a memory reader 256, emitter drivers 254 and digital-to-analog (D/A) converters 255. In general, the drivers 254 convert digital control signals into analog drive signals capable of activating the emitter array 222. The front-end 252 and A/D converter 253 transform composite analog intensity signal(s) from light sensitive detector(s) 224 into digital data input to the DSP 258. In an embodiment, the DSP 258 is adapted to communicate via a reader 256 with one or more information elements such as the memory 228. Al-Ali at [0045] FIGS. 15A-B illustrate emitters 1500, including an eight-LED emitter 1501 particularly advantageously for SpO2, HbCO and HbMet measurements and a thirteen-LED emitter 1502 particularly advantageously for total hemoglobin (Hbt) measurements in addition to SpO2, HbCO and HbMet. Each emitter 1500 has a ceramic substrate 1510, light-emitting diodes (LEDs) 1520 and a thermistor 1530. The ceramic substrate 1510 has a body 1512 defining a cavity 1514. The cavity 1514 contains bonding pads that mount an array of LEDs 1520. The ceramic substrate 1510 also has multiple layers of traces, feed-thrus and solder pads so as to interconnect the LEDs 1520 in an electrical grid. The solder pads allow a monitor to electrically activate the LEDs 1520 via the flex circuit 1112 (FIGS. 11A-B), the connector 1010 (FIG. 10) and an attached patient cable 1000 (FIG. 10). The cavity 1514 also contains a thermistor 1530, the resistance of which can be measured in order to determine the bulk temperature of the LEDs 1520. The thermal characteristics of ceramic stabilize and normalize the bulk temperature of the substrate 1510 so that the thermistor measurement of bulk temperature allows an accurate determination of LED temperature and, hence, LED wavelengths. Al-Ali at [0066] **4**. The physiological sensor according to claim 3 wherein the emitter comprises an array of at least eight light emitting diodes emitting light generally centered around eight unique wavelengths. Al-Ali at Claim 4

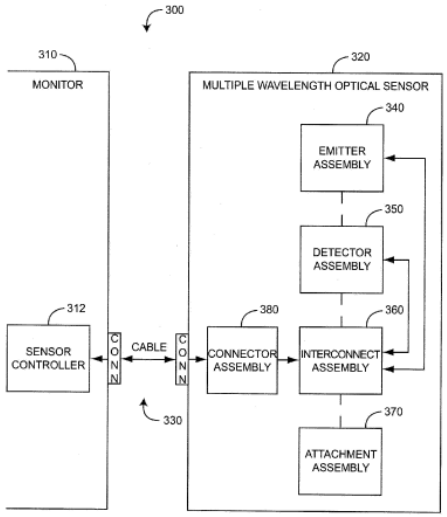
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	5. The physiological sensor according to claim 4 wherein the emitter comprises an array of at least thirteen light emitting diodes emitting light generally centered around at least twelve unique wavelengths. Al-Ali at Claim 5 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	See claim 6 above. Al-Ali discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless Al-Alismitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. According to an embodiment, the DSP 258 comprises a processing device based on the Super Harvard ARChitecture (“SHARC”), such as those commercially available from Analog Devices. However, the DSP 258 can comprise a wide variety of data and/or signal processors capable of executing programs for determining physiological parameters from input data. According to an embodiment, the processor board 250 may comprise one or more microcontrollers (not shown) for board management, including, for example, communications of calculated parameter data and the like to the host instrument 280. Al-Ali at [0046] Also shown in FIG. 2, the host instrument 280 communicates with the processor board 250 to receive signals indicative of the physiological parameter information calculated by the DSP 258. The host instrument 280 preferably includes one or more display devices, alarms, user I/O and communication ports 284. The alarms may be audible or visual indicators or both. The user I/O may be, as examples,

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	keypads, touch screens, pointing devices or voice recognition devices. The displays may be indicators, numerics or graphics for displaying one or more of a pulse rate, plethysmograph data, signal quality, perfusion index and blood constituents values, such as SpO2, carboxyhemoglobin (HbCO), methemoglobin (HbMet) and total hemoglobin (Hbt), or the like. The host instrument 280 may also be capable of storing or displaying historical or trending data related to one or more of the measured values or combinations of the measured values. A patient monitor is disclosed in U.S. App. No. 11,367,033, filed on Mar. 1, 2006, titled Noninvasive Multi-Parameter Patient Monitor, which is assigned to Masimo and incorporated by reference herein. Al-Ali at [0047] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Al-Ali discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. See above at claim 1[pre] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a light source configured to be on or off, responsive to the light	Al-Ali discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light.

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source being on, the light source generates an output light,	See above at claim 1[c], 1[j], 1[k] FIGS. 21A-B illustrate additional embodiments of a multiple wavelength optical sensor 2100. In particular, disposable sensors include an adult/pediatric sensor 2101 and an infant/pediatric sensor 2102. Each sensor 2100 has a tape end 2110 and an opposite connector end 2120 electrically and mechanically interconnected via a cable 2130. The tape end 2110 attaches an emitter and detector to a tissue site. An emitter, described below, emits transmits light into the tissue site and a detector, also described below, generates a sensor signal responsive to the emitted light after tissue absorption. The sensor signal is communicated via the cable 2130 to the connector 2120. The connector 2120 mates with a patient cable (not shown) that communicates the sensor signal to a monitor (not shown). The relative spacing between the emitter and detector are selected to obtain a desired alignment of the emitter and detector when the sensor is attached to the body tissue of a patient. Al-Ali at [0073] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Al-Ali discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. See above at claim 1[d] Another aspect of a physiological sensor comprising an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs disposed within an emitter ceramic substrate**.** A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive total hemoglobin (Hbt). The detector comprises a plurality of photodiodes disposed within a detector ceramic substrate. A first set of the photodiodes is responsive to a first set of the wavelengths and a second set of the photodiodes is responsive to a second set of the wavelengths. In various embodiments a diffuser scatters the radiated light so that a tissue site is uniformly illuminated

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	across all of the wavelengths. A first encapsulate containing glass beads is mounted in a spacer proximate the emitter ceramic substrate. A second encapsulate mixed with microspheres is disposed on the LEDs within the emitter ceramic substrate. The photodiodes comprise at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The LEDs radiate light generally centered around at least twelve unique wavelengths. The LEDs are mounted in an array of at least thirteen LEDs connected within an electrical grid. The twelve unique wavelengths comprise eight wavelengths within a first range of about 620-905 nm. and four wavelengths within a second range of about 1040-1270 nm. Al-Ali at [0009]  FIG. 2 Al-Ali at Fig. 2 FIG. 2 illustrates a block diagram a physiological measurement system 200. This measurement system includes a monitor 210 and an optical sensor 220 communicating via a patient cable 230. The monitor 210 has one or more processor boards 250 communicating with a host instrument 280. Generally, the processor board 250 communicates with the sensor 220 so as to control the emission of light into a tissue

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	site 10. Also the processor board 250 receives and processes a corresponding sensor signal responsive to the emitted light after scattering and absorption by tissue site constituents. Accordingly, the processor board 250 derives physiological parameters relating to pulsatile blood flow within the tissue site and communicates values for those parameters to the host instrument 280. Generally, the host instrument 280 provides user I/O and communications with external devices so as to define operating conditions and communicate those conditions to the processor board 250. The host instrument 280 also transfers parameter values from the processor board for display and for triggering alarms. Al-Ali at [0042] In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters. Al-Ali at [0043] Although described herein with respect to various disposable sensor embodiments, a sensor may be reusable, resposable (partially reusable/partially disposable), adhesive or non-adhesive, or a transmittance, reflectance or transflectance sensor. Further, a sensor may be configured for a variety of tissue sites such as a finger, hand, foot, forehead or ear or for attachment to multiple tissue sites, including multiple-head sensors capable of simultaneous multi-site measurements. Al-Ali at [0044]

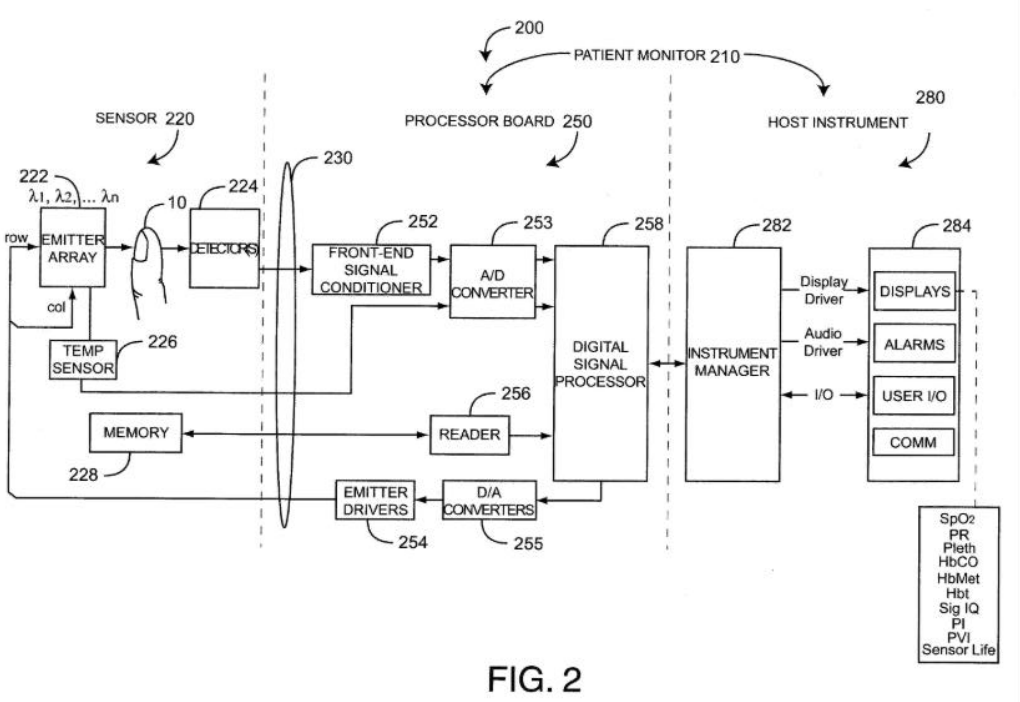
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	 FIG. 3 Al-Ali at Fig. 3 As shown in FIG. 3, the emitter assembly 340 responds to drive signals received from the sensor controller 312 so as to emit light having a plurality of wavelengths. The detector assembly 350 provides a sensor signal to the sensor controller 312 in response to the emitted light after absorption by a tissue site. The interconnect assembly 360 mechanically mounts the emitter assembly 340 and the detector assembly 350 and provides electrical communication between the cable 330 and these assemblies 340, 350. The attachment assembly 370 attaches the emitter assembly 340 and detector assembly 350 to a tissue site. The connector assembly 380 provides a mechanical and electrical interface to the connector at one end of the cable 330. A tape assembly example of an attachment assembly is described with respect to FIGS. 11A-B, below. A contact assembly example of a connector assembly is described with respect to FIGS. 13-14, below. Al-Ali at [0049] FIG. 4 illustrates an emitter assembly 400 having a substrate 410, an emitter array 420, an equalization 430 and a diffusion 440. The emitter array 420 has multiple light emitting sources, each activated by drive signals 422. The light emitting sources are capable of generating light 442 having multiple

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	wavelengths. The equalization 430 accounts for differences in emitter intensity and tissue absorption of the light across the multiple wavelengths so as to at least partially equalize wavelength-dependent variations in intensity at the detector. The substrate 410 provides a physical mount for the emitter array and emitter-related equalization and an electrical connection between the emitter array and an interconnect assembly, such as described above. Advantageously, the substrate 410 also maintains a uniform bulk temperature measurement so as to calculate the operating wavelengths for the light emitting sources. One example of an emitter array embodiment 420 is described with respect to FIG. 6, below. One example of equalization 430 is described with respect to encapsulants, below. Examples of substrates 410 are described with respect to ceramic and board substrates, below. Al-Ali at [0050] FIGS. 9A-B illustrate embodiments of a multiple wavelength optical sensor. In particular, illustrated are a disposable sensor 900 including an adult/pediatric sensor 901 configured for finger placement and an infant/neonate sensor 902 configured for toe, foot or hand placement. Each sensor 900 has a tape end 910 and an opposite connector end 920 electrically and mechanically interconnected via a flexible coupling 930. The tape end 910 attaches an emitter and detector to a tissue site, as described below. The emitter illuminates the tissue site and the detector generates a sensor signal responsive to the light after tissue absorption, such as absorption by pulsatle arterial blood flow within the tissue site. The sensor signal is communicated via the flexible coupling 930 to the connector end 920. The connector mates with a cable (not shown) that communicates the sensor signal to a monitor (not shown). The monitor calculates a variety of physiological parameters from the detector signal, such as pulse rate (PR), oxygen saturation (SpO_2), carboxyhemoglobin (HbCO), methemoglobin (HbMet) and total hemoglobin (Hbt), to name a few. A sensor configured for measurement of at least some of the above-mentioned physiological parameters is described in U.S. Provisional Application Ser. No. 60/920,474, filed Mar. 27, 2007, titled Disposable Multiple Wavelength Optical Sensor; and U.S. Provisional Application Ser. No. 60/923,630, filed Apr. 14, 2007, titled Disposable Multiple Wavelength Optical Sensor, both applications incorporated by reference herein. Al-Ali at [0057] FIGS. 12A-C further illustrate optical components 1200 having emitter components 1220 and a detector 1250 mounted to a flex circuit 1210. The emitter components 1220 include a cover 1222, a light block 1224, an emitter 1280, a spacer 1226 and an encapsulant 1228. Advantageously, the spacer 1226 and encapsulant 1228 provide a relatively uniform illumination of a tissue site across all emitted wavelengths.

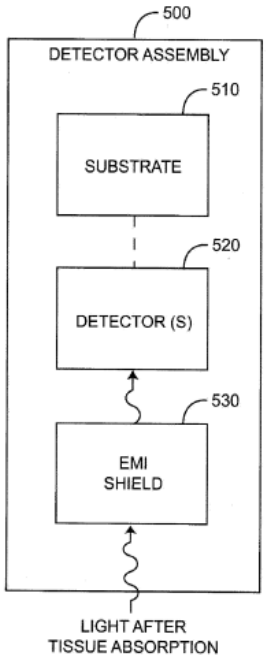
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	In particular, the spacer 1226 provides a gap between the emitter 1280 and a tissue site, allowing emitted light from, say, individual LEDs of the emitter 1280 to spread as the multiple wavelength light propagates to a tissue site. Further, the encapsulant 1228 can be configured to diffuse or scatter emitted light as the light propagates to a tissue site. In an embodiment, the spacer 1226 gap is 70 mm. In an embodiment, the encapsulant 1228 contains 0.1 mm glass beads, 25% by weight, in a clear silicon RTV. In an embodiment, the emitter has an epoxy fill over LEDs incorporated within the emitter that contain microspheres so as to diffuse or scatter LED transmitted light, as described below. In an embodiment, an attenuation epoxy is dispersed over selected emitter LEDs so as to equalize intensities of the various LEDs, also as described, below. LED intensity equalization is disclosed in U.S. patent application Ser. No. 11/366,995, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Equalization, incorporated by reference herein. In an embodiment, the encapsulant or LED fill or both provide notch filter characteristics according to emitted wavelengths so as to substantially attenuate secondary emissions from one or more LEDs. Al-Ali at [0060] FIGS. 19A-B illustrate a detector 1900 having a detector component 1700 and a shield 1910. The shield 1910 has a conductive surface 1920 defining windows 1930. The windows 1930 can be any shape appropriate to the passage of light and the blocking of electromagnetic noise. In an embodiment, the windows 1930 are large rectangles with minimal interconnect so as to allow for a substantial passage of emitted light to the photodiodes 1720. In an embodiment, the shield 1910 is soldered to the ceramic substrate 1710 on at least the four corners, electrically and mechanically coupling the shield 1910 to the ceramic substrate 1710 and allowing the shield to form one side of a Faraday cage. Mechanical coupling can be, for example, gluing, welding, soldering, screwing, snap fitting, or other suitable fastening. Electrical coupling can be, for example, soldering, wire bonding, die bonding, or other suitable forms of electrical connection. In an embodiment, the ceramic substrate 1710 is printed with shielding material to complete the Faraday cage. Additional shielding material can be attached to or plated on the ceramic substrate 1710. Al-Ali at [0071] FIGS. 21A-B illustrate additional embodiments of a multiple wavelength optical sensor 2100. In particular, disposable sensors include an adult/pediatric sensor 2101 and an infant/pediatric sensor 2102. Each sensor 2100 has a tape end 2110 and an opposite connector end 2120 electrically and mechanically interconnected via a cable 2130. The tape end 2110 attaches an emitter and detector to a tissue site. An

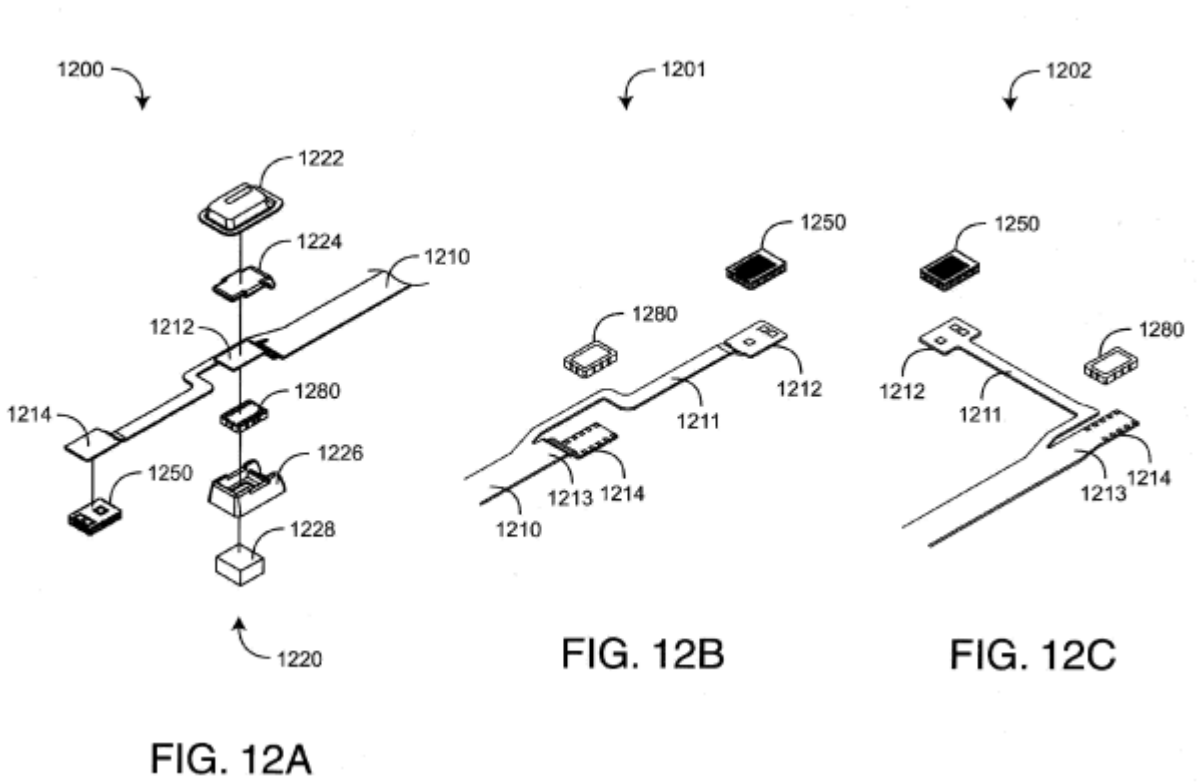
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	emitter, described below, emits transmits light into the tissue site and a detector, also described below, generates a sensor signal responsive to the emitted light after tissue absorption. The sensor signal is communicated via the cable 2130 to the connector 2120. The connector 2120 mates with a patient cable (not shown) that communicates the sensor signal to a monitor (not shown). The relative spacing between the emitter and detector are selected to obtain a desired alignment of the emitter and detector when the sensor is attached to the body tissue of a patient. Al-Ali at [0073] A physiological sensor comprising: an emitter that emits light having a plurality of wavelengths; a detector that generates an output signal responsive to the emitted light after absorption by tissue; an attachment assembly that removably attaches the emitter and the detector to tissue; a spacer that provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue; and a light scattering medium disposed in a optical path between the emitter and tissue; the spacer and the light scattering medium providing at least a substantially uniform illumination of tissue by the emitted light for each of the wavelengths. Al-Ali at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Al-Ali discloses or renders obvious a detector. See above at claim 1[e] A multiple wavelength optical sensor has an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs configured in an array and connected within an electrical grid. A detector is configured to receive the light after absorption by

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	pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive oxygen saturation, carboxyhemoglobin, methemoglobin and total hemoglobin. Al-Ali at [Abstract] One aspect of a physiological sensor is an emitter that emits light having a plurality of wavelengths. A detector generates an output signal responsive to the emitted light after absorption by tissue. An attachment assembly removably attaches the emitter and the detector to tissue. A spacer provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue. A light scattering medium is disposed in a optical path between the emitter and tissue. The spacer and the light scattering medium provide at least a substantially uniform illumination of tissue by the emitted light for each of the wavelengths. In various embodiments, the light scattering medium comprises glass beads mixed with an encapsulant disposed proximate the spacer. The light scattering medium comprises microspheres mixed with an epoxy disposed proximate the emitter. The emitter comprises an array of at least eight light emitting diodes emitting light generally centered around eight unique wavelengths. The emitter comprises an array of at least thirteen light emitting diodes emitting light generally centered around at least twelve unique wavelengths. The detector comprises at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The detector comprises two Si photodiodes and four InGaAs photodiodes all connected in parallel. The light emitting diodes emit light within a first range of about 620-905 nm and within a second range of about 1040-1270 nm. Al-Ali at [0008]

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	 FIG. 2 Al-Ali at Fig. 2 In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters.

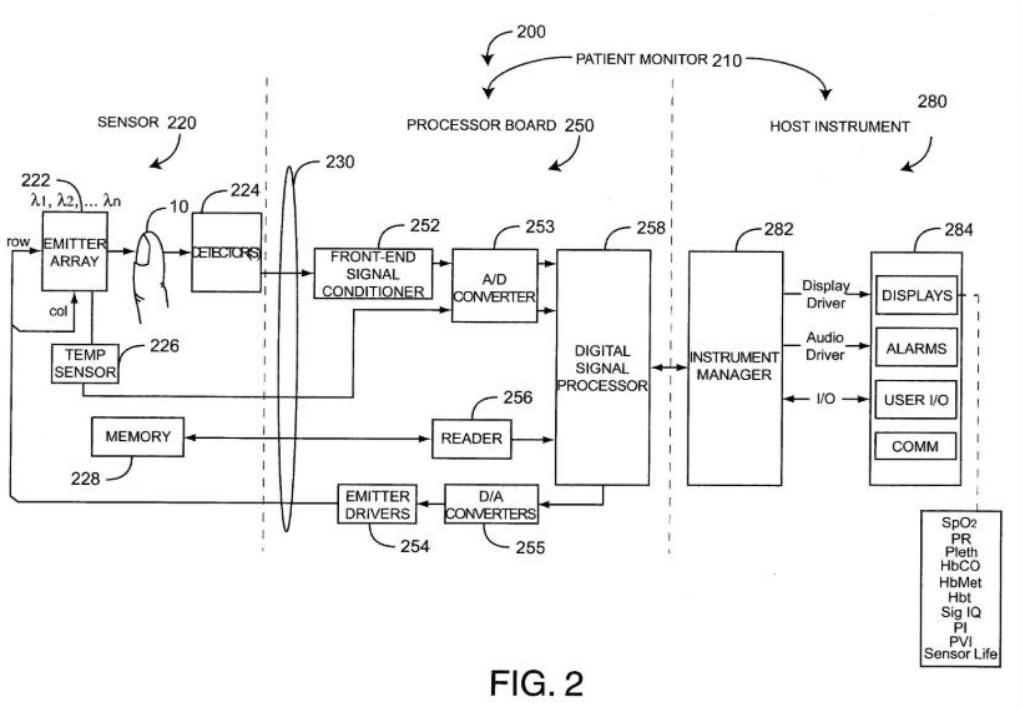
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	Al-Ali at [0043] As shown in FIG. 2, the processor board 250 includes a front end signal conditioner 252, an analog-to-digital (A/D) converter 253, a digital signal processor (DSP) 258, a memory reader 256, emitter drivers 254 and digital-to-analog (D/A) converters 255. In general, the drivers 254 convert digital control signals into analog drive signals capable of activating the emitter array 222. The front-end 252 and A/D converter 253 transform composite analog intensity signal(s) from light sensitive detector(s) 224 into digital data input to the DSP 258. In an embodiment, the DSP 258 is adapted to communicate via a reader 256 with one or more information elements such as the memory 228. Al-Ali at [0045] FIG. 3 illustrates a physiological measurement system 300 having a monitor 310 and a multiple wavelength sensor 320. The sensor 320 has an emitter assembly 340, a detector assembly 350, an interconnect assembly 360, an attachment assembly 370 and a connector assembly 380. The monitor 310 has a sensor controller 312 that communicates with the sensor 320 via a cable 330. As but one example, the sensor controller 312 may include emitter drivers, detector signal conditioning circuitry, A/D and D/A connectors, and a DSP incorporated onto a processor board, such as described with respect to FIG. 2, above. Al-Ali at [0048] As shown in FIG. 3, the emitter assembly 340 responds to drive signals received from the sensor controller 312 so as to emit light having a plurality of wavelengths. The detector assembly 350 provides a sensor signal to the sensor controller 312 in response to the emitted light after absorption by a tissue site. The interconnect assembly 360 mechanically mounts the emitter assembly 340 and the detector assembly 350 and provides electrical communication between the cable 330 and these assemblies 340, 350. The attachment assembly 370 attaches the emitter assembly 340 and detector assembly 350 to a tissue site. The connector assembly 380 provides a mechanical and electrical interface to the connector at one end of the cable 330. A tape assembly example of an attachment assembly is described with respect to FIGS. 11A-B, below. A contact assembly example of a connector assembly is described with respect to FIGS. 13-14, below. Al-Ali at [0049]

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	 FIG. 5 Al-Ali at Fig. 5 FIG. 5 illustrates a detector assembly 500 including a substrate 510, detector(s) 520 and an EMI shield 530. The substrate 510 acts as a mechanical support for, and provides electrical contacts to, the detector(s) 520. In an embodiment, the substrate 510 acts as an electrical insulator allowing the detector(s) 520 to be electrically isolated from EMI shielding 530 applied to a detector component. In an embodiment, the substrate 510 is a ceramic material. Al-Ali at [0051]

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	 FIG. 12A FIG. 12B FIG. 12C Al-Ali at Fig. 12A-12C FIGS. 12A-C further illustrate optical components 1200 having emitter components 1220 and a detector 1250 mounted to a flex circuit 1210. The emitter components 1220 include a cover 1222, a light block 1224, an emitter 1280, a spacer 1226 and an encapsulant 1228. Advantageously, the spacer 1226 and encapsulant 1228 provide a relatively uniform illumination of a tissue site across all emitted wavelengths. In particular, the spacer 1226 provides a gap between the emitter 1280 and a tissue site, allowing emitted light from, say, individual LEDs of the emitter 1280 to spread as the multiple wavelength light propagates to a tissue site. Further, the encapsulant 1228 can be configured to diffuse or scatter emitted light as the light propagates to a tissue site. In an embodiment, the spacer 1226 gap is 70 mm. In an embodiment, the encapsulant 1228 contains 0.1 mm glass beads, 25% by weight, in a clear silicon RTV. In an embodiment, the emitter has an epoxy fill over LEDs incorporated within the emitter that contain

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	microspheres so as to diffuse or scatter LED transmitted light, as described below. In an embodiment, an attenuation epoxy is dispersed over selected emitter LEDs so as to equalize intensities of the various LEDs, also as described, below. LED intensity equalization is disclosed in U.S. patent application Ser. No. 11/366,995, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Equalization, incorporated by reference herein. In an embodiment, the encapsulant or LED fill or both provide notch filter characteristics according to emitted wavelengths so as to substantially attenuate secondary emissions from one or more LEDs. Al-Ali at [0060] 1. A physiological sensor comprising: an emitter that emits light having a plurality of wavelengths; a detector that generates an output signal responsive to the emitted light after absorption by tissue; an attachment assembly that removably attaches the emitter and the detector to tissue; a spacer that provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue; and a light scattering medium disposed in a optical path between the emitter and tissue; the spacer and the light scattering medium providing at least a substantially uniform illumination of tissue by the emitted light for each of the wavelengths. Al-Ali at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light	Al-Ali discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. See above at claim 1[e], 1[k], [5]

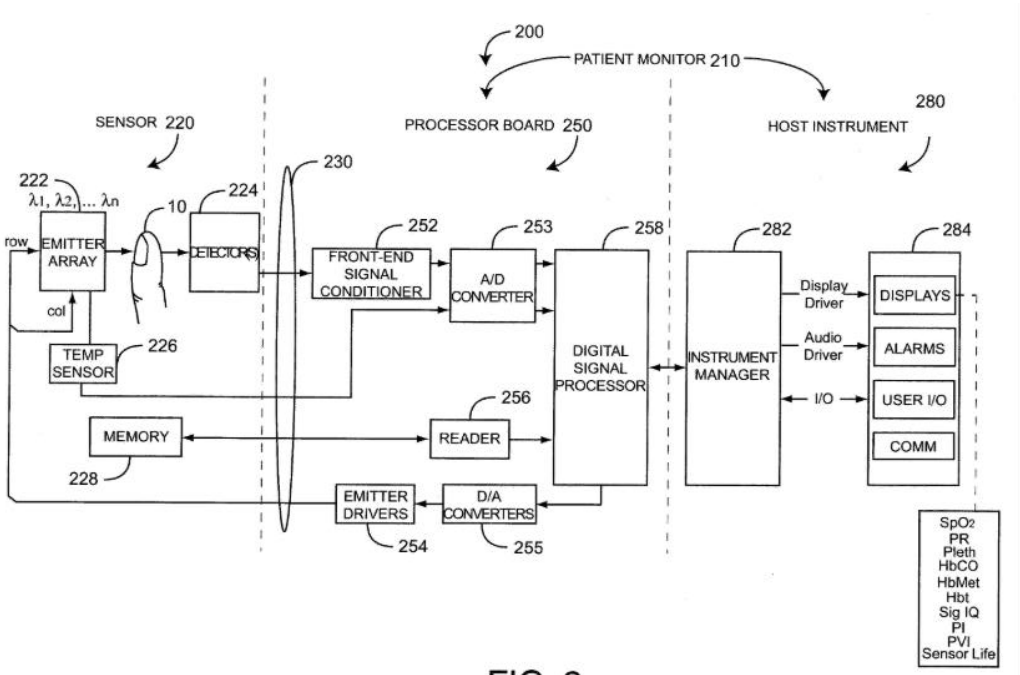
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that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Pulse oximeters capable of reading through motion induced noise are disclosed in at least U.S. Pat. Nos. 6,770,028, 6,658,276, 6,650,917, 6,157,850, 6,002,952, 5,769,785, and 5,758,644; low noise pulse oximetry sensors are disclosed in at least U.S. Pat. Nos. 6,088,607 and 5,782,757; all of which are assigned to Masimo Corporation, Irvine, Calif. ("Masimo") and are incorporated by reference herein. Al-Ali at [0004] Another aspect of a physiological sensor comprising an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs disposed within an emitter ceramic substrate. A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive total hemoglobin (Hbt). The detector comprises a plurality of photodiodes disposed within a detector ceramic substrate. A first set of the photodiodes is responsive to a first set of the wavelengths and a second set of the photodiodes is responsive to a second set of the wavelengths. In various embodiments a diffuser scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths. A first encapsulate containing glass beads is mounted in a spacer proximate the emitter ceramic substrate. A second encapsulate mixed with microspheres is disposed on the LEDs within the emitter ceramic substrate. The photodiodes comprise at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The LEDs radiate light generally centered around at least twelve unique wavelengths. The LEDs are mounted in an array of at least thirteen LEDs connected within an electrical grid. The twelve unique wavelengths comprise eight wavelengths within a first range of about 620-905 nm. and four wavelengths within a second range of about 1040-1270 nm. Al-Ali at [0009] FIG. 2 illustrates a block diagram a physiological measurement system 200. This measurement system includes a monitor 210 and an optical sensor 220 communicating via a patient cable 230. The monitor 210 has one or more processor boards 250 communicating with a host instrument 280. Generally, the processor board 250 communicates with the sensor 220 so as to control the emission of light into a tissue site 10. Also the processor board 250 receives and processes a corresponding sensor signal responsive to the emitted light after scattering and absorption by tissue site constituents. Accordingly, the processor board 250 derives physiological parameters relating to pulsatile blood flow within the tissue site and communicates values for those parameters to the host instrument 280. Generally, the host instrument 280 provides user I/O and communications with external devices so as to define operating conditions and

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	communicate those conditions to the processor board 250. The host instrument 280 also transfers parameter values from the processor board for display and for triggering alarms. Al-Ali at [0042]  FIG. 2 Al-Ali at Fig. 2 In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can

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	advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters. Al-Ali at [0043] Although described herein with respect to various disposable sensor embodiments, a sensor may be reusable, resposable (partially reusable/partially disposable), adhesive or non-adhesive, or a transmittance, reflectance or transflectance sensor. Further, a sensor may be configured for a variety of tissue sites such as a finger, hand, foot, forehead or ear or for attachment to multiple tissue sites, including multiple-head sensors capable of simultaneous multi-site measurements. Al-Ali at [0044] FIGS. 19A-B illustrate a detector 1900 having a detector component 1700 and a shield 1910. The shield 1910 has a conductive surface 1920 defining windows 1930. The windows 1930 can be any shape appropriate to the passage of light and the blocking of electromagnetic noise. In an embodiment, the windows 1930 are large rectangles with minimal interconnect so as to allow for a substantial passage of emitted light to the photodiodes 1720. In an embodiment, the shield 1910 is soldered to the ceramic substrate 1710 on at least the four corners, electrically and mechanically coupling the shield 1910 to the ceramic substrate 1710 and allowing the shield to form one side of a Faraday cage. Mechanical coupling can be, for example, gluing, welding, soldering, screwing, snap fitting, or other suitable fastening. Electrical coupling can be, for example, soldering, wire bonding, die bonding, or other suitable forms of electrical connection. In an embodiment, the ceramic substrate 1710 is printed with shielding material to complete the Faraday cage. Additional shielding material can be attached to or plated on the ceramic substrate 1710. Al-Ali at [0071] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Al-Ali discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. See above at claim 1[e], 1[j], [5] Pulse oximeters capable of reading through motion induced noise are disclosed in at least U.S. Pat. Nos. 6,770,028, 6,658,276, 6,650,917, 6,157,850, 6,002,952, 5,769,785, and 5,758,644; low noise pulse oximetry sensors are disclosed in at least U.S. Pat. Nos. 6,088,607 and 5,782,757; all of which are assigned to Masimo Corporation, Irvine, Calif. (“Masimo”) and are incorporated by reference herein. Al-Ali at [0004] As shown in FIGS. 15A-B, an LED array 1520 is connected within an electrical grid of n rows and m columns totaling n+m LED drive lines where n and m are integers greater than one. The electrical grid advantageously minimizes the number of drive lines required to activate the LEDs 1520 while preserving flexibility to selectively activate individual LEDs 1520 in any sequence and multiple LEDs 1520 simultaneously. The electrical grid also facilitates setting LED currents so as to control intensity at each LED wavelength, determining operating wavelengths and monitoring total grid current so as to limit power dissipation. The LED array 1520 is physically configured in rows, which facilitates clustering LEDs according to wavelength so as to minimize pathlength variations and which facilitates equalization of LED intensities. In an embodiment the LED array 1520 comprises up to sixteen LEDs configured in an electrical grid of four rows and four columns. Each of four row drive lines provide a common anode connection to four LEDs, and each of four column drive lines provide a common cathode connection to four LEDs. Thus, sixteen LEDs are advantageously driven with only eight wires, including four anode drive lines and four cathode drive lines. In an embodiment, an LED array is partially populated with eight LEDs having nominal wavelengths as shown in TABLE 1. In an embodiment, the LED array is partially populated with thirteen LEDs having nominal wavelengths as shown in TABLE 2. Advantageously, LED array and the corresponding LED wavelengths are adapted to measure total hemoglobin (Hbt) in addition to SpO2, pulse rate, HbCO and HbMet, among other physiological parameters. In an embodiment, LEDs D1-D5 are encapsulated with an attenuating epoxy 1660 (FIGS. 16B, F) so as to equalize LED intensities. In an embodiment, a clear fill epoxy 1670 (FIGS. 16B, F)

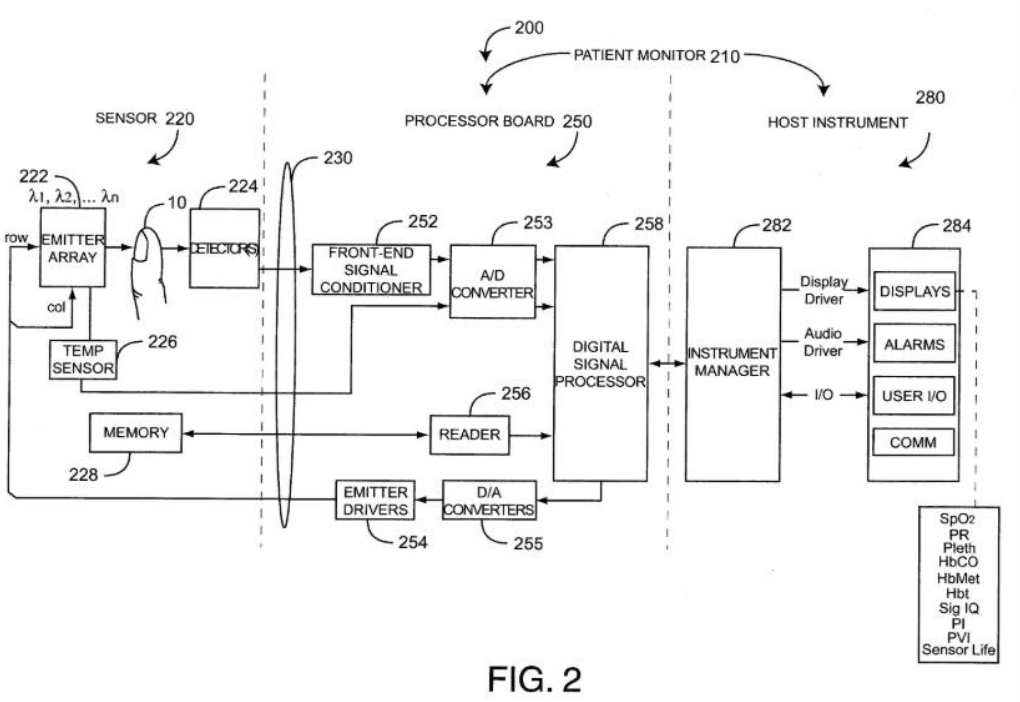
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	mixed with 1-20 μm microspheres is dispersed and cured over the LEDs. An LED array and corresponding drivers for an electrical grid are disclosed in U.S. patent application Ser. No. 11/367,013, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Emitters, incorporated by reference herein. Al-Ali at [0067] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	Al-Ali discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. See above at claim 1[b], 1[e], 1[l], [5] Pulse oximeters capable of reading through motion induced noise are disclosed in at least U.S. Pat. Nos. 6,770,028, 6,658,276, 6,650,917, 6,157,850, 6,002,952, 5,769,785, and 5,758,644; low noise pulse oximetry sensors are disclosed in at least U.S. Pat. Nos. 6,088,607 and 5,782,757; all of which are assigned to Masimo Corporation, Irvine, Calif. ("Masimo") and are incorporated by reference herein. Al-Ali at [0004] Another aspect of a physiological sensor comprising an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs disposed within an emitter ceramic substrate**.** A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive total hemoglobin (Hbt). The detector comprises a plurality of photodiodes disposed within a detector ceramic substrate. A first set of the photodiodes is responsive to a first set of the wavelengths and a second set of the photodiodes is responsive to a second set of the wavelengths. In

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	various embodiments a diffuser scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths. A first encapsulate containing glass beads is mounted in a spacer proximate the emitter ceramic substrate. A second encapsulate mixed with microspheres is disposed on the LEDs within the emitter ceramic substrate. The photodiodes comprise at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The LEDs radiate light generally centered around at least twelve unique wavelengths. The LEDs are mounted in an array of at least thirteen LEDs connected within an electrical grid. The twelve unique wavelengths comprise eight wavelengths within a first range of about 620-905 nm. and four wavelengths within a second range of about 1040-1270 nm. Al-Ali at [0009]  FIG. 2 Al-Ali at Fig. 2 In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The

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	temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters. Al-Ali at [0043] Although described herein with respect to various disposable sensor embodiments, a sensor may be reusable, resposable (partially reusable/partially disposable), adhesive or non-adhesive, or a transmittance, reflectance or transflectance sensor. Further, a sensor may be configured for a variety of tissue sites such as a finger, hand, foot, forehead or ear or for attachment to multiple tissue sites, including multiple-head sensors capable of simultaneous multi-site measurements. Al-Ali at [0044] As shown in FIGS. 15A-B, an LED array 1520 is connected within an electrical grid of n rows and m columns totaling n+m LED drive lines where n and m are integers greater than one. The electrical grid advantageously minimizes the number of drive lines required to activate the LEDs 1520 while preserving flexibility to selectively activate individual LEDs 1520 in any sequence and multiple LEDs 1520 simultaneously. The electrical grid also facilitates setting LED currents so as to control intensity at each LED wavelength, determining operating wavelengths and monitoring total grid current so as to limit power dissipation. The LED array 1520 is physically configured in rows, which facilitates clustering LEDs according to wavelength so as to minimize pathlength variations and which facilitates equalization of LED intensities. In an embodiment the LED array 1520 comprises up to sixteen LEDs configured in an electrical grid of four rows and four columns. Each of four row drive lines provide a common anode connection to four LEDs, and each of four column drive lines provide a common cathode connection to four LEDs. Thus, sixteen LEDs are advantageously driven with only eight wires, including four anode drive lines and four cathode drive lines. In an embodiment, an LED array is partially populated with eight LEDs having nominal wavelengths as shown in TABLE 1. In an embodiment, the LED array is

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	partially populated with thirteen LEDs having nominal wavelengths as shown in TABLE 2. Advantageously, LED array and the corresponding LED wavelengths are adapted to measure total hemoglobin (Hbt) in addition to SpO2, pulse rate, HbCO and HbMet, among other physiological parameters. In an embodiment, LEDs D1-D5 are encapsulated with an attenuating epoxy 1660 (FIGS. 16B, F) so as to equalize LED intensities. In an embodiment, a clear fill epoxy 1670 (FIGS. 16B, F) mixed with 1-20 μm microspheres is dispersed and cured over the LEDs. An LED array and corresponding drivers for an electrical grid are disclosed in U.S. patent application Ser. No. 11/367,013, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Emitters, incorporated by reference herein. Al-Ali at [0067] FIGS. 19A-B illustrate a detector 1900 having a detector component 1700 and a shield 1910. The shield 1910 has a conductive surface 1920 defining windows 1930. The windows 1930 can be any shape appropriate to the passage of light and the blocking of electromagnetic noise. In an embodiment, the windows 1930 are large rectangles with minimal interconnect so as to allow for a substantial passage of emitted light to the photodiodes 1720. In an embodiment, the shield 1910 is soldered to the ceramic substrate 1710 on at least the four corners, electrically and mechanically coupling the shield 1910 to the ceramic substrate 1710 and allowing the shield to form one side of a Faraday cage. Mechanical coupling can be, for example, gluing, welding, soldering, screwing, snap fitting, or other suitable fastening. Electrical coupling can be, for example, soldering, wire bonding, die bonding, or other suitable forms of electrical connection. In an embodiment, the ceramic substrate 1710 is printed with shielding material to complete the Faraday cage. Additional shielding material can be attached to or plated on the ceramic substrate 1710. Al-Ali at [0071] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third	Al-Ali discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.

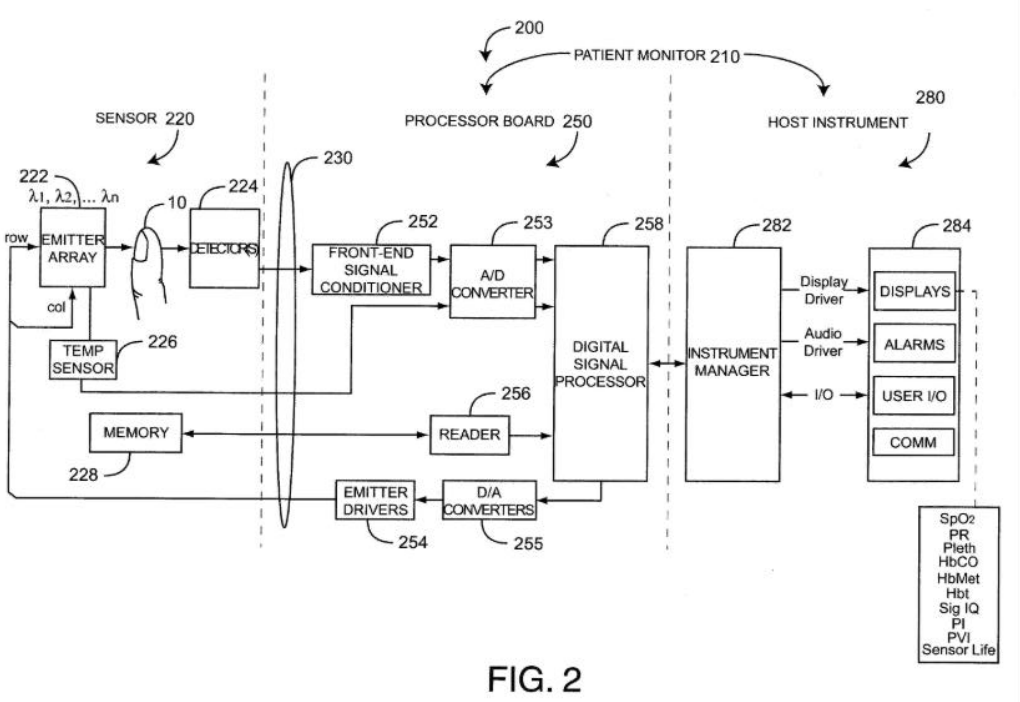
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output signal, that the wearable device is being worn by the user.	Pulse oximeters capable of reading through motion induced noise are disclosed in at least U.S. Pat. Nos. 6,770,028, 6,658,276, 6,650,917, 6,157,850, 6,002,952, 5,769,785, and 5,758,644; low noise pulse oximetry sensors are disclosed in at least U.S. Pat. Nos. 6,088,607 and 5,782,757; all of which are assigned to Masimo Corporation, Irvine, Calif. (“Masimo”) and are incorporated by reference herein. Al-Ali at [0004] Another aspect of a physiological sensor comprising an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs disposed within an emitter ceramic substrate**.** A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive total hemoglobin (Hbt). The detector comprises a plurality of photodiodes disposed within a detector ceramic substrate. A first set of the photodiodes is responsive to a first set of the wavelengths and a second set of the photodiodes is responsive to a second set of the wavelengths. In various embodiments a diffuser scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths. A first encapsulate containing glass beads is mounted in a spacer proximate the emitter ceramic substrate. A second encapsulate mixed with microspheres is disposed on the LEDs within the emitter ceramic substrate. The photodiodes comprise at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The LEDs radiate light generally centered around at least twelve unique wavelengths. The LEDs are mounted in an array of at least thirteen LEDs connected within an electrical grid. The twelve unique wavelengths comprise eight wavelengths within a first range of about 620-905 nm. and four wavelengths within a second range of about 1040-1270 nm. Al-Ali at [0009]

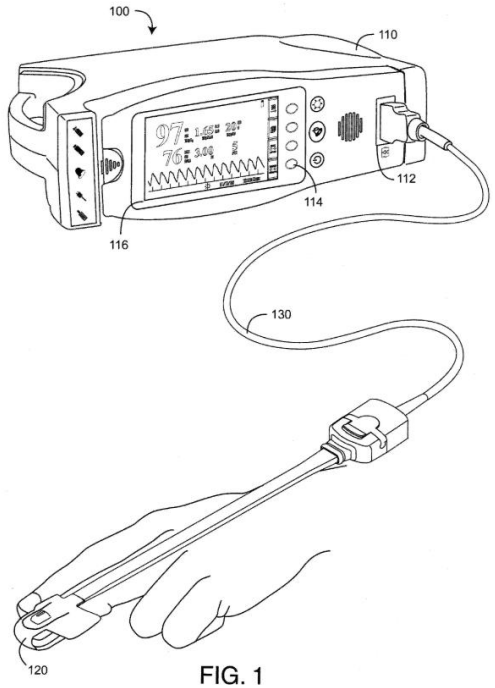
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	 FIG. 2 Al-Ali at Fig. 2 In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters.

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	Al-Ali at [0043] Although described herein with respect to various disposable sensor embodiments, a sensor may be reusable, resposable (partially reusable/partially disposable), adhesive or non-adhesive, or a transmittance, reflectance or transflectance sensor. Further, a sensor may be configured for a variety of tissue sites such as a finger, hand, foot, forehead or ear or for attachment to multiple tissue sites, including multiple-head sensors capable of simultaneous multi-site measurements. Al-Ali at [0044] As shown in FIGS. 15A-B, an LED array 1520 is connected within an electrical grid of n rows and m columns totaling n+m LED drive lines where n and m are integers greater than one. The electrical grid advantageously minimizes the number of drive lines required to activate the LEDs 1520 while preserving flexibility to selectively activate individual LEDs 1520 in any sequence and multiple LEDs 1520 simultaneously. The electrical grid also facilitates setting LED currents so as to control intensity at each LED wavelength, determining operating wavelengths and monitoring total grid current so as to limit power dissipation. The LED array 1520 is physically configured in rows, which facilitates clustering LEDs according to wavelength so as to minimize pathlength variations and which facilitates equalization of LED intensities. In an embodiment the LED array 1520 comprises up to sixteen LEDs configured in an electrical grid of four rows and four columns. Each of four row drive lines provide a common anode connection to four LEDs, and each of four column drive lines provide a common cathode connection to four LEDs. Thus, sixteen LEDs are advantageously driven with only eight wires, including four anode drive lines and four cathode drive lines. In an embodiment, an LED array is partially populated with eight LEDs having nominal wavelengths as shown in TABLE 1. In an embodiment, the LED array is partially populated with thirteen LEDs having nominal wavelengths as shown in TABLE 2. Advantageously, LED array and the corresponding LED wavelengths are adapted to measure total hemoglobin (Hbt) in addition to SpO2, pulse rate, HbCO and HbMet, among other physiological parameters. In an embodiment, LEDs D1-D5 are encapsulated with an attenuating epoxy 1660 (FIGS. 16B, F) so as to equalize LED intensities. In an embodiment, a clear fill epoxy 1670 (FIGS. 16B, F) mixed with 1-20 μm microspheres is dispersed and cured over the LEDs. An LED array and corresponding drivers for an electrical grid are disclosed in U.S. patent application Ser. No. 11/367,013, filed Mar. 1, 2006, titled Multiple Wavelength Sensor Emitters, incorporated by reference herein. Al-Ali at [0067]

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	FIGS. 19A-B illustrate a detector 1900 having a detector component 1700 and a shield 1910. The shield 1910 has a conductive surface 1920 defining windows 1930. The windows 1930 can be any shape appropriate to the passage of light and the blocking of electromagnetic noise. In an embodiment, the windows 1930 are large rectangles with minimal interconnect so as to allow for a substantial passage of emitted light to the photodiodes 1720. In an embodiment, the shield 1910 is soldered to the ceramic substrate 1710 on at least the four corners, electrically and mechanically coupling the shield 1910 to the ceramic substrate 1710 and allowing the shield to form one side of a Faraday cage. Mechanical coupling can be, for example, gluing, welding, soldering, screwing, snap fitting, or other suitable fastening. Electrical coupling can be, for example, soldering, wire bonding, die bonding, or other suitable forms of electrical connection. In an embodiment, the ceramic substrate 1710 is printed with shielding material to complete the Faraday cage. Additional shielding material can be attached to or plated on the ceramic substrate 1710. Al-Ali at [0071] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. Al-Ali discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. One aspect of a physiological sensor is an emitter that emits light having a plurality of wavelengths. A detector generates an output signal responsive to the emitted light after absorption by tissue. An attachment assembly removably attaches the emitter and the detector to tissue. A spacer provides a predetermined gap between the emitter and tissue when the emitter is attached to tissue. A light scattering medium is disposed in a optical path between the emitter and tissue. The spacer and the light scattering medium provide at least a substantially uniform illumination of tissue by the emitted light for each of the

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	wavelengths. In various embodiments, the light scattering medium comprises glass beads mixed with an encapsulant disposed proximate the spacer. The light scattering medium comprises microspheres mixed with an epoxy disposed proximate the emitter. The emitter comprises an array of at least eight light emitting diodes emitting light generally centered around eight unique wavelengths. The emitter comprises an array of at least thirteen light emitting diodes emitting light generally centered around at least twelve unique wavelengths. The detector comprises at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The detector comprises two Si photodiodes and four InGaAs photodiodes all connected in parallel. The light emitting diodes emit light within a first range of about 620-905 nm and within a second range of about 1040-1270 nm. Al-Ali at [0008] Another aspect of a physiological sensor comprising an emitter configured to radiate light having a plurality of wavelengths into a tissue site. The emitter comprises a plurality of LEDs disposed within an emitter ceramic substrate. A detector is configured to receive the light after absorption by pulsatile blood flow within the tissue site. The detector generates a sensor signal capable of being processed by a patient monitor so as to derive total hemoglobin (Hbt). The detector comprises a plurality of photodiodes disposed within a detector ceramic substrate. A first set of the photodiodes is responsive to a first set of the wavelengths and a second set of the photodiodes is responsive to a second set of the wavelengths. In various embodiments a diffuser scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths. A first encapsulate containing glass beads is mounted in a spacer proximate the emitter ceramic substrate. A second encapsulate mixed with microspheres is disposed on the LEDs within the emitter ceramic substrate. The photodiodes comprise at least one Si photodiode and at least one InGaAs photodiode connected in parallel. The LEDs radiate light generally centered around at least twelve unique wavelengths. The LEDs are mounted in an array of at least thirteen LEDs connected within an electrical grid. The twelve unique wavelengths comprise eight wavelengths within a first range of about 620-905 nm. and four wavelengths within a second range of about 1040-1270 nm. Al-Ali at [0009]

’475 Patent	Al-Ali
	 FIG. 2 Al-Ali at Fig. 2 In an embodiment, the optical sensor 220 includes an emitter array 222, at least one detector 224, a temperature sensor 226 and a memory 228. The emitter array 222 irradiates a tissue site 10 with multiple wavelength light. One or more detectors 224 detect the light after attenuation by the tissue site 10. The temperature sensor 226 is located so as to detect the bulk temperature of the emitters within the emitter array, so as to accurately determine emitter wavelengths, as described below. The memory 228 can include any of a wide variety of memory devices known to an artisan from the disclosure herein, including an EPROM, an EEPROM, a flash memory, a ROM, a non-volatile RAM and a two-terminal serial memory device, to name a few, and combinations of the same. The memory 228 can advantageously store a wide variety of sensor-related information, including sensor type, manufacturer information, sensor characteristics including wavelengths emitted, wavelength correction data, emitter drive requirements, demodulation data, calculation mode data, calibration data and sensor life data to name a few. The memory can also store software such as scripts and executable code, encryption information, monitor and algorithm upgrade instructions and enabled parameters.

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	Al-Ali at [0043] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. Al-Ali discloses or renders obvious the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.  FIG. 1

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	Al-Ali at Fig. 1 FIG. 1 illustrates a physiological measurement system 100 having a monitor 110 and a multiple wavelength optical sensor 120 with enhanced measurement capabilities as compared with conventional pulse oximetry. In particular, the multiple wavelength optical sensor 120 allows the measurement of various blood constituents and related parameters in addition to oxygen saturation and pulse rate. Alternatively, the multiple wavelength optical sensor 120 allows the measurement of oxygen saturation and pulse rate with increased accuracy or robustness as compared with conventional pulse oximetry. Al-Ali at [0039] In one embodiment, the optical sensor 120 is configured to plug into a monitor sensor port 112 via a patient cable 130. Monitor keys 114 provide control over operating modes and alarms, to name a few. A display 116 provides readouts of measured parameters, such as oxygen saturation, pulse rate, HbCO, HbMet and Hbt to name a few. Other blood parameters that may be measured to provide important clinical information are fractional oxygen saturation, bilirubin and blood glucose, to name a few. Al-Ali at [0040] FIG. 2 illustrates a block diagram a physiological measurement system 200. This measurement system includes a monitor 210 and an optical sensor 220 communicating via a patient cable 230. The monitor 210 has one or more processor boards 250 communicating with a host instrument 280. Generally, the processor board 250 communicates with the sensor 220 so as to control the emission of light into a tissue site 10. Also the processor board 250 receives and processes a corresponding sensor signal responsive to the emitted light after scattering and absorption by tissue site constituents. Accordingly, the processor board 250 derives physiological parameters relating to pulsatile blood flow within the tissue site and communicates values for those parameters to the host instrument 280. Generally, the host instrument 280 provides user I/O and communications with external devices so as to define operating conditions and communicate those conditions to the processor board 250. The host instrument 280 also transfers parameter values from the processor board for display and for triggering alarms. Al-Ali at [0042] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	See claim 8 above. Al-Ali discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency. A further aspect of a physiological sensor comprises a light source that radiates light having a plurality of wavelengths, a diffuser that scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths, and at least one detector that generates a sensor signal responsive to the radiated light after tissue attenuation. In an embodiment, the light source comprises a ceramic substrate having conductors arranged as an electrical grid and a plurality of LEDs mounted within the ceramic substrate in an array. In other embodiments, the diffuser comprises a first encapsulant having microspheres disposed over the LEDs; and a second encapsulant having glass beads disposed proximate the ceramic substrate. A spacer is disposed proximate the ceramic substrate so as to form a gap between the LEDs and the tissue site. A connector connects to a patient cable so as to communicate the sensor signal to a monitor. A flexible coupling has an optical end proximate the light source and the detector and a connector end proximate the connector. The flexible coupling has conductors that communicate the sensor signal from the optical end to the connector end. Al-Ali at [0010] 16. A physiological sensor comprising: a light source that radiates light having a plurality of wavelengths; a diffuser that scatters the radiated light so that a tissue site is uniformly illuminated across all of the wavelengths; and at least one detector that generates a sensor signal responsive to the radiated light after tissue attenuation. Al-Ali at Claim 16

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Al-Ali, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Al-Ali, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

U.S. Pat. No. 12,268,475 in view of
U.S. Pat. Publication No. 2010/0217102 to Steven Francis LeBoeuf ("LeBoeuf")

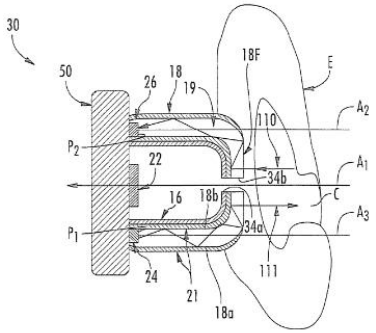
As described in detail below, LeBoeuf (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in LeBoeuf. The cited portions of LeBoeuf are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of LeBoeuf. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that LeBoeuf "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found LeBoeuf does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in LeBoeuf (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in LeBoeuf anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

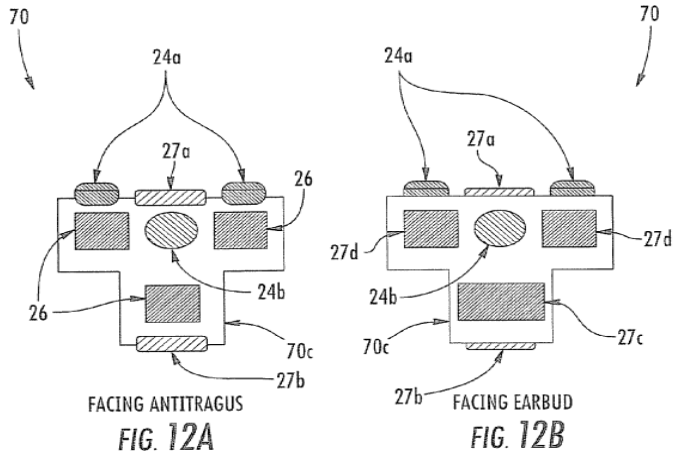
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

’475 Patent	LeBoeuf
Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. LeBoeuf discloses or renders obvious An apparatus adapted to be worn by a user comprising. A monitoring device configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light Transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the device at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at [Abstract] According to some embodiments of the present invention, a headset configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the headset at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. The optical emitter, via the light-guiding cover, directs optical energy towards a particular region of ear and the optical detector detects secondary optical energy emanating from the ear region. In some embodiments, the optical detector may include an optical filter configured to pass secondary optical energy at selective wavelengths. In some embodiments, the light transmissive material of the cover may be configured, for example via the use of cladding and/or light reflective material, such that the cover serves as a light guide that is coupled in parallel to the optical emitter and detector. In some embodiments, the light transmissive material of the cover may be configured, for example via the use of cladding and/or light reflective material, such that the cover serves as a light guide that is coupled perpendicular to the optical emitter and detector. LeBoeuf at [0006] In some embodiments, the headset may include various electronic components secured to the base. For example, the headset may include one or more environmental sensors configured to detect and/or

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	measure environmental conditions in a vicinity of the headset. The headset may include a signal processor configured to receive and process signals produced by the optical detector. For example, in some embodiments, a signal processor may be configured to extract secondary optical energy and remove optical noise or environmental noise. The headset may include a signal processor configured to receive and process signals produced by the one or more environmental sensors. In addition, the headset may include a Transmitter configured to Transmit signals processed by the signal processor to a remote device in real time. Headsets according to embodiments of the present invention may utilize, for example, Bluetooth®, Wi-Fi, ZigBee, or other wireless Transmitters. LeBoeuf at [0007] In some embodiments of the present invention, an earbud may integrate a sensor module containing a plurality of sensor elements for measuring physiological information and at least one noise source for measuring noise information. A “noise source”, as used herein, refers to a sensor, such as an optical sensor, inertial sensor, electrically conductive sensor, capacitive sensor, inductive sensor, etc., and derives it name from the fact that it is a source of input to a filter, such as an adaptive filter described below. LeBoeuf at [0021] The physiological sensors of the sensor module may generate a signal that includes physiological information plus noise information. The noise may be removed by combining the physiological information and noise information from the sensor module with noise information from the noise source of the sensor module via an electronic filtering method, such as a signal processing technique. Specific examples of such signal processing techniques include FIR (Finite Impulse Response), IIR (Infinite Impulse Response), informatics, machine learning, and adaptive filter methods. The output of the adaptive filter may be a physiological signal that is wholly or partially free of noise. In some embodiments, motion-related noise from a subject activity such as running may be removed from the physiological plus noise signal generated by a photoplethysmography (PPG) sensor for measuring blood constituent levels or blood flow properties, such as blood oxygen level, VO2, or heart rate. LeBoeuf at [0022] In some embodiments, an earbud includes one or more sensor modules that includes one or more sensors for sensing physiological information and environmental information, such as noise, for example. As

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	such, the earbud may function as a physiological monitor as well as an environmental monitor. In some embodiments, the earbud may include a microprocessor that is in electrical communication with the sensor module(s). For example, a microprocessor incorporated into an earbud may be configured to execute an adaptive filter algorithm to remove noise from at least one signal generated by a sensor module in the earbud. A microprocessor may also be configured to process information from the one or more sensors to generate a digital output string, wherein the digital output string includes a plurality of physiological and motion-related information. LeBoeuf at [0025]  FIG. 3 LeBoeuf at Fig. 3 Light-guiding earbuds according to the various embodiments of the present invention may be utilized with mono headsets (i.e., headsets having one earbud) as well as stereo headsets (i.e., headsets having two earbuds). Additionally, the light-guiding region of earbuds, according to embodiments of the present invention, may be integrated not only into an earbud cover and earbud housing, but also into each or all components of an earbud. Moreover, light-guiding earbuds according to the various embodiments of the present invention may be utilized with hearing aids, body jewelry, or any other attachment that can be placed near the head region, such as eye glasses or shades, a headband, a cap, helmet, visor, or the like. LeBoeuf at [0029]

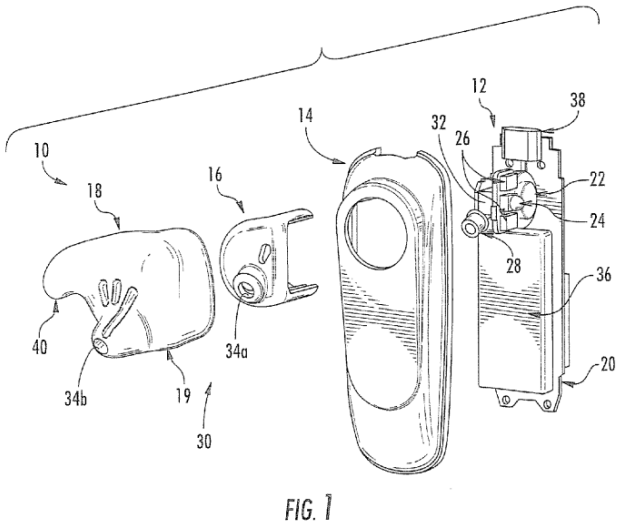
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	Wireless, Bluetooth®-enabled, and/or other personal communication headsets may be configured to incorporate physiological and/or environmental sensors, according to some embodiments of the present invention. As a specific example, Bluetooth® headsets are typically lightweight, unobtrusive devices that have become widely accepted socially. Moreover, Bluetooth® headsets are cost effective, easy to use, and are often worn by users for most of their waking hours while attending or waiting for cell phone calls. Bluetooth® headsets configured according to embodiments of the present invention are advantageous because they provide a function for the user beyond health monitoring, such as personal communication and multimedia applications, thereby encouraging user compliance. Exemplary physiological and environmental sensors that may be incorporated into a Bluetooth® or other type of headsets include, but are not limited to accelerometers, auscultatory sensors, pressure sensors, humidity sensors, color sensors, light intensity sensors, pressure sensors, etc. LeBoeuf at [0086] The main circuit board 20 and secondary circuit board 32 may also support one or more sensor modules (not shown) that contain various physiological and/or environmental sensors. For example, a sensor module, such as sensor module 70 illustrated in FIGS. 12A-12B, may be attached to the circuit boards 20, 32. The circuit boards 20, 32 also may include at least one signal processor (not shown), at least one wireless module (not shown) for communicating with a remote device, and/or at least one memory storage device (not shown). An exemplary wireless module may include a wireless chip, antenna, or RFID tag. In some embodiments, the wireless module may include a low-range wireless chip or chipset, such as a Bluetooth® or ZigBee chip. These electronic components may be located on the main circuit board 20, or on another circuit board, such as the secondary circuit board 32, attached to the main circuit board. LeBoeuf at [0093] Secondary circuit board 32 may also include a temperature sensor, such as a thermopile 28 mounted thereto. The thermopile 28 is oriented so as to point towards the tympanic membrane within the ear of a subject wearing the headset 10 through the acoustic orifices 34 a, 34 b in the earbud housing 16 and cover 18, respectively. The secondary circuit board 32 may be in electrical contact with the main circuit board 20 via soldering, connectors, wiring, or the like. A battery 36, such as a lithium polymer battery or other portable battery, may be mounted to the main circuit board 20 and may be charged via a USB charge port 38. Although not shown in FIG. 1, an ear hook may be attached to the base 12 or housing 14 to help stabilize the earbud 30 and headset 10 worn by a subject and such that the earbud 30 is consistently placed at the same location within the ear canal of a subject.

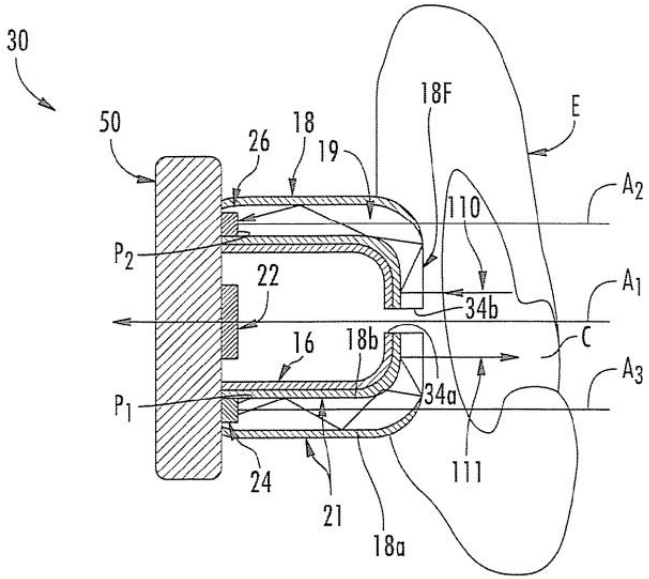
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	LeBoeuf at [0094]  FIG. 12A FIG. 12B LeBoeuf at Fig. 12A-12B Referring now to FIGS. 8A-8B, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an earbud housing 16 extending outwardly from the base 50 that is configured to be positioned within an ear of a subject, and a cover 18 that surrounds the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the speaker 22 can pass. The cover 18 includes at least one aperture 34 b through which sound from the speaker 22 can pass. The cover 18 includes a cladding material 21 on the outer surface 18 a thereof, except at end portion 18 f, as illustrated. In the illustrated embodiment, there is no cladding material on the cover inner surface 18 b. The housing 16 is in contact with the cover inner surface 18 b and serves as a cladding layer to define the light guiding region 19. The cover 18 with the illustrated cladding material 18 c serves as a light guide that delivers light from the optical emitters 24 into an ear canal of a subject through cover end portion 18 f. The cover 18 also collects light through end portion 18 f and delivers the collected light to the optical detectors 26. Various configurations and arrangements of optical emitters and detectors may be utilized in accordance with embodiments of the present invention. LeBoeuf at [0123]

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	The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated. It is important to note that the Channel A information can still be useful despite the presence of noise, and the noise information may still be utilized for the computation of relevant parameters. LeBoeuf at [0143] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	LeBoeuf discloses or renders obvious one or more biosensors adapted to be placed on the user, wherein one or more physiological parameters are measured. A monitoring device configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the device at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at Abstract. In some embodiments, a housing is secured to and overlies the base so as to enclose and protect the speaker, optical emitter and optical detector, as well as other electronic components secured to the base (e.g., sensors, processor, transmitter etc.). LeBoeuf at [0008]

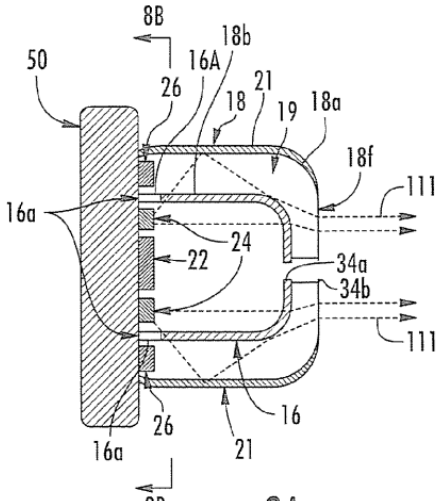
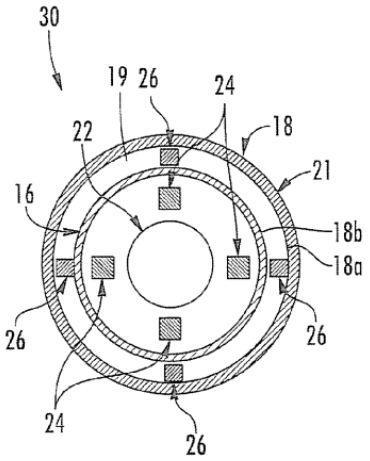
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	In some embodiments of the present invention, an earbud may integrate a sensor module containing a plurality of sensor elements for measuring physiological information and at least one noise source for measuring noise information. A “noise source”, as used herein, refers to a sensor, such as an optical sensor, inertial sensor, electrically conductive sensor, capacitive sensor, inductive sensor, etc., and derives it name from the fact that it is a source of input to a filter, such as an adaptive filter described below. LeBoeuf at [0021] The physiological sensors of the sensor module may generate a signal that includes physiological information plus noise information. The noise may be removed by combining the physiological information and noise information from the sensor module with noise information from the noise source of the sensor module via an electronic filtering method, such as a signal processing technique. Specific examples of such signal processing techniques include FIR (Finite Impulse Response), IIR (Infinite Impulse Response), informatics, machine learning, and adaptive filter methods. The output of the adaptive filter may be a physiological signal that is wholly or partially free of noise. In some embodiments, motion-related noise from a subject activity such as running may be removed from the physiological plus noise signal generated by a photoplethysmography (PPG) sensor for measuring blood constituent levels or blood flow properties, such as blood oxygen level, VO_2, or heart rate. LeBoeuf at [0022] In some embodiments, an earbud includes one or more sensor modules that includes one or more sensors for sensing physiological information and environmental information, such as noise, for example. As such, the earbud may function as a physiological monitor as well as an environmental monitor. In some embodiments, the earbud may include a microprocessor that is in electrical communication with the sensor module(s). For example, a microprocessor incorporated into an earbud may be configured to execute an adaptive filter algorithm to remove noise from at least one signal generated by a sensor module in the earbud. A microprocessor may also be configured to process information from the one or more sensors to generate a digital output string, wherein the digital output string includes a plurality of physiological and motion-related information. LeBoeuf at [0025].

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	Physiological sensors that may be incorporated into headsets and/or earbuds, according to some embodiments of the present invention, may be configured to detect and/or measure one or more of the following types of physiological information: heart rate, pulse rate, breathing rate, blood flow, VO_2, VO_2max, heartbeat signatures, cardio-pulmonary health, organ health, metabolism, electrolyte type and/or concentration, physical activity, caloric intake, caloric metabolism, blood metabolite levels or ratios, blood pH level, physical and/or psychological stress levels and/or stress level indicators, drug dosage and/or dosimetry, physiological drug reactions, drug chemistry, biochemistry, position and/or balance, body strain, neurological functioning, brain activity, brain waves, blood pressure, cranial pressure, hydration level, auscultatory information, auscultatory signals associated with pregnancy, physiological response to infection, skin and/or core body temperature, eye muscle movement, blood volume, inhaled and/or exhaled breath volume, physical exertion, exhaled breath physical and/or chemical composition, the presence and/or identity and/or concentration of viruses and/or bacteria, foreign matter in the body, internal toxins, heavy metals in the body, anxiety, fertility, ovulation, sex hormones, psychological mood, sleep patterns, hunger and/or thirst, hormone type and/or concentration, cholesterol, lipids, blood panel, bone density, organ and/or body weight, reflex response, sexual arousal, mental and/or physical alertness, sleepiness, auscultatory information, response to external stimuli, swallowing volume, swallowing rate, sickness, voice characteristics, voice tone, voice pitch, voice volume, vital signs, head tilt, allergic reactions, inflammation response, auto-immune response, mutagenic response, DNA, proteins, protein levels in the blood, water content of the blood, pheromones, internal body sounds, digestive system functioning, cellular regeneration response, healing response, stem cell regeneration response, etc. LeBoeuf at [0026] Light-guiding earbuds according to the various embodiments of the present invention may be utilized with mono headsets (i.e., headsets having one earbud) as well as stereo headsets (i.e., headsets having two earbuds). Additionally, the light-guiding region of earbuds, according to embodiments of the present invention, may be integrated not only into an earbud cover and earbud housing, but also into each or all components of an earbud. Moreover, light-guiding earbuds according to the various embodiments of the present invention may be utilized with hearing aids, body jewelry, or any other attachment that can be placed near the head region, such as eye glasses or shades, a headband, a cap, helmet, visor, or the like. LeBoeuf at [0029]

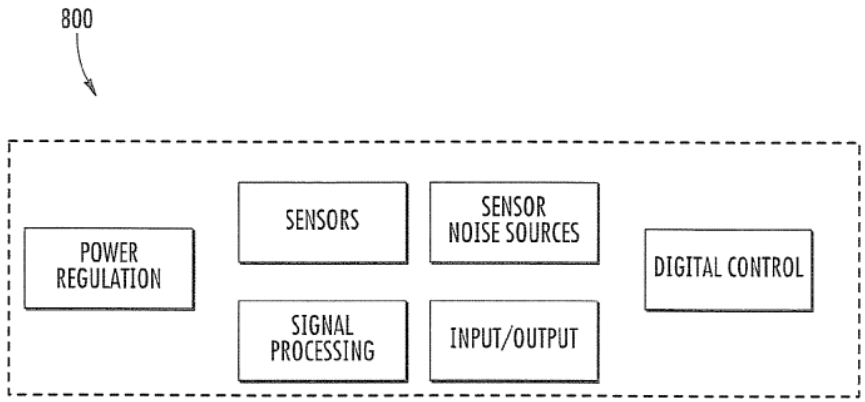
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	Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, optical emitter 24, optical detectors 26, and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, optical emitter 24, optical detectors 26, and thermopile 28. Collectively, the earbud housing 16, cover 18, and various electronic components (e.g., speaker 22, optical emitter 24, optical detectors 26, thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30. The headset housing 14 is secured to the base 12 and is configured to enclose and protect the various electronic components mounted to the base (e.g., main circuit board 20 and components secured thereto, etc.) from ambient interference (air, humidity, particulates, electromagnetic interference, etc). LeBoeuf at [0091]  FIG. 1 LeBoeuf at Fig. 1 Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. **The optical emitter 24 may be a light-emitting diode (LED), laser**

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	diode (LD), compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092].  FIG. 3 LeBoeuf at Fig. 3. The illustrated cover 18 of FIG. 1 includes an alignment member 40 (also referred to as a stabilization arm) that facilitates alignment of the earbud 30 within an ear canal of a subject. The alignment member 40 may facilitate stable measurements of optical scattered light from the ear region, which can be important for PPG measurements and tympanic temperature measurements. LeBoeuf at [0099].

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	FIG. 2 illustrates a stereo headset 100 that utilizes two light-guiding earbuds 130, according to some embodiments of the present invention. The headset 100 also includes various sensor elements 132 located at several regions in the stereo headset 100. A benefit of the stereo headset 100 may be that the total number of sensors measuring the ear region may be doubled; alternatively, the sensors in each earbud may be halved. Another benefit of the stereo headset is that it may enable stereo music during daily activities. Another benefit of the stereo headset is that asymmetric physiological differences can be detected in the user by measuring each side of the user in real-time. For example, differences in blood flow between right and left sides of a user may be detected, indicating changes in right/left brain activity, the onset of a stroke, localized inflammation, or the like. LeBoeuf at [0101] The optical detectors 26 positioned outside the earbud housing 16 of the earbud 30 of FIGS. 7A-7B collect scattered light from an ear originating from inspection light 111 generated by the flexible optical emitter 24. The flexible optical emitter 24 may be mounted to the earbud base 50 through one or more electrical connectors 24 a. In some embodiments, these may be soldered, wired, or detachable connectors. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical emitters and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. For example, these flexible devices may include an organic LED (OLED) and an organic optical detector circuit. This embodiment may be useful for generating a diffuse light beam towards the ear region and for detecting a diffuse optical scatter response from the ear region. In some embodiments, the emitter and detector on the flexible optical emitter 24 may be a traditional light-emitting diode (LED) and photodetector (PD) integrated onto a flexible printed circuit board. In other embodiments, transparent solid state optical emitters, detectors, or switches may be used. For example, an electrically controlled liquid crystal matrix may be embedded within an earbud, covering the flexible optical emitter 24. This may allow localized control of light flow to selected areas from/to the earbud going towards/away-from the ear. Additionally, this may allow localized control of light wavelength to selected areas. LeBoeuf at [0122].

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	Referring now to FIGS. 8A-8B, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an earbud housing 16 extending outwardly from the base 50 that is configured to be positioned within an ear of a subject, and a cover 18 that surrounds the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the speaker 22 can pass. The cover 18 includes at least one aperture 34 b through which sound from the speaker 22 can pass. The cover 18 includes a cladding material 21 on the outer surface 18 a thereof, except at end portion 18 f, as illustrated. In the illustrated embodiment, there is no cladding material on the cover inner surface 18 b. The housing 16 is in contact with the cover inner surface 18 b and serves as a cladding layer to define the light guiding region 19. The cover 18 with the illustrated cladding material 18 c serves as a light guide that delivers light from the optical emitters 24 into an ear canal of a subject through cover end portion 18 f. The cover 18 also collects light through end portion 18 f and delivers the collected light to the optical detectors 26. Various configurations and arrangements of optical emitters and detectors may be utilized in accordance with embodiments of the present invention. LeBoeuf at [0123].  FIG. 8A  FIG. 8B LeBoeuf at Figs. 8A and 8B.

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	A sensor module 70 is located near the earbud periphery, as illustrated. This sensor module 70 is shown in more detail in FIGS. 12 a-12B, and is described below. Three benefits of locating the sensor module 70 near the periphery of the light-guiding earbud 30 are: 1) PPG signals near the antitragus are less corrupted by motion artifacts than are PPG signals in other blood-vessel-rich regions of the ear; 2) the sensor module 70 may be designed somewhat independently of the earbud 30, liberating earbud comfort maximization from PPG signal maximization; and 3) because design constraints may be liberated, sensors need not be located in the acoustic cavity (i.e., within the earbud housing 16), allowing sound to pass through the acoustic orifices 34 a, 34 b with minimal interference. In this embodiment, it may be beneficial to incorporate lenses within the cover 18, similar to the lenses 18L of FIG. 6. It may be beneficial to extend the light-guiding region 19 of the cover 18 near the location where the earbud 30 rests near the antitragus. This light-guide extension 19 a serves as an additional light-coupling region and may improve optical coupling from the light-guiding region 19 to an ear region and/or improve optical coupling from an ear region to the light-guiding region 19, including the antitragus and portions of the acoustic meatus. This is because this extended light-guiding region 19 a may provide skin contact between the light guiding layer 19 and the skin, providing better optomechanical stability and optical coupling. In this embodiment, light may couple into the extended light-guiding region 19 a, from an optical emitter 24, and into the ear region. Similarly, light may couple from the ear region, into the extended light-guiding region 19 a, and to the optical detector 26. This extended light-guiding region 19 a may appear as a bulb or lens near the bottom of the earbud cover 18. LeBoeuf at [0135] FIGS. 12A-12B illustrate respective opposite sides of a sensor module 70 that may be located near the periphery of an earbud 30, for example as illustrated in FIGS. 11A-11B, according to some embodiments of the present invention. Sensor module 70 may include a number of electronic components capable of converting various forms of energy into an electrical signal and digitizing the signal. For example, the sensor module 70 may include light-emitting diodes, optical sensors, accelerometers, capacitive sensors, inertial sensors, mechanical sensors, electromagnetic sensors, thermal sensors, nuclear radiation sensors, biological sensors, and the like. In some embodiments, the optical emitters of this invention may be a combination of side-emitting, edge-emitting, or surface-emitting light-emitting diodes (LEDs) or laser diodes (LDs). LeBoeuf at [0136]

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	FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring Transmitted wavelengths. The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140]  FIG. 20 LeBoeuf at Fig. 20 26. The earbud of claim 20, further comprising at least one sensor module that includes one or more sensors for sensing physiological information and noise information. LeBoeuf at Claim 26

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	29. The earbud of claim 27, wherein the microprocessor is configured to process information from the one or more sensors to generate a digital output string, wherein the digital output string includes a plurality of physiological and motion-related information. LeBoeuf at Claim 29 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	LeBoeuf discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. In some embodiments, the headset may include various electronic components secured to the base. For example, the headset may include one or more environmental sensors configured to detect and/or measure environmental conditions in a vicinity of the headset. The headset may include a signal processor configured to receive and process signals produced by the optical detector. For example, in some embodiments, a signal processor may be configured to extract secondary optical energy and remove optical noise or environmental noise. The headset may include a signal processor configured to receive and process signals produced by the one or more environmental sensors. In addition, the headset may include a Transmitter configured to Transmit signals processed by the signal processor to a remote device in real time. Headsets according to embodiments of the present invention may utilize, for example, Bluetooth®, Wi-Fi, ZigBee, or other wireless Transmitters. LeBoeuf at [0007] Light directed into the ear of a subject from a light emitter and the subsequent collection of light at a light detector, according to embodiments of the present invention, may be utilized for detecting and/or measuring, among other things, body temperature, skin temperature, blood gas levels, muscle tension, heart rate, blood flow, cardiopulmonary functions, etc.

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	LeBoeuf at [0010] In some embodiments of the present invention, an earbud may integrate a sensor module containing a plurality of sensor elements for measuring physiological information and at least one noise source for measuring noise information. A “noise source”, as used herein, refers to a sensor, such as an optical sensor, inertial sensor, electrically conductive sensor, capacitive sensor, inductive sensor, etc., and derives it name from the fact that it is a source of input to a filter, such as an adaptive filter described below. LeBoeuf at [0021] The physiological sensors of the sensor module may generate a signal that includes physiological information plus noise information. The noise may be removed by combining the physiological information and noise information from the sensor module with noise information from the noise source of the sensor module via an electronic filtering method, such as a signal processing technique. Specific examples of such signal processing techniques include FIR (Finite Impulse Response), IIR (Infinite Impulse Response), informatics, machine learning, and adaptive filter methods. The output of the adaptive filter may be a physiological signal that is wholly or partially free of noise. In some embodiments, motion-related noise from a subject activity such as running may be removed from the physiological plus noise signal generated by a photoplethysmography (PPG) sensor for measuring blood constituent levels or blood flow properties, such as blood oxygen level, VO2, or heart rate. LeBoeuf at [0022] In some embodiments, an earbud includes one or more sensor modules that includes one or more sensors for sensing physiological information and environmental information, such as noise, for example. As such, the earbud may function as a physiological monitor as well as an environmental monitor. In some embodiments, the earbud may include a microprocessor that is in electrical communication with the sensor module(s). For example, a microprocessor incorporated into an earbud may be configured to execute an adaptive filter algorithm to remove noise from at least one signal generated by a sensor module in the earbud. A microprocessor may also be configured to process information from the one or more sensors to generate a digital output string, wherein the digital output string includes a plurality of physiological and motion-related information.

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	LeBoeuf at [0025] Physiological sensors that may be incorporated into headsets and/or earbuds, according to some embodiments of the present invention, may be configured to detect and/or measure one or more of the following types of physiological information: heart rate, pulse rate, breathing rate, blood flow, VO2, VO2max, heartbeat signatures, cardio-pulmonary health, organ health, metabolism, electrolyte type and/or concentration, physical activity, caloric intake, caloric metabolism, blood metabolite levels or ratios, blood pH level, physical and/or psychological stress levels and/or stress level indicators, drug dosage and/or dosimetry, physiological drug reactions, drug chemistry, biochemistry, position and/or balance, body strain, neurological functioning, brain activity, brain waves, blood pressure, cranial pressure, hydration level, auscultatory information, auscultatory signals associated with pregnancy, physiological response to infection, skin and/or core body temperature, eye muscle movement, blood volume, inhaled and/or exhaled breath volume, physical exertion, exhaled breath physical and/or chemical composition, the presence and/or identity and/or concentration of viruses and/or bacteria, foreign matter in the body, internal toxins, heavy metals in the body, anxiety, fertility, ovulation, sex hormones, psychological mood, sleep patterns, hunger and/or thirst, hormone type and/or concentration, cholesterol, lipids, blood panel, bone density, organ and/or body weight, reflex response, sexual arousal, mental and/or physical alertness, sleepiness, auscultatory information, response to external stimuli, swallowing volume, swallowing rate, sickness, voice characteristics, voice tone, voice pitch, voice volume, vital signs, head tilt, allergic reactions, inflammation response, auto-immune response, mutagenic response, DNA, proteins, protein levels in the blood, water content of the blood, pheromones, internal body sounds, digestive system functioning, cellular regeneration response, healing response, stem cell regeneration response, etc. LeBoeuf at [0026] Wireless, Bluetooth®-enabled, and/or other personal communication headsets may be configured to incorporate physiological and/or environmental sensors, according to some embodiments of the present invention. As a specific example, Bluetooth® headsets are typically lightweight, unobtrusive devices that have become widely accepted socially. Moreover, Bluetooth® headsets are cost effective, easy to use, and are often worn by users for most of their waking hours while attending or waiting for cell phone calls. Bluetooth® headsets configured according to embodiments of the present invention are advantageous because they provide a function for the user beyond health monitoring, such as personal communication and multimedia applications, thereby encouraging user compliance. Exemplary physiological and environmental sensors that may be incorporated into a Bluetooth® or other type of

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	headsets include, but are not limited to accelerometers, auscultatory sensors, pressure sensors, humidity sensors, color sensors, light intensity sensors, pressure sensors, etc. LeBoeuf at [0086] Accordingly, some embodiments of the present invention combine a personal communications headset device with one or more physiological and/or environmental sensors. Other embodiments may combine physiological and/or environmental sensors into a headset device. LeBoeuf at [0088] The main circuit board 20 and secondary circuit board 32 may also support one or more sensor modules (not shown) that contain various physiological and/or environmental sensors. For example, a sensor module, such as sensor module 70 illustrated in FIGS. 12A-12B, may be attached to the circuit boards 20, 32. The circuit boards 20, 32 also may include at least one signal processor (not shown), at least one wireless module (not shown) for communicating with a remote device, and/or at least one memory storage device (not shown). An exemplary wireless module may include a wireless chip, antenna, or RFID tag. In some embodiments, the wireless module may include a low-range wireless chip or chipset, such as a Bluetooth® or ZigBee chip. These electronic components may be located on the main circuit board 20, or on another circuit board, such as the secondary circuit board 32, attached to the main circuit board. LeBoeuf at [0093] In some embodiments, as illustrated in FIG. 8D, the earbud housing 16 may contain a material that reflects one or more wavelengths of light and transmits one or more wavelengths of light. For example, the earbud housing 16 may be comprised of a polymer, plastic, glass, composite material, or resin that reflects visible wavelengths and transmits IR wavelengths. Exemplary materials include color absorbing materials, such as organic dyes, found in photographic film. Alternatively, the earbud housing 16 may include an optical filter region, such as a Bragg filter or other optical filter layer deposited on one or more sides of the housing region. If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the

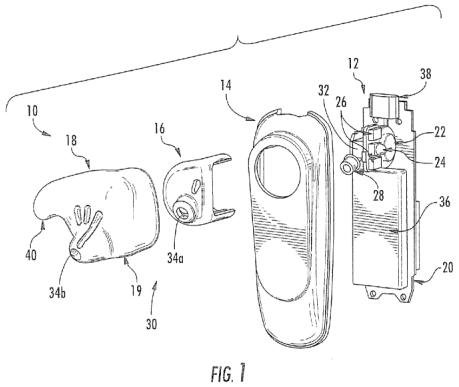
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	signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] The light-guiding region 19 of the cover 18 is designed to diffuse light and/or to generate luminescence. In this embodiment, the light-guiding region 19 includes at least one optical scatter or luminescence region. The optical scatter or luminescence region may be located anywhere within the earbud in the optical path of the optical emitters 24, but preferably within or about the cladding layer itself. When inspection light 111 generated by the optical emitters 24 is scattered or by an optical scatter region, this light may form a more diffuse optical beam 111 a that is more uniform across the earbud 30 than the inspection light 111 generated by the optical emitters 24. This diffused beam, having an intensity distribution being less sensitive to motion of the ear, may be useful in alleviating motion artifacts in the scattered light coming from the ear, such that the scattered light coming from the ear, measured by the optical detector 26, is more indicative of blood flow changes within blood vessels and less indicative of mouth movements and body motion. The optical scatter region within the light-guiding region 19 may be at least partially comprised of impurities or morphological differences within the light-guiding region. An example of such impurities may include point defects, volume defects, native defects, metallics, polymers, microspheres, phosphors, luminescent particles, air pockets, particles, particulate matter, and the like. An example of morphological differences may include density variations, roughness, air pockets, stoichiometry variations, and the like. As a specific example, the light-guiding region 19 may comprise a transparent material, such as glass, a polymer, or silicone, and a luminescent impurity, such as a phosphor or luminescent polymer or molecule, may be integrated within the light-guiding region. This configuration may generate luminescence within the light-guiding region 19 in response to optical excitation from the optical emitters 24. In other embodiments, nanoscale fluctuations or impurities may be used to diffuse or manipulate light through the earbud. Examples of nanoscale fluctuations or impurities may include quantum dots, rods, wires, doughnuts, or the like. LeBoeuf at [0128]. The optical energy generated by these optical emitters 24 a, 24 b may be scattered by blood vessels in the ear. This scattered light may be at least partially captured by the optical detectors 26. This light may be digitized by an optical detector 26 itself or with other circuitry on the sensor module circuit board 70 c. The light-guiding design of the aforementioned light-guiding earbuds 30 may direct light towards each of these detectors 26. For example, this may be accomplished via the light-guiding earbud 30, wherein a

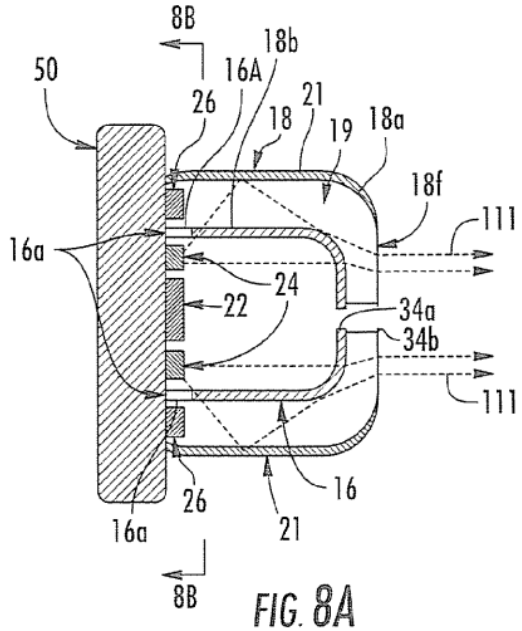
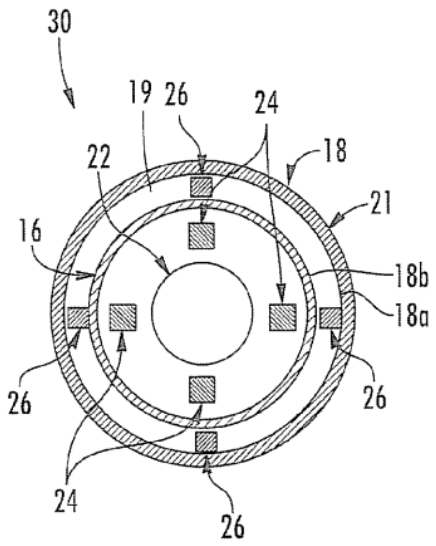
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	lens (e.g., 18L, FIG. 6) facilitates inspection light coupling from the optical emitters 24 into the ear region and facilitates scattered light coupling to the optical detectors 26 from the ear region. Additional sensor components 27 a, 27 b may be used to measure an orthogonal energy component, facilitate sensor analysis, and thus help generate physiological assessments. For example, sensor components 27 a, 27 b may be thermal sensors for measuring the temperature of the inner ear (using the thermal sensors 27 a facing the ear region) with respect to the outer ear (using the thermal sensor 27 b facing away from the ear region). By subtracting the two measured digitized temperatures from these two sensors 27 a, 27 b, an indication of heat flow from the ear can be generated. This temperature differential may be mathematically related to metabolic rate. For example, this temperature differential may be directly proportional metabolic rate. These temperature sensors may include thermistors, thermopiles, thermocouples, solid state sensors, or the like. They may be designed to measure thermal conduction, convection, radiation, or a combination of these temperature components. LeBoeuf at [0138] Thus, the optical scatter signal collected by the detectors 27 d may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). In the same token, the scattered light reaching the optical detectors 27 d may be used to generate a measure of activity. The intensity, phase, and frequency of this scattered light may be related to physical activity. Sinusoidal variations of the heart rate waveform may be counted digitally, by identifying and counting crests and peaks in the waveform, to generate an effective step count. Embodiments of the present invention, however, are not limited to the illustrated location of components in the sensor module 70. Various types and orientations of components may be utilized without limitation. LeBeouf at [0139] As previously described, the optical scatter signal collected by the detectors 27 *d* may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). This is because light detected by these detectors would come from light that has not been scattered by a physiological region but rather light that has been scattered from a region of the associated earpiece that may move along with the ear. Thus, the scattered light reaching the optical detectors 27 *d* may be used to generate a measure of activity.

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	LeBoeuf at [0142] The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated. It is important to note that the Channel A information can still be useful despite the presence of noise, and the noise information may still be utilized for the computation of relevant parameters. LeBoeuf at [0143] FIG. 15 is a graph of processed physiological signal data from a headset having one or more light-guiding earbuds 30, according to some embodiments of the present invention. Specifically, FIG. 15 shows the analysis results 400 of the data summaries 300 a-300 d presented in FIGS. 14A-14D of blood flow (y-axis) versus time (x-axis) following two data processing sequences to extract heart rate. One sequence incorporated the adaptive filtering process 200 of FIG. 13 as well as a beat finder processing step. The second sequence incorporated the beat finder processing step without the adaptive filtering process 200 of FIG. 13. The beat finder process counts each heart beat by monitoring the peaks and valleys of each pulse, such as the peaks and valleys shown in the graph 300 a of FIG. 14A. As shown in FIG. 15, the beat finder was effective at measuring heart rate during resting and jogging. However, the beat finder alone was not sufficient for monitoring heart rate during running. This is because at high motion, the signal 300 d (FIG. 14D) associated with footsteps is strong enough to overwhelm the smaller signal associated with heart rate, and so the motion-related contribution dominated the overall signal 300 d. Thus, the beat finder cannot distinguish heart beats from footsteps. By employing the adaptive filtering process 200 (FIG. 13) before the beat finder process, the footstep motion artifacts during running were effectively removed from the sensor signal (Channel A of FIG. 13) such that the output signal (Channel C of FIG. 13) contained blood flow information with minimal motion artifacts. Thus, this output signal contained blood flow pulse signals that could then be “counted” by the beat finder to generate an accurate heart rate assessment. LeBoeuf at [0147] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

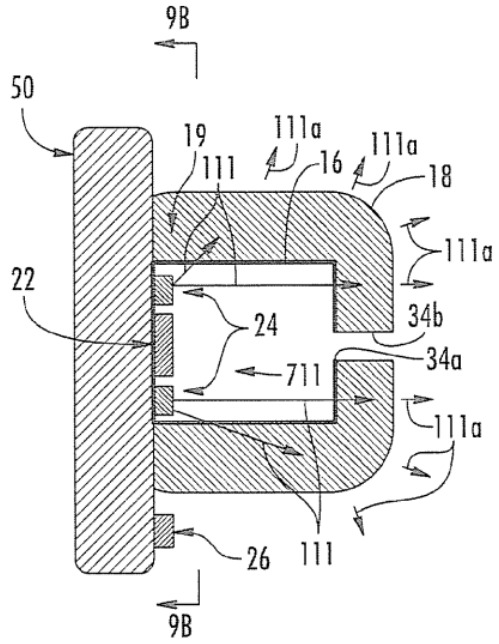
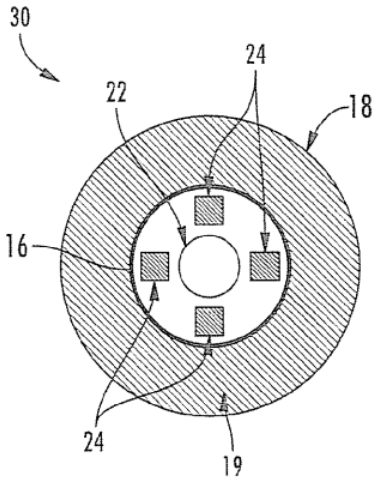
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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	LeBoeuf discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. A monitoring device configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light Transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the device at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at [Abstract] According to some embodiments of the present invention, a headset configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light Transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the headset at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. The optical emitter, via the light-guiding cover, directs optical energy towards a particular region of ear and the optical detector detects secondary optical energy emanating from the ear region. In some embodiments, the optical detector may include an optical filter configured to pass secondary optical energy at selective wavelengths. In some embodiments, the light Transmissive material of the cover may be configured, for example via the use of cladding and/or light reflective material, such that the cover serves as a light guide that is coupled in parallel to the optical emitter and detector. In some embodiments, the light Transmissive material of the cover may be configured, for example via the use of cladding and/or light reflective material, such that the cover serves as a light guide that is coupled perpendicular to the optical emitter and detector. LeBoeuf at [0006]

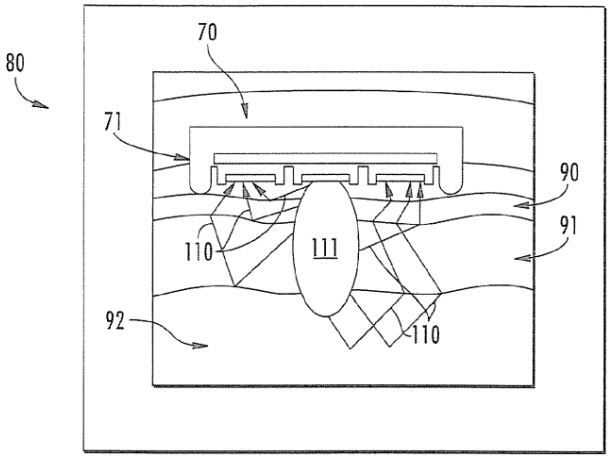
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	In some embodiments, the circular band includes a lens region in optical communication with the optical emitter that focuses light emitted by the optical emitter and/or that collects light reflected from a finger. In some embodiments the circular band includes a phosphor-containing region in optical communication with the light Transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. LeBoeuf at [0031] Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, optical emitter 24, optical detectors 26, and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, optical emitter 24, optical detectors 26, and thermopile 28. Collectively, the earbud housing 16, cover 18, and various electronic components (e.g., speaker 22, optical emitter 24, optical detectors 26, thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30. The headset housing 14 is secured to the base 12 and is configured to enclose and protect the various electronic components mounted to the base (e.g., main circuit board 20 and components secured thereto, etc.) from ambient interference (air, humidity, particulates, electromagnetic interference, etc). LeBoeuf at [0091]

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	 FIG. 1 LeBoeuf at Fig. 1 In the embodiments of FIGS. 4B-4D, the optical energy 110 coming from the ear may include optical wavelengths, such as IR wavelengths, emitting from the tympanic membrane due to black body radiation. If the optical detector 26 is configured to measure this black body radiation, then the earbud can be used to measure tympanic temperature, blood analyte levels, neurological, electrical activity, or metabolic activity of the earbud wearer. LeBoeuf at [0112]

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	 FIG. 8A  FIG. 8B LeBoeuf at Figs. 8A and 8B. In the illustrated embodiment of FIGS. 8A-8B, to reduce the risk of the inspection light 111 interrogating and saturating the optical detectors 26, a bottom portion 16 a of the earbud housing 16 includes a light blocking region that blocks light from passing therethrough. This light blocking region 16 a may be a black-painted region, an optically opaque region, or a material or structure that blocks light transmission. The illustrated configuration of the earbud housing 16 and bottom portion 16 a may help confine inspection light 111 generated by the optical emitters 24 within the light-guiding layer (i.e., 19), guiding this light towards the ear region through the end portion 18 f of the earbud 30. LeBoeuf at [0124]. In some embodiments, as illustrated in FIG. 8D, the earbud housing 16 may contain a material that reflects one or more wavelengths of light and transmits one or more wavelengths of light. For example, the earbud housing 16 may be comprised of a polymer, plastic, glass, composite material, or resin that reflects visible wavelengths and transmits IR wavelengths. Exemplary materials include color absorbing materials, such as organic dyes, found in photographic film. Alternatively, the earbud housing

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	16 may include an optical filter region, such as a Bragg filter or other optical filter layer deposited on one or more sides of the housing region. If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] Referring now to FIGS. 9A-9B, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an earbud housing 16 extending outwardly from the base 50 that is configured to be positioned within an ear of a subject, and a cover 18 surrounding the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the speaker 22 can pass. The cover 18 includes at least one aperture 34 b through which sound from the speaker 22 can pass. A pair of optical emitters 24 are secured to the base 50 and are surrounded by the earbud housing 16, as illustrated. An optical detector 26 is secured to the base 50 and is not surrounded by the earbud housing 16, as illustrated. The cover 18 serves as a light guide that delivers light from the optical emitters 24 into an ear canal of a subject. LeBoeuf at [0127].

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	 FIG. 9A  FIG. 9B LeBoeuf at Figs. 9A and 9B. FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring Transmitted wavelengths. The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140]

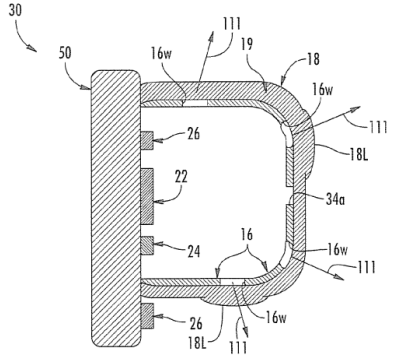
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	 FIG. 19 LeBoeuf at Fig. 19 The optical detectors 26 and emitters 24 may be of multiple wavelengths, with the goal of providing specialized physiological information for each wavelength. Referring to FIG. 19, for example, violet or UV light may be used to measure motion-related aspects of the ear, as violet and UV light may not penetrate greatly through the skin of the ear. Green, red, and IR wavelengths may have deeper penetration and provide information on the blood vessels and blood analyte levels. Blue wavelengths may be particularly useful for gauging changes in the size of the blood vessels. LeBoeuf at [0153] In the illustrated embodiment, windows 74 w are formed in the cladding material 21 and serve as light-guiding interfaces to the finger F. There may be any number of these windows, as may be required for sufficient optical coupling, and the windows 74 w may include lenses such as those described above (e.g., lens 18L illustrated in FIG. 6), to focus light emitted by the optical emitter 24 onto one or more portions of a finger F and/or to focus collected light on the light detectors 26, 26′. Similarly, the windows 74 w may include optical filters to selectively pass one or more optical wavelengths and reflect and/or absorb other optical wavelengths.

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	LeBoeuf at [0161] In some embodiments, multiple light emitters 24 may be utilized. For example, light emitters of different wavelengths may be utilized. In some embodiments, multiple light detectors may be utilized that are configured to measure light at different wavelengths (e.g., light detectors 26 and 26′ may be configured to measure light at different wavelengths). LeBoeuf at [0163] In the illustrated embodiment, windows 74 w are formed in the cladding material 21 and serve as light-guiding interfaces to the body of a subject. There may be any number of these windows, as may be required for sufficient optical coupling, and the windows 74 w may include lenses such as those described above (e.g., lens 18L illustrated in FIG. 6), to focus light emitted by the optical emitter 24 onto one or more portions of the body of a subject and/or to focus collected light on the light detectors 26, 26′. Similarly, the windows 74 w may include optical filters to selectively pass one or more optical wavelengths and reflect and/or absorb other optical wavelengths. LeBoeuf at [0168] In the illustrated embodiment, the light-guiding region 19 includes a light blocking member 80 that isolates light emitter 24 and light detector 26 from each other. In some embodiments, multiple light emitters 24 may be utilized. For example, light emitters of different wavelengths may be utilized. In some embodiments, multiple light detectors may be utilized that are configured to measure light at different wavelengths (e.g., light detectors 26 and 26′ may be configured to measure light at different wavelengths). LeBoeuf at [0169] 36. The device of claim 33, wherein the circular band comprises a phosphor-containing region in optical communication with the light transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. LeBoeuf at Claim 36

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	LeBoeuf discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin. A monitoring device configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the device at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at [Abstract] In some embodiments of the present invention, the light-guiding cover may include a lens that is in optical communication with the optical emitter and/or optical detector. The lens may be configured to focus light emitted by the optical emitter and/or to focus collected light toward the optical detector. In some embodiments, multiple lenses may be incorporated into a light-guiding cover. LeBoeuf at [0011] According to some embodiments of the present invention, a monitoring device includes a circular band capable of encircling a finger of a subject, and a base having an optical emitter and an optical detector attached to the circular band. The circular band includes light transmissive material in optical communication with the optical emitter and optical detector that is configured to deliver light from the optical emitter to one or more portions of the finger of the subject and to collect light from one or more portions of the finger of the subject and deliver the collected light to the optical detector. In some embodiments, the circular band includes first and second concentric body portions.

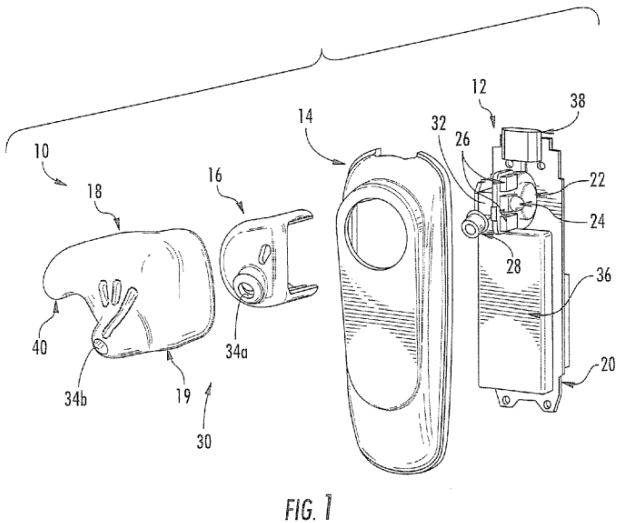
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	LeBoeuf at [0030] In some embodiments, the circular band includes a lens region in optical communication with the optical emitter that focuses light emitted by the optical emitter and/or that collects light reflected from a finger. In some embodiments the circular band includes a phosphor-containing region in optical communication with the light Transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. LeBoeuf at [0031] According to some embodiments of the present invention, a monitoring device configured to be attached to the body of a subject includes a base having an optical emitter and an optical detector, and light transmissive material attached to the base. The light transmissive material is in optical communication with the optical emitter and optical detector and is configured to deliver light from the optical emitter to one or more portions of the body of the subject and to collect light from one or more portions of the body of the subject and deliver the collected light to the optical detector. The light transmissive material may include adhesive material in one or more locations that is configured to adhesively secure the device to the body of the subject. LeBoeuf at [0034] The term “body” refers to the body of a subject (human or animal) that may wear a headset incorporating one or more light-guiding earbuds, according to embodiments of the present invention. LeBoeuf at [0083] Secondary circuit board 32 may also include a temperature sensor, such as a thermopile 28 mounted thereto. The thermopile 28 is oriented so as to point towards the tympanic membrane within the ear of a subject wearing the headset 10 through the acoustic orifices 34 a, 34 b in the earbud housing 16 and cover 18, respectively. The secondary circuit board 32 may be in electrical contact with the main circuit board 20 via soldering, connectors, wiring, or the like. A battery 36, such as a lithium polymer battery or other portable battery, may be mounted to the main circuit board 20 and may be charged via a USB charge port 38. Although not shown in FIG. 1, an ear hook may be attached to the base 12 or housing 14

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	to help stabilize the earbud 30 and headset 10 worn by a subject and such that the earbud 30 is consistently placed at the same location within the ear canal of a subject.\ LeBoeuf at [0094] The cover 18 includes light Transmissive material in a portion 19 thereof that is referred to as a light-guiding region. The light Transmissive material in light-guiding region 19 is in optical communication with the optical emitter 24 and detectors 26. The light Transmissive material in light-guiding region 19 is configured to deliver light from the optical emitter 24 into an ear canal of the subject at one or more predetermined locations and to collect light external to the earbud 30 and deliver the collected light to the optical detectors 26. As such, the earbud 30 of the illustrated headset 10 is referred to as a “light-guiding” earbud 30. LeBoeuf at [0096] In some embodiments, the light Transmissive material in the light-guiding region 19 may include a lens (e.g., lens 18L illustrated in FIG. 6). The lens 18L is in optical communication with the optical emitter 24 and/or with the optical detectors 26. For example, a lens 18L may be configured to focus light emitted by the optical emitter 24 onto one or more portions of an ear and/or to focus collected light on the light detectors 26. Lenses are described below with respect to FIGS. 5-6. LeBoeuf at [0097] The illustrated cover 18 of FIG. 1 includes an alignment member 40 (also referred to as a stabilization arm) that facilitates alignment of the earbud 30 within an ear canal of a subject. The alignment member 40 may facilitate stable measurements of optical scattered light from the ear region, which can be important for PPG measurements and tympanic temperature measurements. LeBoeuf at [0099]

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	 FIG. 6 LeBoeuf at Fig. 6 It may be beneficial to extend the light-guiding region 19 of the cover 18 near the location where the earbud 30 rests near the antitragus. This light-guide extension 19 a serves as an additional light-coupling region and may improve optical coupling from the light-guiding region 19 to an ear region and/or improve optical coupling from an ear region to the light-guiding region 19, including the antitragus and portions of the acoustic meatus. This is because this extended light-guiding region 19 a may provide skin contact between the light guiding layer 19 and the skin, providing better optomechanical stability and optical coupling. In this embodiment, light may couple into the extended light-guiding region 19 a, from an optical emitter 24, and into the ear region. Similarly, light may couple from the ear region, into the extended light-guiding region 19 a, and to the optical detector 26. This extended light-guiding region 19 a may appear as a bulb or lens near the bottom of the earbud cover 18. LeBoeuf at [0135] 1. A headset, comprising: a base comprising a speaker, an optical emitter, and an optical detector; an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, wherein the earbud housing is in acoustical communication with the speaker and comprises at least one aperture through which sound from the speaker can pass; and a cover surrounding the earbud housing, wherein the cover includes at least one aperture through which sound from the speaker can pass, and wherein the cover comprises light transmissive material in optical communication with the optical emitter and detector, wherein the light transmissive material is

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	configured to deliver light from the optical emitter into an ear region of the subject at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	LeBoeuf discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. A monitoring device configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the device at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at [Abstract] In some embodiments, the headset may include various electronic components secured to the base. For example, the headset may include one or more environmental sensors configured to detect and/or measure environmental conditions in a vicinity of the headset. The headset may include a signal processor configured to receive and process signals produced by the optical detector. For example, in some embodiments, a signal processor may be configured to extract secondary optical energy and remove optical noise or environmental noise. The headset may include a signal processor configured to receive and process signals produced by the one or more environmental sensors. In addition, the headset may include a transmitter configured to transmit signals processed by the signal processor to a remote device

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	in real time. Headsets according to embodiments of the present invention may utilize, for example, Bluetooth®, Wi-Fi, ZigBee, or other wireless transmitters. LeBoeuf at [0007] The physiological sensors of the sensor module may generate a signal that includes physiological information plus noise information. The noise may be removed by combining the physiological information and noise information from the sensor module with noise information from the noise source of the sensor module via an electronic filtering method, such as a signal processing technique. Specific examples of such signal processing techniques include FIR (Finite Impulse Response), IIR (Infinite Impulse Response), informatics, machine learning, and adaptive filter methods. The output of the adaptive filter may be a physiological signal that is wholly or partially free of noise. In some embodiments, motion-related noise from a subject activity such as running may be removed from the physiological plus noise signal generated by a photoplethysmography (PPG) sensor for measuring blood constituent levels or blood flow properties, such as blood oxygen level, VO2, or heart rate. LeBoeuf at [0022] In some embodiments, the circular band includes a lens region in optical communication with the optical emitter that focuses light emitted by the optical emitter and/or that collects light reflected from a finger. In some embodiments the circular band includes a phosphor-containing region in optical communication with the light transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. LeBoeuf at [0031] In some embodiments, the light transmissive material includes a lens region that is in optical communication with the optical emitter and that focuses light emitted by the optical emitter and/or that collects light reflected from a finger. In some embodiments, the light transmissive material includes a phosphor-containing region that receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. In some embodiments, the light transmissive material has an outer surface and an inner surface, and a light reflective material is disposed on or near at least a portion of one or both of the inner and outer surfaces.

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	LeBoeuf at [0037] Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, optical emitter 24, optical detectors 26, and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, optical emitter 24, optical detectors 26, and thermopile 28. Collectively, the earbud housing 16, cover 18, and various electronic components (e.g., speaker 22, optical emitter 24, optical detectors 26, thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30. The headset housing 14 is secured to the base 12 and is configured to enclose and protect the various electronic components mounted to the base (e.g., main circuit board 20 and components secured thereto, etc.) from ambient interference (air, humidity, particulates, electromagnetic interference, etc). LeBoeuf at [0091]  FIG. 1 LeBoeuf at Fig. 1

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	In some embodiments, the light transmissive material in the light-guiding region 19 may include a lens (e.g., lens 18L illustrated in FIG. 6). The lens 18L is in optical communication with the optical emitter 24 and/or with the optical detectors 26. For example, a lens 18L may be configured to focus light emitted by the optical emitter 24 onto one or more portions of an ear and/or to focus collected light on the light detectors 26. Lenses are described below with respect to FIGS. 5-6. LeBoeuf at [0097] If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] A sensor module 70 is located near the earbud periphery, as illustrated. This sensor module 70 is shown in more detail in FIGS. 12 a-12B, and is described below. Three benefits of locating the sensor module 70 near the periphery of the light-guiding earbud 30 are: 1) PPG signals near the antitragus are less corrupted by motion artifacts than are PPG signals in other blood-vessel-rich regions of the ear; 2) the sensor module 70 may be designed somewhat independently of the earbud 30, liberating earbud comfort maximization from PPG signal maximization; and 3) because design constraints may be liberated, sensors need not be located in the acoustic cavity (i.e., within the earbud housing 16), allowing sound to pass through the acoustic orifices 34 a, 34 b with minimal interference. In this embodiment, it may be beneficial to incorporate lenses within the cover 18, similar to the lenses 18L of FIG. 6. It may be beneficial to extend the light-guiding region 19 of the cover 18 near the location where the earbud 30 rests near the antitragus. This light-guide extension 19 a serves as an additional light-coupling region and may improve optical coupling from the light-guiding region 19 to an ear region and/or improve optical coupling from an ear region to the light-guiding region 19, including the antitragus and portions of the acoustic meatus. This is because this extended light-guiding region 19 a may provide skin contact between the light guiding layer 19 and the skin, providing better optomechanical stability and optical coupling. In this embodiment, light may couple into the extended light-guiding region 19 a, from an optical emitter 24, and into the ear region. Similarly, light may couple from the ear region, into the

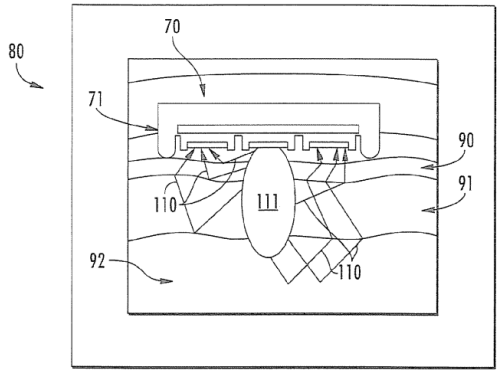
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	extended light-guiding region 19 a, and to the optical detector 26. This extended light-guiding region 19 a may appear as a bulb or lens near the bottom of the earbud cover 18. LeBoeuf at [0135] The earbud-facing side (FIG. 12B) of the sensor module **70** may include sensors that do not need to be located on the antitragus-facing side of the sensor module. For example, one or more inertial sensors **27** *c* may be located on the earbud-facing side (FIG. 12B) of the sensor module **70**. In a particular embodiment, the inertial sensor **27** *c* may be a 3-axis accelerometer, and because this sensor does not need to optically couple with the ear region, a better use of sensor real estate may be to locate this sensor on the earbud-facing side of the sensor module **70**. Additional optical emitters **24** *a*, **24** *b* may be located on the earbud-facing side to facilitate an optical noise reference. Namely, as the person wearing the earbud module **30** moves around, the interrogation light generated by the optical emitters **24** *a*, **24** *b* may be scattered off the earbud and be detected by optical detectors **27** *d*. This scattered light intensity, phase, and/or frequency due to body motion may be proportional to the motion-related component of the scattered light intensity from the ear region. The motion-related component is the component due to the physical motion of the ear and not the component related to blood flow. Thus, the optical scatter signal collected by the detectors **27** *d* may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). In the same token, the scattered light reaching the optical detectors **27** *d* may be used to generate a measure of activity. The intensity, phase, and frequency of this scattered light may be related to physical activity. Sinusoidal variations of the heart rate waveform may be counted digitally, by identifying and counting crests and peaks in the waveform, to generate an effective step count. Embodiments of the present invention, however, are not limited to the illustrated location of components in the sensor module **70**. Various types and orientations of components may be utilized without limitation. LeBoeuf at [0139] As previously described, the optical scatter signal collected by the detectors 27 *d* may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). This is because light detected by these detectors would come from light that has not been scattered by a physiological region but rather light that has been scattered from a region of the associated

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	earpiece that may move along with the ear. Thus, the scattered light reaching the optical detectors 27 *d* may be used to generate a measure of activity. LeBoeuf at [0142] FIG. 13 illustrates the basic configuration of an adaptive noise cancellation scheme 200 for extracting a physiological signal from noise. The two types of sensor inputs are represented by the terms “Channel A” and “Channel B”. Channel A refers to inputs from sensors that collect physiological information plus noise information, and Channel B refers to inputs from sensors that collect primarily (or substantially) noise information. Channel B information is passed through an electronic filter 203 whose properties are updated adaptively and dynamically. The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated. It is important to note that the Channel A information can still be useful despite the presence of noise, and the noise information may still be utilized for the computation of relevant parameters. For instance, the residual noise information in Channel A may be extracted by a parameter estimator 201 and the output in Channel D may be one or more activity assessments or the like. Similarly, the raw noise channel, Channel B, may be post-processed by a parameter estimator 205 to extract activity assessments for Channel E. Activity assessments may include exertion, activity level, distance traveled, speed, step count, pace, limb motion, poise, performance of an activity, mastication rate, intensity, or volume, and the like. The noise cancellation scheme 200 may be integrated into the firmware of a microprocessor or the like. LeBoeuf at [0143] Although the embodiment of FIG. 13 for cancelling motion noise has been presented for an earbud configuration, this does not limit the invention to earbuds. An element of the adaptive noise cancellation scheme 200 for cancelling motion noise with an optical noise source may be that the optical detectors (such as 27 d) are configured such that they do not receive scattered light from a physiological region while the detectors are simultaneously receiving scattered light from a region that is moving in synchronization with the physiological region. Even the slightest physiological signal existing in the optical noise reference of Channel B may prevent the adaptive filter from working properly such that the physiological signal may inadvertently be removed altogether by the filter 203. Furthermore, although the noise source Channel B is described as an optical noise source, other forms of energy may be used

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	in this invention. Namely, any inertial sensor input may constitute the input for Channel B. More specifically, a sensor for measuring changes in capacitance along the earbud with respect to the ear may provide an inertial noise reference without also measuring physiological information. Similarly, an accelerometer may provide an inertial noise reference without also measuring physiological information. An inductive sensor may also provide an inertial noise reference without also measuring physiological information. For each noise source, a defining element may be that the noise source may be configured to measure physical motion only (or mostly) and not physiological information (such as blood flow, blood oxygen, blood pressure, and the like). The utility of an optical noise source is that because the optical signal Channel A and the optical noise Channel B have the same linearity response, the adaptive filter scheme 200 may be more effective than the case where the signal and noise channels operate via different forms of sensed energy. For example, the response linearity characteristics of an accelerometer sensor in response to inertial changes may not be the same as the response linearity characteristics of an optical sensor. LeBoeuf at [0144] The adaptive noise cancellation scheme 200 for cancelling motion noise with an optical source (specifically an infrared LED) has been demonstrated in the laboratory, with a human wearing a light-guiding earbud while resting, jogging, and running over a treadmill, and various data summaries 300 a-300 d are presented in FIGS. 14A-14D. The data was recorded by a chip and memory card embedded in an earbud 30, having electrical connectivity with the sensor module 70 within the earbud 30. The raw signal in low motion 300 a and raw signal in high motion 300 c may be equated with the signal of Channel A of FIG. 13. Similarly, the “blocked channel” in low motion 300 b and “blocked channel” in high motion 300 d may be equated with Channel B of FIG. 13. In this experiment, the “block channel” consisted of an optical noise source, wherein the optical noise source included an optical emitter-detector module such as 70 of FIGS. 12A-12B. However, instead of being exposed to the ear, the optical emitter-detector module was covered with a layer of clear silicone that was then covered by black tape to prevent light from the emitter (such as 24 a and 24 b) from reaching the ear. Thus, scatter from the black tape was scattered back to the emitter-detector module through the silicone and sensed as motion noise by the detectors (such as 26 and 27 d). In a sense, for this configuration, the optical channel to the human ear is “blocked”, hence the term “blocked channel”. The purpose of the clear silicone below the black tape was to: 1) provide an unobstructed, transparent optical scatter path for the IR light and 2) provide motion sensitivity similar to that of human skin, as silicone has a vibration response that may be similar to that of human skin.

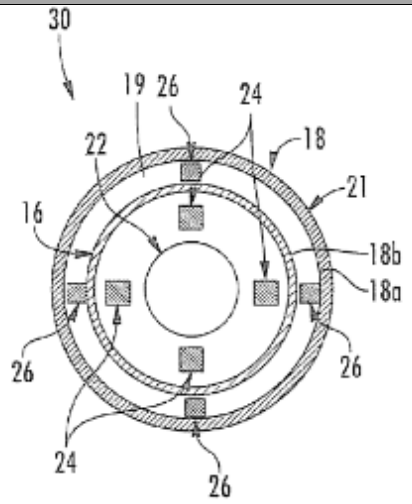
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	LeBoeuf at [0145] n some cases, it may be important to remove the effects of ambient optical noise from the physiological signal of a light-guiding earbud 30. In such cases, one or more optical detectors 26 may be configured to measure outdoor or ambient lighting, and this information may be fed back into the processor 602 (FIG. 17) to extract external optical noise from the physiological signal. For example, some optical detectors may be configured to measure light from the ear, whereas others may be configured to measure light from the ambient environment, such as sunlight, room light, headlights, or the like. This may be achieved by directing the optical detectors towards and away from the ear, respectively. In a specific example, the ambient light reaching the optical detectors 26 may generate an undesirable sinusoidal response on an optical detector that is configured to measure light from the ear. This undesirable sinusoidal noise response may be generated as an earbud user moves their head from side to side while running. Thus, Channel A of the adaptive filter 200 (FIG. 13) may include physiological information plus undesired ambient optical noise information. To remove this noise from the final output Channel C, the output of the optical detector configured to measure ambient optical noise may be an input (Channel B of FIG. 13) into the adaptive filter 200. In this way, ambient noise from Channel A may be removed to generate a mostly physiological signal in Channel C. LeBoeuf at [0152] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	LeBoeuf discloses or renders obvious, the detection system is configured to be synchronized to the light source. The physiological sensors of the sensor module may generate a signal that includes physiological information plus noise information. The noise may be removed by combining the physiological information and noise information from the sensor module with noise information from the noise source of the sensor module via an electronic filtering method, such as a signal processing technique. Specific examples of such signal processing techniques include FIR (Finite Impulse Response), IIR (Infinite

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	Impulse Response), informatics, machine learning, and adaptive filter methods. The output of the adaptive filter may be a physiological signal that is wholly or partially free of noise. In some embodiments, motion-related noise from a subject activity such as running may be removed from the physiological plus noise signal generated by a photoplethysmography (PPG) sensor for measuring blood constituent levels or blood flow properties, such as blood oxygen level, VO2, or heart rate. LeBoeuf at [0022] Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD), compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092] In some embodiments, the light transmissive material in the light-guiding region 19 may include a lens (e.g., lens 18L illustrated in FIG. 6). The lens 18L is in optical communication with the optical emitter 24 and/or with the optical detectors 26. For example, a lens 18L may be configured to focus light emitted by the optical emitter 24 onto one or more portions of an ear and/or to focus collected light on the light detectors 26. Lenses are described below with respect to FIGS. 5-6. LeBoeuf at [0097] The optical emitter 24 generates inspection light 111 and the light-guiding region 19 of the light guide 18 directs the inspection light 111 towards an ear region. This light is called inspection light because it interrogates the surface of the ear, penetrates the skin of the ear, and generates a scattered light response 110 which may effectively inspect blood vessels within the ear region. The optical detector 26 detects scattered light 110 from an ear region and the light-guiding region 19 of the light guide 18 guides the light to the optical detector 26 through the light-guiding region 19, as illustrated. LeBoeuf at [0105]

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	In the embodiment of FIG. 3, the light-guiding earbud 30 is configured for optical coupling that is parallel to the light guide (i.e., cover 18). The optical detector 26 and optical emitter 24 are configured to detect and generate light substantially parallel to the light-guiding region 19 of the light guide 18. For example, the light guide 18 defines an axial direction A1. The optical emitter 24 and optical detector 26 are each oriented such that their respective primary emitting and detecting planes P1, P2 are each facing a respective direction A3, A2 that is substantially parallel with direction A1. LeBoeuf at [0106]  FIG. 19 LeBoeuf at Fig. 19 FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring transmitted wavelengths. The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths.

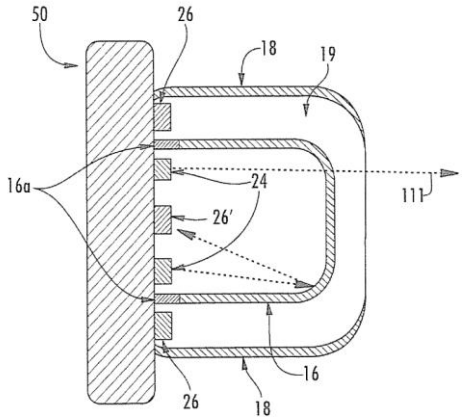
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	LeBoeuf at [0140] 28. The earbud of claim 27, wherein the microprocessor is configured to execute an adaptive filter algorithm to remove noise from at least one signal generated by the sensor module. LeBoeuf at Claim 28 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	LeBoeuf discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD), compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092] The cover 18 includes light transmissive material in a portion 19 thereof that is referred to as a light-guiding region. The light transmissive material in light-guiding region 19 is in optical communication with the optical emitter 24 and detectors 26. The light transmissive material in light-guiding region 19 is configured to deliver light from the optical emitter 24 into an ear canal of the subject at one or more predetermined locations and to collect light external to the earbud 30 and deliver the collected light to

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	the optical detectors 26. As such, the earbud 30 of the illustrated headset 10 is referred to as a “light-guiding” earbud 30. LeBoeuf at [0096] Referring now to FIGS. 8A-8B, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an earbud housing 16 extending outwardly from the base 50 that is configured to be positioned within an ear of a subject, and a cover 18 that surrounds the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the speaker 22 can pass. The cover 18 includes at least one aperture 34 b through which sound from the speaker 22 can pass. The cover 18 includes a cladding material 21 on the outer surface 18 a thereof, except at end portion 18 f, as illustrated. In the illustrated embodiment, there is no cladding material on the cover inner surface 18 b. The housing 16 is in contact with the cover inner surface 18 b and serves as a cladding layer to define the light guiding region 19. The cover 18 with the illustrated cladding material 18 c serves as a light guide that delivers light from the optical emitters 24 into an ear canal of a subject through cover end portion 18 f. The cover 18 also collects light through end portion 18 f and delivers the collected light to the optical detectors 26. Various configurations and arrangements of optical emitters and detectors may be utilized in accordance with embodiments of the present invention. LeBoeuf at [0123]

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	 FIG. 8B LeBoeuf at 8B FIGS. 12A-12B illustrate respective opposite sides of a sensor module 70 that may be located near the periphery of an earbud 30, for example as illustrated in FIGS. 11A-11B, according to some embodiments of the present invention. Sensor module 70 may include a number of electronic components capable of converting various forms of energy into an electrical signal and digitizing the signal. LeBoeuf at [0136] In some cases, it may be important to remove the effects of ambient optical noise from the physiological signal of a light-guiding earbud 30. In such cases, one or more optical detectors 26 may be configured to measure outdoor or ambient lighting, and this information may be fed back into the processor 602 (FIG. 17) to extract external optical noise from the physiological signal. For example, some optical detectors may be configured to measure light from the ear, whereas others may be configured to measure light from the ambient environment, such as sunlight, room light, headlights, or the like. This may be achieved by directing the optical detectors towards and away from the ear, respectively. In a specific example, the ambient light reaching the optical detectors 26 may generate an undesirable sinusoidal response on an optical detector that is configured to measure light from the ear. This undesirable sinusoidal noise

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	response may be generated as an earbud user moves their head from side to side while running. Thus, Channel A of the adaptive filter 200 (FIG. 13) may include physiological information plus undesired ambient optical noise information. To remove this noise from the final output Channel C, the output of the optical detector configured to measure ambient optical noise may be an input (Channel B of FIG. 13) into the adaptive filter 200. In this way, ambient noise from Channel A may be removed to generate a mostly physiological signal in Channel C. LeBoeuf at [0152] The optical detectors 26 and emitters 24 may be of multiple wavelengths, with the goal of providing specialized physiological information for each wavelength. Referring to FIG. 19, for example, violet or UV light may be used to measure motion-related aspects of the ear, as violet and UV light may not penetrate greatly through the skin of the ear. Green, red, and IR wavelengths may have deeper penetration and provide information on the blood vessels and blood analyte levels. Blue wavelengths may be particularly useful for gauging changes in the size of the blood vessels. LeBoeuf at [0153] Embodiments of the present invention may be more generally applied to non-optical or mix-optical configurations. For example, one or more of the detectors 26 and emitters 24 may be mechanical, acoustical, electrical, gravimetric, or nuclear detectors and emitters, all providing physiological information to the processor 602 (FIG. 17). For example, an accelerometer or capacitor may be used as a detector 26 for the noise reference (Channel B) input of an adaptive filter running in real-time on the processor 602. LeBoeuf at [0154] Referring to FIG. 20, a chipset 800 for use in light-guiding earbuds 30, according to some embodiments of the present invention, may include optical emitters, optical detectors, mechanical, acoustical, electrical, gravimetric, nuclear detectors, additional sensors, signal processing, power regulation, digital control, and input/output lines. The chipset 800 may include firmware for signal extraction and for generating physiological assessments from information derived from the sensors and noise sources. One benefit of the chipset configuration is that the chipset 800 may be fully or partially integrated and hence compact and scalable to a wide range of products. To be integrated with a light-guiding earbud 30, the chipset 800 may be aligned such that the sensor region has an exposed window to a subject's ear. For

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	example, the chipset 800 may be attached to the earbud base 50 or an earbud sensor module 70 and aligned line-of-sight through an acoustic orifice of an earbud and/or through a transparent end portion of an earbud 30 (e.g., through end portion 18 f of the earbud 30 of FIGS. 8A-8B or 18 w of FIGS. 4 & 5). LeBoeuf at [0155] According to other embodiments of the present invention, monitoring devices with light-guiding regions may be configured to be attached to earlobes, fingers, toes, other digits, etc. For example, FIGS. 22A-22B illustrate a monitoring device 70 that is configured to fit over a finger F, for example, as a finger ring, according to some embodiments of the present invention. The illustrated monitoring device 70 includes a generally circular band capable of encircling a finger F of a subject, with a cylindrical outer body portion 72 and a generally cylindrical inner body portion 74 secured together in concentric relationship. The outer body portion may be formed from virtually any type of material and may have an ornamental configuration. In some embodiments, the outer body portion 72 may include a flex circuit containing various electronic components, such as a microprocessor, D/A converter, power source, power regulator, and the like. However, in some embodiments, the outer body portion 72 may not be required and the circular band of the monitoring device 70 includes only the inner body portion 74 secured to the base 50 (described below). LeBoeuf at [0157]

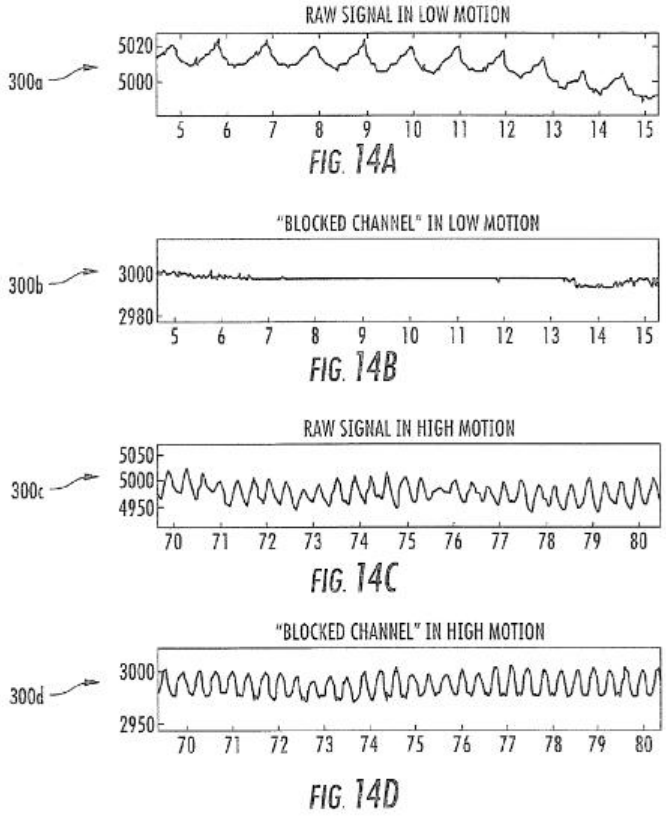
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	 FIG 8D LeBoeuf at Fig. 8D In some embodiments, multiple light emitters 24 may be utilized. For example, light emitters of different wavelengths may be utilized. In some embodiments, multiple light detectors may be utilized that are configured to measure light at different wavelengths (e.g., light detectors 26 and 26′ may be configured to measure light at different wavelengths). LeBoeuf at [0163] Referring now to FIG. 23, a monitoring device 70′, according to some embodiments of the present invention, may be configured to be attached to a body of a subject as a bandage or “band-aid”. The illustrated monitoring device 70′ includes an outer layer or body portion 72 and an inner layer or body portion 74 secured together, as illustrated. The outer body portion may be formed from virtually any type of material and may have an ornamental configuration. In some embodiments, the outer body portion 72 may include a flex circuit containing various electronic components, such as a microprocessor, D/A converter, power source, power regulator, and the like. However, in some embodiments, the outer body portion 72 may not be required and the monitoring device 70′ includes only the inner body portion 74 secured to the base 50 (described below). LeBoeuf at [0164]

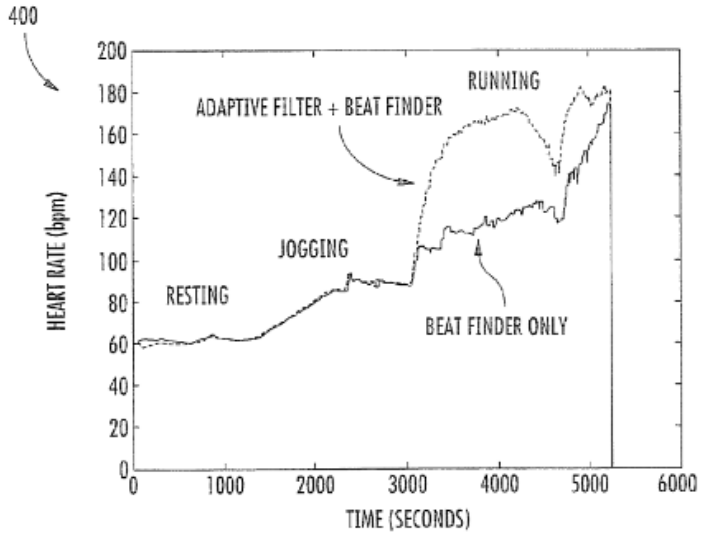
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	LeBoeuf discloses or renders obvious the output signal is indicative of the one or more physiological parameters. In some embodiments, the headset may include various electronic components secured to the base. For example, the headset may include one or more environmental sensors configured to detect and/or measure environmental conditions in a vicinity of the headset. The headset may include a signal processor configured to receive and process signals produced by the optical detector. For example, in some embodiments, a signal processor may be configured to extract secondary optical energy and remove optical noise or environmental noise. The headset may include a signal processor configured to receive and process signals produced by the one or more environmental sensors. In addition, the headset may include a Transmitter configured to Transmit signals processed by the signal processor to a remote device in real time. Headsets according to embodiments of the present invention may utilize, for example, Bluetooth®, Wi-Fi, ZigBee, or other wireless Transmitters. LeBoeuf at [0007] Light directed into the ear of a subject from a light emitter and the subsequent collection of light at a light detector, according to embodiments of the present invention, may be utilized for detecting and/or measuring, among other things, body temperature, skin temperature, blood gas levels, muscle tension, heart rate, blood flow, cardiopulmonary functions, etc. LeBoeuf at [0010] In some embodiments of the present invention, an earbud may integrate a sensor module containing a plurality of sensor elements for measuring physiological information and at least one noise source for measuring noise information. A “noise source”, as used herein, refers to a sensor, such as an optical sensor, inertial sensor, electrically conductive sensor, capacitive sensor, inductive sensor, etc., and

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	derives it name from the fact that it is a source of input to a filter, such as an adaptive filter described below. LeBoeuf at [0021] The physiological sensors of the sensor module may generate a signal that includes physiological information plus noise information. The noise may be removed by combining the physiological information and noise information from the sensor module with noise information from the noise source of the sensor module via an electronic filtering method, such as a signal processing technique. Specific examples of such signal processing techniques include FIR (Finite Impulse Response), IIR (Infinite Impulse Response), informatics, machine learning, and adaptive filter methods. The output of the adaptive filter may be a physiological signal that is wholly or partially free of noise. In some embodiments, motion-related noise from a subject activity such as running may be removed from the physiological plus noise signal generated by a photoplethysmography (PPG) sensor for measuring blood constituent levels or blood flow properties, such as blood oxygen level, VO2, or heart rate. LeBoeuf at [0022] In some embodiments of the present invention, a processor/multiplexor processes physiological signals and noise signals into a data string. This data string may contain information relating to physiological information and motion-related information. The processing method may include signal processing techniques such as pre-adaptive signal conditioning, adaptive filtering, and parameter extraction. LeBoeuf at [0024] Accordingly, some embodiments of the present invention combine a personal communications headset device with one or more physiological and/or environmental sensors. Other embodiments may combine physiological and/or environmental sensors into a headset device. LeBoeuf at [0088] The main circuit board 20 and secondary circuit board 32 may also support one or more sensor modules (not shown) that contain various physiological and/or environmental sensors. For example, a sensor module, such as sensor module 70 illustrated in FIGS. 12A-12B, may be attached to the circuit boards 20, 32. The circuit boards 20, 32 also may include at least one signal processor (not shown), at least one

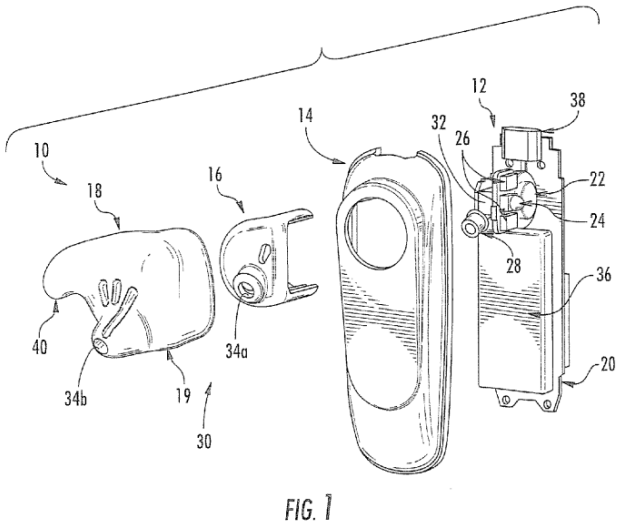
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	wireless module (not shown) for communicating with a remote device, and/or at least one memory storage device (not shown). An exemplary wireless module may include a wireless chip, antenna, or RFID tag. In some embodiments, the wireless module may include a low-range wireless chip or chipset, such as a Bluetooth® or ZigBee chip. These electronic components may be located on the main circuit board 20, or on another circuit board, such as the secondary circuit board 32, attached to the main circuit board. LeBoeuf at [0093] In some embodiments, as illustrated in FIG. 8D, the earbud housing 16 may contain a material that reflects one or more wavelengths of light and transmits one or more wavelengths of light. For example, the earbud housing 16 may be comprised of a polymer, plastic, glass, composite material, or resin that reflects visible wavelengths and transmits IR wavelengths. Exemplary materials include color absorbing materials, such as organic dyes, found in photographic film. Alternatively, the earbud housing 16 may include an optical filter region, such as a Bragg filter or other optical filter layer deposited on one or more sides of the housing region. If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] The optical energy generated by these optical emitters 24 a, 24 b may be scattered by blood vessels in the ear. This scattered light may be at least partially captured by the optical detectors 26. This light may be digitized by an optical detector 26 itself or with other circuitry on the sensor module circuit board 70 c. The light-guiding design of the aforementioned light-guiding earbuds 30 may direct light towards each of these detectors 26. For example, this may be accomplished via the light-guiding earbud 30, wherein a lens (e.g., 18L, FIG. 6) facilitates inspection light coupling from the optical emitters 24 into the ear region and facilitates scattered light coupling to the optical detectors 26 from the ear region. Additional sensor components 27 a, 27 b may be used to measure an orthogonal energy component, facilitate sensor analysis, and thus help generate physiological assessments. For example, sensor components 27 a, 27 b may be thermal sensors for measuring the temperature of the inner ear (using the thermal sensors 27 a facing the ear region) with respect to the outer ear (using the thermal sensor 27 b facing away from the

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	ear region). By subtracting the two measured digitized temperatures from these two sensors 27 a, 27 b, an indication of heat flow from the ear can be generated. This temperature differential may be mathematically related to metabolic rate. For example, this temperature differential may be directly proportional metabolic rate. These temperature sensors may include thermistors, thermopiles, thermocouples, solid state sensors, or the like. They may be designed to measure thermal conduction, convection, radiation, or a combination of these temperature components. LeBoeuf at [0138] The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated. It is important to note that the Channel A information can still be useful despite the presence of noise, and the noise information may still be utilized for the computation of relevant parameters. LeBoeuf at [0143] FIG. 15 is a graph of processed physiological signal data from a headset having one or more light-guiding earbuds 30, according to some embodiments of the present invention. Specifically, FIG. 15 shows the analysis results 400 of the data summaries 300 a-300 d presented in FIGS. 14A-14D of blood flow (y-axis) versus time (x-axis) following two data processing sequences to extract heart rate. One sequence incorporated the adaptive filtering process 200 of FIG. 13 as well as a beat finder processing step. The second sequence incorporated the beat finder processing step without the adaptive filtering process 200 of FIG. 13. The beat finder process counts each heart beat by monitoring the peaks and valleys of each pulse, such as the peaks and valleys shown in the graph 300 a of FIG. 14A. As shown in FIG. 15, the beat finder was effective at measuring heart rate during resting and jogging. However, the beat finder alone was not sufficient for monitoring heart rate during running. This is because at high motion, the signal 300 d (FIG. 14D) associated with footsteps is strong enough to overwhelm the smaller signal associated with heart rate, and so the motion-related contribution dominated the overall signal 300 d. Thus, the beat finder cannot distinguish heart beats from footsteps. By employing the adaptive filtering process 200 (FIG. 13) before the beat finder process, the footstep motion artifacts during running were effectively removed from the sensor signal (Channel A of FIG. 13) such that the output signal (Channel C of FIG. 13) contained blood flow information with minimal motion artifacts. Thus, this output signal

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	contained blood flow pulse signals that could then be “counted” by the beat finder to generate an accurate heart rate assessment. LeBoeuf at [0147]  LeBoeuf at Fig. 14A-14D

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	 FIG. 15 LeBoeuf at Fig. 15 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of	LeBoeuf discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. A monitoring device configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a

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light emitting diodes from an initial light intensity;	cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the device at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at [Abstract] In some embodiments, the headset may include various electronic components secured to the base. For example, the headset may include one or more environmental sensors configured to detect and/or measure environmental conditions in a vicinity of the headset. The headset may include a signal processor configured to receive and process signals produced by the optical detector. For example, in some embodiments, a signal processor may be configured to extract secondary optical energy and remove optical noise or environmental noise. The headset may include a signal processor configured to receive and process signals produced by the one or more environmental sensors. In addition, the headset may include a transmitter configured to transmit signals processed by the signal processor to a remote device in real time. Headsets according to embodiments of the present invention may utilize, for example, Bluetooth®, Wi-Fi, ZigBee, or other wireless transmitters. LeBoeuf at [0007] The physiological sensors of the sensor module may generate a signal that includes physiological information plus noise information. The noise may be removed by combining the physiological information and noise information from the sensor module with noise information from the noise source of the sensor module via an electronic filtering method, such as a signal processing technique. Specific examples of such signal processing techniques include FIR (Finite Impulse Response), IIR (Infinite Impulse Response), informatics, machine learning, and adaptive filter methods. The output of the adaptive filter may be a physiological signal that is wholly or partially free of noise. In some embodiments, motion-related noise from a subject activity such as running may be removed from the physiological plus noise signal generated by a photoplethysmography (PPG) sensor for measuring blood constituent levels or blood flow properties, such as blood oxygen level, VO2, or heart rate. LeBoeuf at [0022]

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	Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, optical emitter 24, optical detectors 26, and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, optical emitter 24, optical detectors 26, and thermopile 28. Collectively, the earbud housing 16, cover 18, and various electronic components (e.g., speaker 22, optical emitter 24, optical detectors 26, thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30. The headset housing 14 is secured to the base 12 and is configured to enclose and protect the various electronic components mounted to the base (e.g., main circuit board 20 and components secured thereto, etc.) from ambient interference (air, humidity, particulates, electromagnetic interference, etc). LeBoeuf at [0091]  FIG. 1 LeBoeuf at Fig. 1

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	In some embodiments, the light transmissive material in the light-guiding region 19 may include a lens (e.g., lens 18L illustrated in FIG. 6). The lens 18L is in optical communication with the optical emitter 24 and/or with the optical detectors 26. For example, a lens 18L may be configured to focus light emitted by the optical emitter 24 onto one or more portions of an ear and/or to focus collected light on the light detectors 26. Lenses are described below with respect to FIGS. 5-6. LeBoeuf at [0097] If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] The earbud-facing side (FIG. 12B) of the sensor module **70** may include sensors that do not need to be located on the antitragus-facing side of the sensor module. For example, one or more inertial sensors **27** *c* may be located on the earbud-facing side (FIG. 12B) of the sensor module **70**. In a particular embodiment, the inertial sensor **27** *c* may be a 3-axis accelerometer, and because this sensor does not need to optically couple with the ear region, a better use of sensor real estate may be to locate this sensor on the earbud-facing side of the sensor module **70**. Additional optical emitters **24** *a,* **24** *b* may be located on the earbud-facing side to facilitate an optical noise reference. Namely, as the person wearing the earbud module **30** moves around, the interrogation light generated by the optical emitters **24** *a,* **24** *b* may be scattered off the earbud and be detected by optical detectors **27** *d.* This scattered light intensity, phase, and/or frequency due to body motion may be proportional to the motion-related component of the scattered light intensity from the ear region. The motion-related component is the component due to the physical motion of the ear and not the component related to blood flow. Thus, the optical scatter signal collected by the detectors **27** *d* may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). In the same token, the scattered light reaching the optical detectors **27** *d* may be used to generate a measure of activity. The intensity, phase, and frequency of this scattered light may be related to physical activity. Sinusoidal variations of the heart rate waveform may be counted digitally, by identifying and counting crests and

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	peaks in the waveform, to generate an effective step count. Embodiments of the present invention, however, are not limited to the illustrated location of components in the sensor module **70**. Various types and orientations of components may be utilized without limitation. LeBoeuf at [0139] As previously described, the optical scatter signal collected by the detectors 27 *d* may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). This is because light detected by these detectors would come from light that has not been scattered by a physiological region but rather light that has been scattered from a region of the associated earpiece that may move along with the ear. Thus, the scattered light reaching the optical detectors 27 *d* may be used to generate a measure of activity. LeBoeuf at [0142] FIG. 13 illustrates the basic configuration of an adaptive noise cancellation scheme 200 for extracting a physiological signal from noise. The two types of sensor inputs are represented by the terms “Channel A” and “Channel B”. Channel A refers to inputs from sensors that collect physiological information plus noise information, and Channel B refers to inputs from sensors that collect primarily (or substantially) noise information. Channel B information is passed through an electronic filter 203 whose properties are updated adaptively and dynamically. The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated. It is important to note that the Channel A information can still be useful despite the presence of noise, and the noise information may still be utilized for the computation of relevant parameters. For instance, the residual noise information in Channel A may be extracted by a parameter estimator 201 and the output in Channel D may be one or more activity assessments or the like. Similarly, the raw noise channel, Channel B, may be post-processed by a parameter estimator 205 to extract activity assessments for Channel E. Activity assessments may include exertion, activity level, distance traveled, speed, step count, pace, limb motion, poise, performance of an activity, mastication rate, intensity, or volume, and the like. The noise cancellation scheme 200 may be integrated into the firmware of a microprocessor or the like.

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	LeBoeuf at [0143] Although the embodiment of FIG. 13 for cancelling motion noise has been presented for an earbud configuration, this does not limit the invention to earbuds. An element of the adaptive noise cancellation scheme 200 for cancelling motion noise with an optical noise source may be that the optical detectors (such as 27 d) are configured such that they do not receive scattered light from a physiological region while the detectors are simultaneously receiving scattered light from a region that is moving in synchronization with the physiological region. Even the slightest physiological signal existing in the optical noise reference of Channel B may prevent the adaptive filter from working properly such that the physiological signal may inadvertently be removed altogether by the filter 203. Furthermore, although the noise source Channel B is described as an optical noise source, other forms of energy may be used in this invention. Namely, any inertial sensor input may constitute the input for Channel B. More specifically, a sensor for measuring changes in capacitance along the earbud with respect to the ear may provide an inertial noise reference without also measuring physiological information. Similarly, an accelerometer may provide an inertial noise reference without also measuring physiological information. An inductive sensor may also provide an inertial noise reference without also measuring physiological information. For each noise source, a defining element may be that the noise source may be configured to measure physical motion only (or mostly) and not physiological information (such as blood flow, blood oxygen, blood pressure, and the like). The utility of an optical noise source is that because the optical signal Channel A and the optical noise Channel B have the same linearity response, the adaptive filter scheme 200 may be more effective than the case where the signal and noise channels operate via different forms of sensed energy. For example, the response linearity characteristics of an accelerometer sensor in response to inertial changes may not be the same as the response linearity characteristics of an optical sensor. LeBoeuf at [0144] The adaptive noise cancellation scheme 200 for cancelling motion noise with an optical source (specifically an infrared LED) has been demonstrated in the laboratory, with a human wearing a light-guiding earbud while resting, jogging, and running over a treadmill, and various data summaries 300 a-300 d are presented in FIGS. 14A-14D. The data was recorded by a chip and memory card embedded in an earbud 30, having electrical connectivity with the sensor module 70 within the earbud 30. The raw signal in low motion 300 a and raw signal in high motion 300 c may be equated with the signal of Channel A of FIG. 13. Similarly, the “blocked channel” in low motion 300 b and “blocked channel” in high motion 300 d may be equated with Channel B of FIG. 13. In this experiment, the “block channel”

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	consisted of an optical noise source, wherein the optical noise source included an optical emitter-detector module such as 70 of FIGS. 12A-12B. However, instead of being exposed to the ear, the optical emitter-detector module was covered with a layer of clear silicone that was then covered by black tape to prevent light from the emitter (such as 24 a and 24 b) from reaching the ear. Thus, scatter from the black tape was scattered back to the emitter-detector module through the silicone and sensed as motion noise by the detectors (such as 26 and 27 d). In a sense, for this configuration, the optical channel to the human ear is “blocked”, hence the term “blocked channel”. The purpose of the clear silicone below the black tape was to: 1) provide an unobstructed, transparent optical scatter path for the IR light and 2) provide motion sensitivity similar to that of human skin, as silicone has a vibration response that may be similar to that of human skin. LeBoeuf at [0145] n some cases, it may be important to remove the effects of ambient optical noise from the physiological signal of a light-guiding earbud 30. In such cases, one or more optical detectors 26 may be configured to measure outdoor or ambient lighting, and this information may be fed back into the processor 602 (FIG. 17) to extract external optical noise from the physiological signal. For example, some optical detectors may be configured to measure light from the ear, whereas others may be configured to measure light from the ambient environment, such as sunlight, room light, headlights, or the like. This may be achieved by directing the optical detectors towards and away from the ear, respectively. In a specific example, the ambient light reaching the optical detectors 26 may generate an undesirable sinusoidal response on an optical detector that is configured to measure light from the ear. This undesirable sinusoidal noise response may be generated as an earbud user moves their head from side to side while running. Thus, Channel A of the adaptive filter 200 (FIG. 13) may include physiological information plus undesired ambient optical noise information. To remove this noise from the final output Channel C, the output of the optical detector configured to measure ambient optical noise may be an input (Channel B of FIG. 13) into the adaptive filter 200. In this way, ambient noise from Channel A may be removed to generate a mostly physiological signal in Channel C. LeBoeuf at [0152] In some embodiments, multiple light emitters 24 may be utilized. For example, light emitters of different wavelengths may be utilized. In some embodiments, multiple light detectors may be utilized that are configured to measure light at different wavelengths (e.g., light detectors 26 and 26′ may be configured to measure light at different wavelengths). In this way, either optical detector may be configured to

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	measure light mostly due to motion (such as finger motion) or to measure light mostly due to physiological processes and motion. For example, if the windows 74 w incorporate IR-pass filters, visible light will not pass through the windows 74 w and the light will be scattered to the photodetectors 26 and 26′. Or, if the two illustrated blocking regions 80 are in place, and if photodetector 26′ is configured to measure only visible light and photodetector 26 is configured to measure only IR light, then only the photodetector 26′ will detect scattered visible light. As this visible scattered light cannot reach the finger, the scatter intensity measured by optical detector 26′ may be indicative of motion and not physiological activity. LeBoeuf at [0163] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	LeBoeuf discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,. The optical detectors 26 positioned outside the earbud housing 16 of the earbud 30 of FIGS. 7A-7B collect scattered light from an ear originating from inspection light 111 generated by the flexible optical emitter 24. The flexible optical emitter 24 may be mounted to the earbud base 50 through one or more electrical connectors 24 a. In some embodiments, these may be soldered, wired, or detachable connectors. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical emitters and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. For example, these flexible devices may include an organic LED (OLED) and an organic optical detector circuit. This embodiment may be useful for generating a diffuse light beam towards the ear region and for detecting a diffuse optical scatter response from the ear region. In some embodiments, the emitter and detector on the flexible optical emitter 24 may be a traditional light-emitting diode (LED) and

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	photodetector (PD) integrated onto a flexible printed circuit board. In other embodiments, transparent solid state optical emitters, detectors, or switches may be used. For example, an electrically controlled liquid crystal matrix may be embedded within an earbud, covering the flexible optical emitter 24. This may allow localized control of light flow to selected areas from/to the earbud going towards/away-from the ear. Additionally, this may allow localized control of light wavelength to selected areas. LeBoeuf at [0122] In some embodiments, as illustrated in FIG. 8D, the earbud housing 16 may contain a material that reflects one or more wavelengths of light and transmits one or more wavelengths of light. For example, the earbud housing 16 may be comprised of a polymer, plastic, glass, composite material, or resin that reflects visible wavelengths and transmits IR wavelengths. Exemplary materials include color absorbing materials, such as organic dyes, found in photographic film. Alternatively, the earbud housing 16 may include an optical filter region, such as a Bragg filter or other optical filter layer deposited on one or more sides of the housing region. If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] Thus, the optical scatter signal collected by the detectors 27 d may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). In the same token, the scattered light reaching the optical detectors 27 d may be used to generate a measure of activity. The intensity, phase, and frequency of this scattered light may be related to physical activity. Sinusoidal variations of the heart rate waveform may be counted digitally, by identifying and counting crests and peaks in the waveform, to generate an effective step count. Embodiments of the present invention, however, are not limited to the illustrated location of components in the sensor module 70. Various types and orientations of components may be utilized without limitation. LeBoeuf at [0139]

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	In some cases, it may be important to remove the effects of ambient optical noise from the physiological signal of a light-guiding earbud 30. In such cases, one or more optical detectors 26 may be configured to measure outdoor or ambient lighting, and this information may be fed back into the processor 602 (FIG. 17) to extract external optical noise from the physiological signal. For example, some optical detectors may be configured to measure light from the ear, whereas others may be configured to measure light from the ambient environment, such as sunlight, room light, headlights, or the like. This may be achieved by directing the optical detectors towards and away from the ear, respectively. In a specific example, the ambient light reaching the optical detectors 26 may generate an undesirable sinusoidal response on an optical detector that is configured to measure light from the ear. This undesirable sinusoidal noise response may be generated as an earbud user moves their head from side to side while running. Thus, Channel A of the adaptive filter 200 (FIG. 13) may include physiological information plus undesired ambient optical noise information. To remove this noise from the final output Channel C, the output of the optical detector configured to measure ambient optical noise may be an input (Channel B of FIG. 13) into the adaptive filter 200. In this way, ambient noise from Channel A may be removed to generate a mostly physiological signal in Channel C. LeBoeuf at [0152] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	LeBoeuf discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. The optical detectors 26 positioned outside the earbud housing 16 of the earbud 30 of FIGS. 7A-7B collect scattered light from an ear originating from inspection light 111 generated by the flexible optical emitter 24. The flexible optical emitter 24 may be mounted to the earbud base 50 through one or more electrical connectors 24 a. In some embodiments, these may be soldered, wired, or detachable connectors. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical

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	emitters and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. For example, these flexible devices may include an organic LED (OLED) and an organic optical detector circuit. This embodiment may be useful for generating a diffuse light beam towards the ear region and for detecting a diffuse optical scatter response from the ear region. In some embodiments, the emitter and detector on the flexible optical emitter 24 may be a traditional light-emitting diode (LED) and photodetector (PD) integrated onto a flexible printed circuit board. In other embodiments, transparent solid state optical emitters, detectors, or switches may be used. For example, an electrically controlled liquid crystal matrix may be embedded within an earbud, covering the flexible optical emitter 24. This may allow localized control of light flow to selected areas from/to the earbud going towards/away-from the ear. Additionally, this may allow localized control of light wavelength to selected areas. LeBoeuf at [0122] In some embodiments, as illustrated in FIG. 8D, the earbud housing 16 may contain a material that reflects one or more wavelengths of light and transmits one or more wavelengths of light. For example, the earbud housing 16 may be comprised of a polymer, plastic, glass, composite material, or resin that reflects visible wavelengths and transmits IR wavelengths. Exemplary materials include color absorbing materials, such as organic dyes, found in photographic film. Alternatively, the earbud housing 16 may include an optical filter region, such as a Bragg filter or other optical filter layer deposited on one or more sides of the housing region. If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] Thus, the optical scatter signal collected by the detectors 27 d may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). In the same token, the scattered light reaching the optical detectors 27 d may be used to generate a measure of activity. The intensity, phase, and frequency of this scattered light may be related to physical activity. Sinusoidal

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	variations of the heart rate waveform may be counted digitally, by identifying and counting crests and peaks in the waveform, to generate an effective step count. Embodiments of the present invention, however, are not limited to the illustrated location of components in the sensor module 70. Various types and orientations of components may be utilized without limitation. LeBoeuf at [0139] FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring transmitted wavelengths. The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140] In some cases, it may be important to remove the effects of ambient optical noise from the physiological signal of a light-guiding earbud 30. In such cases, one or more optical detectors 26 may be configured to measure outdoor or ambient lighting, and this information may be fed back into the processor 602 (FIG. 17) to extract external optical noise from the physiological signal. For example, some optical detectors may be configured to measure light from the ear, whereas others may be configured to measure light from the ambient environment, such as sunlight, room light, headlights, or the like. This may be achieved by directing the optical detectors towards and away from the ear, respectively. In a specific example, the ambient light reaching the optical detectors 26 may generate an undesirable sinusoidal response on an optical detector that is configured to measure light from the ear. This undesirable sinusoidal noise response may be generated as an earbud user moves their head from side to side while running. Thus, Channel A of the adaptive filter 200 (FIG. 13) may include physiological information plus undesired ambient optical noise information. To remove this noise from the final output Channel C, the output of the optical detector configured to measure ambient optical noise may be an input (Channel B of FIG. 13) into the adaptive filter 200. In this way, ambient noise from Channel A may be removed to generate a mostly physiological signal in Channel C.

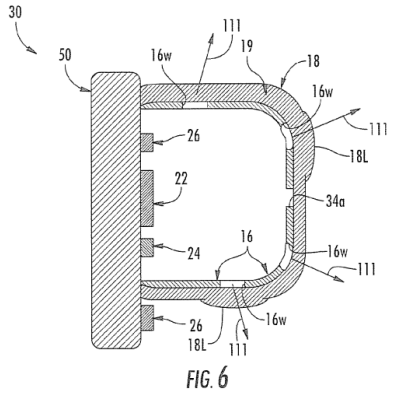
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	LeBoeuf at [0152] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	LeBoeuf discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. The optical detectors 26 positioned outside the earbud housing 16 of the earbud 30 of FIGS. 7A-7B collect scattered light from an ear originating from inspection light 111 generated by the flexible optical emitter 24. The flexible optical emitter 24 may be mounted to the earbud base 50 through one or more electrical connectors 24 a. In some embodiments, these may be soldered, wired, or detachable connectors. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical emitters and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. For example, these flexible devices may include an organic LED (OLED) and an organic optical detector circuit. This embodiment may be useful for generating a diffuse light beam towards the ear region and for detecting a diffuse optical scatter response from the ear region. In some embodiments, the emitter and detector on the flexible optical emitter 24 may be a traditional light-emitting diode (LED) and photodetector (PD) integrated onto a flexible printed circuit board. In other embodiments, transparent solid state optical emitters, detectors, or switches may be used. For example, an electrically controlled liquid crystal matrix may be embedded within an earbud, covering the flexible optical emitter 24. This may allow localized control of light flow to selected areas from/to the earbud going towards/away-from the ear. Additionally, this may allow localized control of light wavelength to selected areas. LeBoeuf at [0122]

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	In some embodiments, as illustrated in FIG. 8D, the earbud housing 16 may contain a material that reflects one or more wavelengths of light and transmits one or more wavelengths of light. For example, the earbud housing 16 may be comprised of a polymer, plastic, glass, composite material, or resin that reflects visible wavelengths and transmits IR wavelengths. Exemplary materials include color absorbing materials, such as organic dyes, found in photographic film. Alternatively, the earbud housing 16 may include an optical filter region, such as a Bragg filter or other optical filter layer deposited on one or more sides of the housing region. If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] Thus, the optical scatter signal collected by the detectors 27 d may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). In the same token, the scattered light reaching the optical detectors 27 d may be used to generate a measure of activity. The intensity, phase, and frequency of this scattered light may be related to physical activity. Sinusoidal variations of the heart rate waveform may be counted digitally, by identifying and counting crests and peaks in the waveform, to generate an effective step count. Embodiments of the present invention, however, are not limited to the illustrated location of components in the sensor module 70. Various types and orientations of components may be utilized without limitation. LeBoeuf at [0139] In some cases, it may be important to remove the effects of ambient optical noise from the physiological signal of a light-guiding earbud 30. In such cases, one or more optical detectors 26 may be configured to measure outdoor or ambient lighting, and this information may be fed back into the processor 602 (FIG. 17) to extract external optical noise from the physiological signal. For example, some optical detectors may be configured to measure light from the ear, whereas others may be configured to measure light from the ambient environment, such as sunlight, room light, headlights, or the like. This may be achieved by directing the optical detectors towards and away from the ear, respectively. In a specific example, the ambient light reaching the optical detectors 26 may generate an undesirable sinusoidal response on an

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	optical detector that is configured to measure light from the ear. This undesirable sinusoidal noise response may be generated as an earbud user moves their head from side to side while running. Thus, Channel A of the adaptive filter 200 (FIG. 13) may include physiological information plus undesired ambient optical noise information. To remove this noise from the final output Channel C, the output of the optical detector configured to measure ambient optical noise may be an input (Channel B of FIG. 13) into the adaptive filter 200. In this way, ambient noise from Channel A may be removed to generate a mostly physiological signal in Channel C. LeBoeuf at [0152] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	LeBoeuf discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. A monitoring device configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the device at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at [Abstract] In some embodiments of the present invention, the light-guiding cover may include a lens that is in optical communication with the optical emitter and/or optical detector. The lens may be configured to focus light emitted by the optical emitter and/or to focus collected light toward the optical detector. In some embodiments, multiple lenses may be incorporated into a light-guiding cover.

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	LeBoeuf at [0011] According to some embodiments of the present invention, a monitoring device includes a circular band capable of encircling a finger of a subject, and a base having an optical emitter and an optical detector attached to the circular band. The circular band includes light transmissive material in optical communication with the optical emitter and optical detector that is configured to deliver light from the optical emitter to one or more portions of the finger of the subject and to collect light from one or more portions of the finger of the subject and deliver the collected light to the optical detector. In some embodiments, the circular band includes first and second concentric body portions. LeBoeuf at [0030] In some embodiments, the circular band includes a lens region in optical communication with the optical emitter that focuses light emitted by the optical emitter and/or that collects light reflected from a finger. In some embodiments the circular band includes a phosphor-containing region in optical communication with the light Transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. LeBoeuf at [0031] According to some embodiments of the present invention, a monitoring device configured to be attached to the body of a subject includes a base having an optical emitter and an optical detector, and light transmissive material attached to the base. The light transmissive material is in optical communication with the optical emitter and optical detector and is configured to deliver light from the optical emitter to one or more portions of the body of the subject and to collect light from one or more portions of the body of the subject and deliver the collected light to the optical detector. The light transmissive material may include adhesive material in one or more locations that is configured to adhesively secure the device to the body of the subject. LeBoeuf at [0034] The term “body” refers to the body of a subject (human or animal) that may wear a headset incorporating one or more light-guiding earbuds, according to embodiments of the present invention.

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	LeBoeuf at [0083] Secondary circuit board 32 may also include a temperature sensor, such as a thermopile 28 mounted thereto. The thermopile 28 is oriented so as to point towards the tympanic membrane within the ear of a subject wearing the headset 10 through the acoustic orifices 34 a, 34 b in the earbud housing 16 and cover 18, respectively. The secondary circuit board 32 may be in electrical contact with the main circuit board 20 via soldering, connectors, wiring, or the like. A battery 36, such as a lithium polymer battery or other portable battery, may be mounted to the main circuit board 20 and may be charged via a USB charge port 38. Although not shown in FIG. 1, an ear hook may be attached to the base 12 or housing 14 to help stabilize the earbud 30 and headset 10 worn by a subject and such that the earbud 30 is consistently placed at the same location within the ear canal of a subject.\ LeBoeuf at [0094] The cover 18 includes light Transmissive material in a portion 19 thereof that is referred to as a light-guiding region. The light Transmissive material in light-guiding region 19 is in optical communication with the optical emitter 24 and detectors 26. The light Transmissive material in light-guiding region 19 is configured to deliver light from the optical emitter 24 into an ear canal of the subject at one or more predetermined locations and to collect light external to the earbud 30 and deliver the collected light to the optical detectors 26. As such, the earbud 30 of the illustrated headset 10 is referred to as a “light-guiding” earbud 30. LeBoeuf at [0096] In some embodiments, the light Transmissive material in the light-guiding region 19 may include a lens (e.g., lens 18L illustrated in FIG. 6). The lens 18L is in optical communication with the optical emitter 24 and/or with the optical detectors 26. For example, a lens 18L may be configured to focus light emitted by the optical emitter 24 onto one or more portions of an ear and/or to focus collected light on the light detectors 26. Lenses are described below with respect to FIGS. 5-6. LeBoeuf at [0097] The illustrated cover 18 of FIG. 1 includes an alignment member 40 (also referred to as a stabilization arm) that facilitates alignment of the earbud 30 within an ear canal of a subject. The alignment member

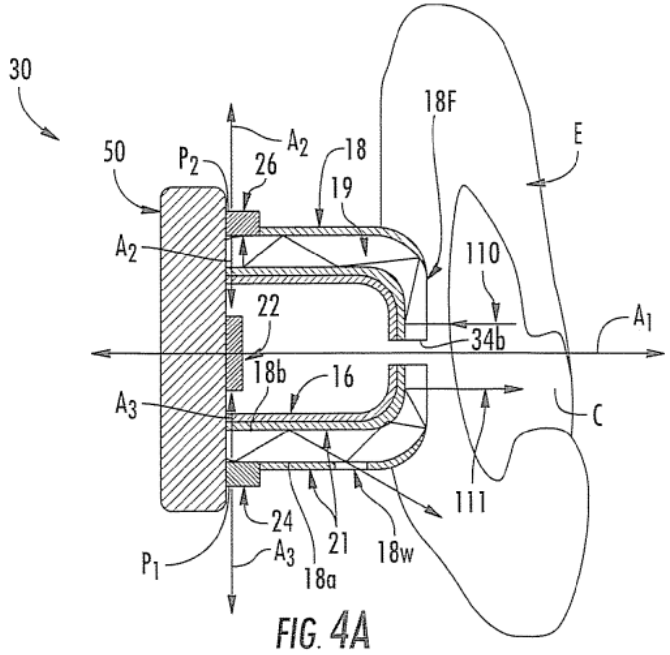
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	40 may facilitate stable measurements of optical scattered light from the ear region, which can be important for PPG measurements and tympanic temperature measurements. LeBoeuf at [0099]  FIG. 6 LeBoeuf at Fig. 6 It may be beneficial to extend the light-guiding region 19 of the cover 18 near the location where the earbud 30 rests near the antitragus. This light-guide extension 19 a serves as an additional light-coupling region and may improve optical coupling from the light-guiding region 19 to an ear region and/or improve optical coupling from an ear region to the light-guiding region 19, including the antitragus and portions of the acoustic meatus. This is because this extended light-guiding region 19 a may provide skin contact between the light guiding layer 19 and the skin, providing better optomechanical stability and optical coupling. In this embodiment, light may couple into the extended light-guiding region 19 a, from an optical emitter 24, and into the ear region. Similarly, light may couple from the ear region, into the extended light-guiding region 19 a, and to the optical detector 26. This extended light-guiding region 19 a may appear as a bulb or lens near the bottom of the earbud cover 18. LeBoeuf at [0135] 1. A headset, comprising: a base comprising a speaker, an optical emitter, and an optical detector;

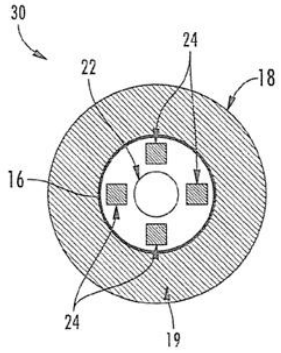
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	an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, wherein the earbud housing is in acoustical communication with the speaker and comprises at least one aperture through which sound from the speaker can pass; and a cover surrounding the earbud housing, wherein the cover includes at least one aperture through which sound from the speaker can pass, and wherein the cover comprises light transmissive material in optical communication with the optical emitter and detector, wherein the light transmissive material is configured to deliver light from the optical emitter into an ear region of the subject at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-Transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.	See claim 1 above. LeBoeuf discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non- Transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.. In some embodiments, the headset may include various electronic components secured to the base. For example, the headset may include one or more environmental sensors configured to detect and/or measure environmental conditions in a vicinity of the headset. The headset may include a signal processor configured to receive and process signals produced by the optical detector. For example, in some embodiments, a signal processor may be configured to extract secondary optical energy and remove optical noise or environmental noise. The headset may include a signal processor configured to receive and process signals produced by the one or more environmental sensors. In addition, the headset may include a transmitter configured to transmit signals processed by the signal processor to a remote device

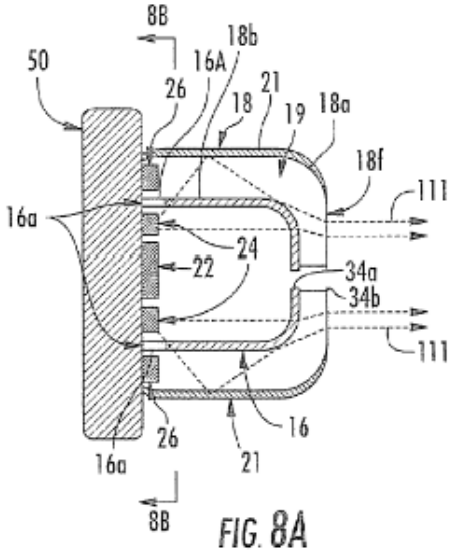
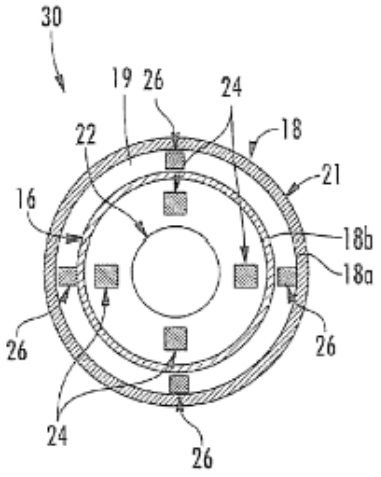
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	in real time. Headsets according to embodiments of the present invention may utilize, for example, Bluetooth®, Wi-Fi, ZigBee, or other wireless transmitters. LeBoeuf at [0007] The term “real-time” is used to describe a process of sensing, processing, or transmitting information in a time frame which is equal to or shorter than the minimum timescale at which the information is needed. For example, the real-time monitoring of pulse rate may result in a single average pulse-rate measurement every minute, averaged over 30 seconds, because an instantaneous pulse rate is often useless to the end user. Typically, averaged physiological and environmental information is more relevant than instantaneous changes. Thus, in the context of the present invention, signals may sometimes be processed over several seconds, or even minutes, in order to generate a “real-time” response. LeBoeuf at [0080] The term “monitoring” refers to the act of measuring, quantifying, qualifying, estimating, sensing, calculating, interpolating, extrapolating, inferring, deducing, or any combination of these actions. More generally, “monitoring” refers to a way of getting information via one or more sensing elements. For example, “blood health monitoring” includes monitoring blood gas levels, blood hydration, and metabolite/electrolyte levels. LeBoeuf at [0081] Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD), compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092] The main circuit board 20 and secondary circuit board 32 may also support one or more sensor modules (not shown) that contain various physiological and/or environmental sensors. For example, a sensor

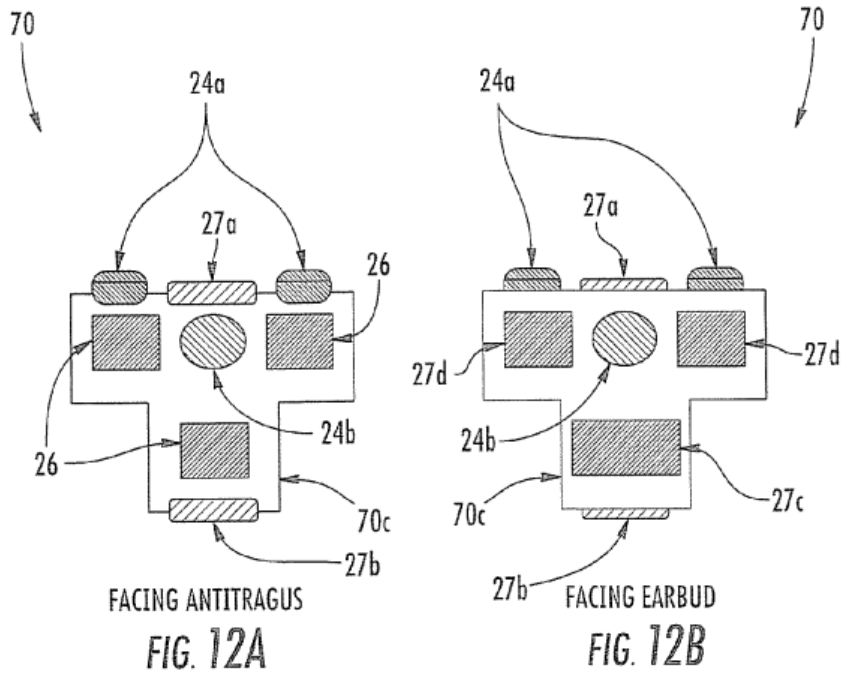
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	module, such as sensor module 70 illustrated in FIGS. 12A-12B, may be attached to the circuit boards 20, 32. The circuit boards 20, 32 also may include at least one signal processor (not shown), at least one wireless module (not shown) for communicating with a remote device, and/or at least one memory storage device (not shown). An exemplary wireless module may include a wireless chip, antenna, or RFID tag. In some embodiments, the wireless module may include a low-range wireless chip or chipset, such as a Bluetooth® or ZigBee chip. These electronic components may be located on the main circuit board 20, or on another circuit board, such as the secondary circuit board 32, attached to the main circuit board. LeBoeuf at [0093] 32. An earbud for a headset, comprising a chipset having at least one sensor element, noise source element, signal processor, input/output line, digital control, and power regulator. LeBoeuf at Claim 32 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	
6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	See claim 1 above. LeBoeuf discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. FIG. 8A is a side section view of a light-guiding earbud for a headset, according to some embodiments of the present invention. LeBoeuf at [0048] FIG. 8B is a cross-sectional view of the earbud of FIG. 8A taken along lines 8B-8B.

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	LeBoeuf at [0049] Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD), compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092] The cover 18 includes light transmissive material in a portion 19 thereof that is referred to as a light-guiding region. The light transmissive material in light-guiding region 19 is in optical communication with the optical emitter 24 and detectors 26. The light transmissive material in light-guiding region 19 is configured to deliver light from the optical emitter 24 into an ear canal of the subject at one or more predetermined locations and to collect light external to the earbud 30 and deliver the collected light to the optical detectors 26. As such, the earbud 30 of the illustrated headset 10 is referred to as a “light-guiding” earbud 30. LeBoeuf at [0096]

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	 FIG. 4A LeBoeuf at Fig. 4A In the embodiment of FIG. 4A, the light-guiding earbud 30 is configured for optical coupling that is substantially perpendicular to the light guide (i.e., cover 18). The optical detector 26 and optical emitter 24 are configured to detect and generate light substantially perpendicular to the light-guiding region 19 of the light guide 18. For example, the light guide 18 defines an axial direction A1. The optical emitter 24 and optical detector 26 are each oriented such that their respective primary emitting and detecting planes P1, P2 are each facing a respective direction A3, A2 that is substantially perpendicular to direction A1. The orientation of the optical emitter 24 and optical detector 26 in FIG. 4A may be convenient for manufacturing purposes, where side-emitting LEDs and side-detecting photodetectors can couple directly to the light-guiding region 19 for generating light 111 and detecting light 110. This may relax size constraints for an earbud 30 because the dimensions of the light-guiding region 19 may be independent of the optical emitter 24 and optical detector 26. LeBoeuf at [0108]

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	 FIG. 9B LeBoeuf at Fig. 9B Referring now to FIGS. 8A-8B, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an earbud housing 16 extending outwardly from the base 50 that is configured to be positioned within an ear of a subject, and a cover 18 that surrounds the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the speaker 22 can pass. The cover 18 includes at least one aperture 34 b through which sound from the speaker 22 can pass. The cover 18 includes a cladding material 21 on the outer surface 18 a thereof, except at end portion 18 f, as illustrated. In the illustrated embodiment, there is no cladding material on the cover inner surface 18 b. The housing 16 is in contact with the cover inner surface 18 b and serves as a cladding layer to define the light guiding region 19. The cover 18 with the illustrated cladding material 18 c serves as a light guide that delivers light from the optical emitters 24 into an ear canal of a subject through cover end portion 18 f. The cover 18 also collects light through end portion 18 f and delivers the collected light to the optical detectors 26. Various configurations and arrangements of optical emitters and detectors may be utilized in accordance with embodiments of the present invention. LeBoeuf at [0123] In some embodiments, as illustrated in FIG. 8C, the earbud housing 16 may be at least partially reflective to scatter light within the cavity defined by the earbud housing 16. In such case, the optical energy 111 may exit the earbud 30 through apertures 34 a, 34 b in the housing 16 and cover 18. An

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	advantage of this configuration is that light 111 can be focused on a particular region of the ear where a particular physiological activity may be located. Also, this configuration may reduce unwanted optical signals from regions that may not be relevant to the physiological activity of interest. Although FIG. 8C shows the apertures 34 a, 34 b positioned toward the tympanic membrane, the apertures 34 a, 34 b may be located at one or more other locations about the earbud 30. For example, an aperture may be formed in the housing 16 and cover 18 at the location where the earbud 30 contacts the antitragus of an ear to allow optical energy 111 to interrogate the antitragus region of the ear. LeBoeuf at [0125]  FIG. 8A  FIG. 8B LeBoeuf at Figs. 8A & 8B Referring now to FIGS. 9A-9B, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an earbud housing 16 extending outwardly from the base 50 that is configured to be positioned within an ear of a subject, and a cover 18 surrounding the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one

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	aperture 34 a through which sound from the speaker 22 can pass. The cover 18 includes at least one aperture 34 b through which sound from the speaker 22 can pass. A pair of optical emitters 24 are secured to the base 50 and are surrounded by the earbud housing 16, as illustrated. An optical detector 26 is secured to the base 50 and is not surrounded by the earbud housing 16, as illustrated. The cover 18 serves as a light guide that delivers light from the optical emitters 24 into an ear canal of a subject. LeBoeuf at [0127]  LeBoeuf at Fig. 12A-12B FIGS. 12A-12B illustrate respective opposite sides of a sensor module 70 that may be located near the periphery of an earbud 30, for example as illustrated in FIGS. 11A-11B, according to some embodiments of the present invention. Sensor module 70 may include a number of electronic components capable of converting various forms of energy into an electrical signal and digitizing the signal. For example, the sensor module 70 may include light-emitting diodes, optical sensors, accelerometers, capacitive sensors,

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	inertial sensors, mechanical sensors, electromagnetic sensors, thermal sensors, nuclear radiation sensors, biological sensors, and the like. In some embodiments, the optical emitters of this invention may be a combination of side-emitting, edge-emitting, or surface-emitting light-emitting diodes (LEDs) or laser diodes (LDs). LeBoeuf at [0136] The optical detectors 26 and emitters 24 may be of multiple wavelengths, with the goal of providing specialized physiological information for each wavelength. Referring to FIG. 19, for example, violet or UV light may be used to measure motion-related aspects of the ear, as violet and UV light may not penetrate greatly through the skin of the ear. Green, red, andc IR wavelengths may have deeper penetration and provide information on the blood vessels and blood analyte levels. Blue wavelengths may be particularly useful for gauging changes in the size of the blood vessels. LeBoeuf at [0153] In some embodiments, multiple light emitters 24 may be utilized. For example, light emitters of different wavelengths may be utilized. In some embodiments, multiple light detectors may be utilized that are configured to measure light at different wavelengths (e.g., light detectors 26 and 26′ may be configured to measure light at different wavelengths). LeBoeuf at [0163] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart	See claim 6 above. LeBoeuf discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless Transmitter, a

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phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless Transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. In some embodiments, the headset may include various electronic components secured to the base. For example, the headset may include one or more environmental sensors configured to detect and/or measure environmental conditions in a vicinity of the headset. The headset may include a signal processor configured to receive and process signals produced by the optical detector. For example, in some embodiments, a signal processor may be configured to extract secondary optical energy and remove optical noise or environmental noise. The headset may include a signal processor configured to receive and process signals produced by the one or more environmental sensors. In addition, the headset may include a transmitter configured to transmit signals processed by the signal processor to a remote device in real time. Headsets according to embodiments of the present invention may utilize, for example, Bluetooth®, Wi-Fi, ZigBee, or other wireless transmitters. LeBoeuf at [0007] In some embodiments, an earbud includes one or more sensor modules that includes one or more sensors for sensing physiological information and environmental information, such as noise, for example. As such, the earbud may function as a physiological monitor as well as an environmental monitor. In some embodiments, the earbud may include a microprocessor that is in electrical communication with the sensor module(s). For example, a microprocessor incorporated into an earbud may be configured to execute an adaptive filter algorithm to remove noise from at least one signal generated by a sensor module in the earbud. A microprocessor may also be configured to process information from the one or more sensors to generate a digital output string, wherein the digital output string includes a plurality of physiological and motion-related information. LeBoeuf at [0025] Wireless, Bluetooth®-enabled, and/or other personal communication headsets may be configured to incorporate physiological and/or environmental sensors, according to some embodiments of the present invention. As a specific example, Bluetooth® headsets are typically lightweight, unobtrusive devices that have become widely accepted socially. Moreover, Bluetooth® headsets are cost effective, easy to use, and are often worn by users for most of their waking hours while attending or waiting for cell phone calls. Bluetooth® headsets configured according to embodiments of the present invention are advantageous because they provide a function for the user beyond health monitoring, such as personal

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	communication and multimedia applications, thereby encouraging user compliance. Exemplary physiological and environmental sensors that may be incorporated into a Bluetooth® or other type of headsets include, but are not limited to accelerometers, auscultatory sensors, pressure sensors, humidity sensors, color sensors, light intensity sensors, pressure sensors, etc. LeBoeuf at [0086] Embodiments of the present invention are not limited to headsets that communicate wirelessly. In some embodiments of the present invention, headsets configured to monitor an individual's physiology and/or environment may be wired to a device that stores and/or processes data. In some embodiments, this information may be stored on the headset itself. Furthermore, embodiments of the present invention are not limited to earbuds. In some embodiments, the light-guiding structure may be molded around another part of the body, such as a digit, finger, toe, limb, around the nose or earlobe, or the like. In other embodiments, the light-guiding structure may be integrated into a patch, such as a bandage that sticks on a person's body. LeBoeuf at [0090] The main circuit board 20 and secondary circuit board 32 may also support one or more sensor modules (not shown) that contain various physiological and/or environmental sensors. For example, a sensor module, such as sensor module 70 illustrated in FIGS. 12A-12B, may be attached to the circuit boards 20, 32. The circuit boards 20, 32 also may include at least one signal processor (not shown), at least one wireless module (not shown) for communicating with a remote device, and/or at least one memory storage device (not shown). An exemplary wireless module may include a wireless chip, antenna, or RFID tag. In some embodiments, the wireless module may include a low-range wireless chip or chipset, such as a Bluetooth® or ZigBee chip. These electronic components may be located on the main circuit board 20, or on another circuit board, such as the secondary circuit board 32, attached to the main circuit board. LeBoeuf at [0093] In some embodiments, these may be soldered, wired, or detachable connectors. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical emitters and detectors

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	as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location LeBoeuf at [0122] 39. The device of claim 33, wherein the base comprises a transmitter configured to transmit signals processed by the signal processor to a remote device. LeBoeuf at Claim 39. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. LeBoeuf discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. See above at claim 1[pre] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

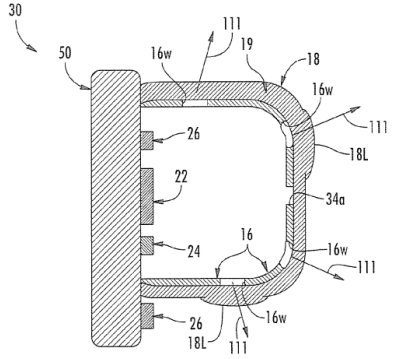
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8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	LeBoeuf discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light;. The optical detectors 26 positioned outside the earbud housing 16 of the earbud 30 of FIGS. 7A-7B collect scattered light from an ear originating from inspection light 111 generated by the flexible optical emitter 24. The flexible optical emitter 24 may be mounted to the earbud base 50 through one or more electrical connectors 24 a. In some embodiments, these may be soldered, wired, or detachable connectors. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical emitters and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. For example, these flexible devices may include an organic LED (OLED) and an organic optical detector circuit. This embodiment may be useful for generating a diffuse light beam towards the ear region and for detecting a diffuse optical scatter response from the ear region. In some embodiments, the emitter and detector on the flexible optical emitter 24 may be a traditional light-emitting diode (LED) and photodetector (PD) integrated onto a flexible printed circuit board. In other embodiments, transparent solid state optical emitters, detectors, or switches may be used. For example, an electrically controlled liquid crystal matrix may be embedded within an earbud, covering the flexible optical emitter 24. This may allow localized control of light flow to selected areas from/to the earbud going towards/away-from the ear. Additionally, this may allow localized control of light wavelength to selected areas. LeBoeuf at [0122] In some embodiments, as illustrated in FIG. 8D, the earbud housing 16 may contain a material that reflects one or more wavelengths of light and transmits one or more wavelengths of light. For example, the earbud housing 16 may be comprised of a polymer, plastic, glass, composite material, or resin that reflects visible wavelengths and transmits IR wavelengths. Exemplary materials include color absorbing materials, such as organic dyes, found in photographic film. Alternatively, the earbud housing 16 may include an optical filter region, such as a Bragg filter or other optical filter layer deposited on one or more sides of the housing region. If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the

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	signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] Thus, the optical scatter signal collected by the detectors 27 d may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). In the same token, the scattered light reaching the optical detectors 27 d may be used to generate a measure of activity. The intensity, phase, and frequency of this scattered light may be related to physical activity. Sinusoidal variations of the heart rate waveform may be counted digitally, by identifying and counting crests and peaks in the waveform, to generate an effective step count. Embodiments of the present invention, however, are not limited to the illustrated location of components in the sensor module 70. Various types and orientations of components may be utilized without limitation. LeBoeuf at [0139] In some cases, it may be important to remove the effects of ambient optical noise from the physiological signal of a light-guiding earbud 30. In such cases, one or more optical detectors 26 may be configured to measure outdoor or ambient lighting, and this information may be fed back into the processor 602 (FIG. 17) to extract external optical noise from the physiological signal. For example, some optical detectors may be configured to measure light from the ear, whereas others may be configured to measure light from the ambient environment, such as sunlight, room light, headlights, or the like. This may be achieved by directing the optical detectors towards and away from the ear, respectively. In a specific example, the ambient light reaching the optical detectors 26 may generate an undesirable sinusoidal response on an optical detector that is configured to measure light from the ear. This undesirable sinusoidal noise response may be generated as an earbud user moves their head from side to side while running. Thus, Channel A of the adaptive filter 200 (FIG. 13) may include physiological information plus undesired ambient optical noise information. To remove this noise from the final output Channel C, the output of the optical detector configured to measure ambient optical noise may be an input (Channel B of FIG. 13) into the adaptive filter 200. In this way, ambient noise from Channel A may be removed to generate a mostly physiological signal in Channel C. LeBoeuf at [0152]

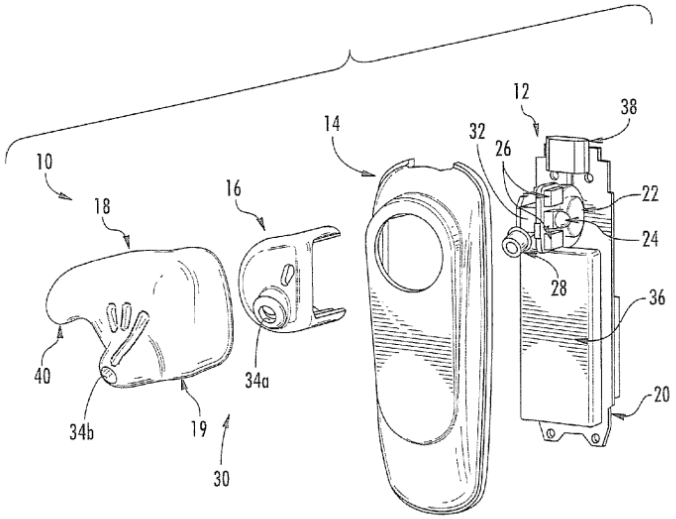
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	LeBoeuf discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. A monitoring device configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the device at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at [Abstract] In some embodiments of the present invention, the light-guiding cover may include a lens that is in optical communication with the optical emitter and/or optical detector. The lens may be configured to focus light emitted by the optical emitter and/or to focus collected light toward the optical detector. In some embodiments, multiple lenses may be incorporated into a light-guiding cover. LeBoeuf at [0011] According to some embodiments of the present invention, a monitoring device includes a circular band capable of encircling a finger of a subject, and a base having an optical emitter and an optical detector attached to the circular band. The circular band includes light transmissive material in optical communication with the optical emitter and optical detector that is configured to deliver light from the optical emitter to one or more portions of the finger of the subject and to collect light from one or more portions of the finger of the subject and deliver the collected light to the optical detector. In some embodiments, the circular band includes first and second concentric body portions.

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	LeBoeuf at [0030] In some embodiments, the circular band includes a lens region in optical communication with the optical emitter that focuses light emitted by the optical emitter and/or that collects light reflected from a finger. In some embodiments the circular band includes a phosphor-containing region in optical communication with the light Transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. LeBoeuf at [0031] According to some embodiments of the present invention, a monitoring device configured to be attached to the body of a subject includes a base having an optical emitter and an optical detector, and light transmissive material attached to the base. The light transmissive material is in optical communication with the optical emitter and optical detector and is configured to deliver light from the optical emitter to one or more portions of the body of the subject and to collect light from one or more portions of the body of the subject and deliver the collected light to the optical detector. The light transmissive material may include adhesive material in one or more locations that is configured to adhesively secure the device to the body of the subject. LeBoeuf at [0034] The term “body” refers to the body of a subject (human or animal) that may wear a headset incorporating one or more light-guiding earbuds, according to embodiments of the present invention. LeBoeuf at [0083] Secondary circuit board 32 may also include a temperature sensor, such as a thermopile 28 mounted thereto. The thermopile 28 is oriented so as to point towards the tympanic membrane within the ear of a subject wearing the headset 10 through the acoustic orifices 34 a, 34 b in the earbud housing 16 and cover 18, respectively. The secondary circuit board 32 may be in electrical contact with the main circuit board 20 via soldering, connectors, wiring, or the like. A battery 36, such as a lithium polymer battery or other portable battery, may be mounted to the main circuit board 20 and may be charged via a USB charge port 38. Although not shown in FIG. 1, an ear hook may be attached to the base 12 or housing 14

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	to help stabilize the earbud 30 and headset 10 worn by a subject and such that the earbud 30 is consistently placed at the same location within the ear canal of a subject.\ LeBoeuf at [0094] The cover 18 includes light Transmissive material in a portion 19 thereof that is referred to as a light-guiding region. The light Transmissive material in light-guiding region 19 is in optical communication with the optical emitter 24 and detectors 26. The light Transmissive material in light-guiding region 19 is configured to deliver light from the optical emitter 24 into an ear canal of the subject at one or more predetermined locations and to collect light external to the earbud 30 and deliver the collected light to the optical detectors 26. As such, the earbud 30 of the illustrated headset 10 is referred to as a “light-guiding” earbud 30. LeBoeuf at [0096] In some embodiments, the light Transmissive material in the light-guiding region 19 may include a lens (e.g., lens 18L illustrated in FIG. 6). The lens 18L is in optical communication with the optical emitter 24 and/or with the optical detectors 26. For example, a lens 18L may be configured to focus light emitted by the optical emitter 24 onto one or more portions of an ear and/or to focus collected light on the light detectors 26. Lenses are described below with respect to FIGS. 5-6. LeBoeuf at [0097] The illustrated cover 18 of FIG. 1 includes an alignment member 40 (also referred to as a stabilization arm) that facilitates alignment of the earbud 30 within an ear canal of a subject. The alignment member 40 may facilitate stable measurements of optical scattered light from the ear region, which can be important for PPG measurements and tympanic temperature measurements. LeBoeuf at [0099]

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	 FIG. 6 LeBoeuf at Fig. 6 It may be beneficial to extend the light-guiding region 19 of the cover 18 near the location where the earbud 30 rests near the antitragus. This light-guide extension 19 a serves as an additional light-coupling region and may improve optical coupling from the light-guiding region 19 to an ear region and/or improve optical coupling from an ear region to the light-guiding region 19, including the antitragus and portions of the acoustic meatus. This is because this extended light-guiding region 19 a may provide skin contact between the light guiding layer 19 and the skin, providing better optomechanical stability and optical coupling. In this embodiment, light may couple into the extended light-guiding region 19 a, from an optical emitter 24, and into the ear region. Similarly, light may couple from the ear region, into the extended light-guiding region 19 a, and to the optical detector 26. This extended light-guiding region 19 a may appear as a bulb or lens near the bottom of the earbud cover 18. LeBoeuf at [0135] 1. A headset, comprising: a base comprising a speaker, an optical emitter, and an optical detector; an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, wherein the earbud housing is in acoustical communication with the speaker and comprises at least one aperture through which sound from the speaker can pass; and a cover surrounding the earbud housing, wherein the cover includes at least one aperture through which sound from the speaker can pass, and wherein the cover comprises light transmissive material in optical communication with the optical emitter and detector, wherein the light transmissive material is

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	configured to deliver light from the optical emitter into an ear region of the subject at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at Claim 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	LeBoeuf discloses or renders obvious a detector. Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, optical emitter 24, optical detectors 26, and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, optical emitter 24, optical detectors 26, and thermopile 28. Collectively, the earbud housing 16, cover 18, and various electronic components (e.g., speaker 22, optical emitter 24, optical detectors 26, thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30. LeBoeuf at [0091]

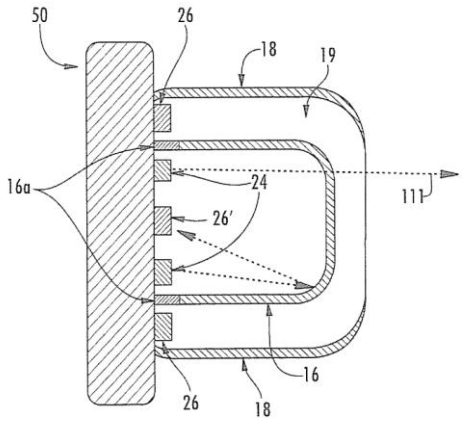
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	 FIG. 1 LeBoeuf at Fig. 1. Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD), compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092] The cover 18 includes light transmissive material in a portion 19 thereof that is referred to as a light-guiding region. The light transmissive material in light-guiding region 19 is in optical communication with the optical emitter 24 and detectors 26. The light transmissive material in light-guiding region 19 is configured to deliver light from the optical emitter 24 into an ear canal of the subject at one or more predetermined locations and to collect light external to the earbud 30 and deliver the collected light to the optical detectors 26. As such, the earbud 30 of the illustrated headset 10 is referred to as a “light-guiding” earbud 30.

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	LeBoeuf at [0096] If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] A sensor module 70 is located near the earbud periphery, as illustrated. This sensor module 70 is shown in more detail in FIGS. 12 a-12B, and is described below. Three benefits of locating the sensor module 70 near the periphery of the light-guiding earbud 30 are: 1) PPG signals near the antitragus are less corrupted by motion artifacts than are PPG signals in other blood-vessel-rich regions of the ear; 2) the sensor module 70 may be designed somewhat independently of the earbud 30, liberating earbud comfort maximization from PPG signal maximization; and 3) because design constraints may be liberated, sensors need not be located in the acoustic cavity (i.e., within the earbud housing 16), allowing sound to pass through the acoustic orifices 34 a, 34 b with minimal interference. In this embodiment, it may be beneficial to incorporate lenses within the cover 18, similar to the lenses 18L of FIG. 6. It may be beneficial to extend the light-guiding region 19 of the cover 18 near the location where the earbud 30 rests near the antitragus. This light-guide extension 19 a serves as an additional light-coupling region and may improve optical coupling from the light-guiding region 19 to an ear region and/or improve optical coupling from an ear region to the light-guiding region 19, including the antitragus and portions of the acoustic meatus. This is because this extended light-guiding region 19 a may provide skin contact between the light guiding layer 19 and the skin, providing better optomechanical stability and optical coupling. In this embodiment, light may couple into the extended light-guiding region 19 a, from an optical emitter 24, and into the ear region. Similarly, light may couple from the ear region, into the extended light-guiding region 19 a, and to the optical detector 26. This extended light-guiding region 19 a may appear as a bulb or lens near the bottom of the earbud cover 18. LeBoeuf at [0135]

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	FIGS. 12A-12B illustrate respective opposite sides of a sensor module 70 that may be located near the periphery of an earbud 30, for example as illustrated in FIGS. 11A-11B, according to some embodiments of the present invention. Sensor module 70 may include a number of electronic components capable of converting various forms of energy into an electrical signal and digitizing the signal. LeBoeuf at [0136] FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring transmitted wavelengths. The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140] As previously described, the optical scatter signal collected by the detectors 27 *d* may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). This is because light detected by these detectors would come from light that has not been scattered by a physiological region but rather light that has been scattered from a region of the associated earpiece that may move along with the ear. Thus, the scattered light reaching the optical detectors 27 *d* may be used to generate a measure of activity. LeBoeuf at [0142] In some cases, it may be important to remove the effects of ambient optical noise from the physiological signal of a light-guiding earbud 30. In such cases, one or more optical detectors 26 may be configured to measure outdoor or ambient lighting, and this information may be fed back into the processor 602 (FIG. 17) to extract external optical noise from the physiological signal. For example, some optical detectors may be configured to measure light from the ear, whereas others may be configured to measure light from the ambient environment, such as sunlight, room light, headlights, or the like. This may be achieved

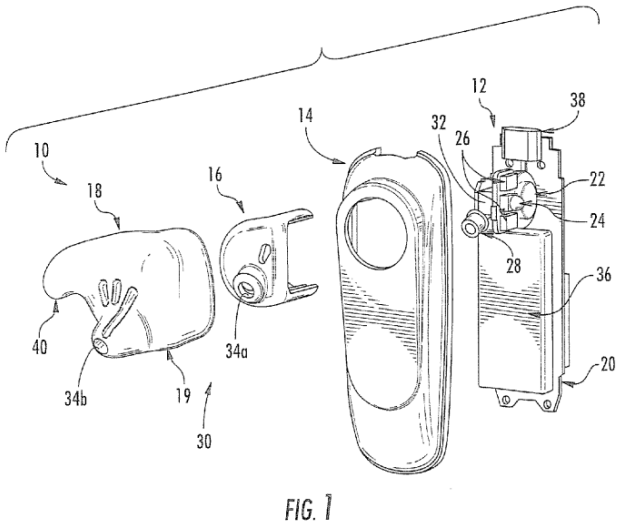
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	by directing the optical detectors towards and away from the ear, respectively. In a specific example, the ambient light reaching the optical detectors 26 may generate an undesirable sinusoidal response on an optical detector that is configured to measure light from the ear. This undesirable sinusoidal noise response may be generated as an earbud user moves their head from side to side while running. Thus, Channel A of the adaptive filter 200 (FIG. 13) may include physiological information plus undesired ambient optical noise information. To remove this noise from the final output Channel C, the output of the optical detector configured to measure ambient optical noise may be an input (Channel B of FIG. 13) into the adaptive filter 200. In this way, ambient noise from Channel A may be removed to generate a mostly physiological signal in Channel C. LeBoeuf at [0152] The optical detectors 26 and emitters 24 may be of multiple wavelengths, with the goal of providing specialized physiological information for each wavelength. Referring to FIG. 19, for example, violet or UV light may be used to measure motion-related aspects of the ear, as violet and UV light may not penetrate greatly through the skin of the ear. Green, red, and IR wavelengths may have deeper penetration and provide information on the blood vessels and blood analyte levels. Blue wavelengths may be particularly useful for gauging changes in the size of the blood vessels. LeBoeuf at [0153] Embodiments of the present invention may be more generally applied to non-optical or mix-optical configurations. For example, one or more of the detectors 26 and emitters 24 may be mechanical, acoustical, electrical, gravimetric, or nuclear detectors and emitters, all providing physiological information to the processor 602 (FIG. 17). For example, an accelerometer or capacitor may be used as a detector 26 for the noise reference (Channel B) input of an adaptive filter running in real-time on the processor 602. LeBoeuf at [0154] Referring to FIG. 20, a chipset 800 for use in light-guiding earbuds 30, according to some embodiments of the present invention, may include optical emitters, optical detectors, mechanical, acoustical, electrical, gravimetric, nuclear detectors, additional sensors, signal processing, power regulation, digital control, and input/output lines. The chipset 800 may include firmware for signal extraction and for generating physiological assessments from information derived from the sensors and noise sources. One

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	benefit of the chipset configuration is that the chipset 800 may be fully or partially integrated and hence compact and scalable to a wide range of products. To be integrated with a light-guiding earbud 30, the chipset 800 may be aligned such that the sensor region has an exposed window to a subject's ear. For example, the chipset 800 may be attached to the earbud base 50 or an earbud sensor module 70 and aligned line-of-sight through an acoustic orifice of an earbud and/or through a transparent end portion of an earbud 30 (e.g., through end portion 18 f of the earbud 30 of FIGS. 8A-8B or 18 w of FIGS. 4 & 5). LeBoeuf at [0155] According to other embodiments of the present invention, monitoring devices with light-guiding regions may be configured to be attached to earlobes, fingers, toes, other digits, etc. For example, FIGS. 22A-22B illustrate a monitoring device 70 that is configured to fit over a finger F, for example, as a finger ring, according to some embodiments of the present invention. The illustrated monitoring device 70 includes a generally circular band capable of encircling a finger F of a subject, with a cylindrical outer body portion 72 and a generally cylindrical inner body portion 74 secured together in concentric relationship. The outer body portion may be formed from virtually any type of material and may have an ornamental configuration. In some embodiments, the outer body portion 72 may include a flex circuit containing various electronic components, such as a microprocessor, D/A converter, power source, power regulator, and the like. However, in some embodiments, the outer body portion 72 may not be required and the circular band of the monitoring device 70 includes only the inner body portion 74 secured to the base 50 (described below). LeBoeuf at [0157]

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	 FIG 8D LeBoeuf at Fig. 8D In some embodiments, multiple light emitters 24 may be utilized. For example, light emitters of different wavelengths may be utilized. In some embodiments, multiple light detectors may be utilized that are configured to measure light at different wavelengths (e.g., light detectors 26 and 26′ may be configured to measure light at different wavelengths). LeBoeuf at [0163] Referring now to FIG. 23, a monitoring device 70′, according to some embodiments of the present invention, may be configured to be attached to a body of a subject as a bandage or “band-aid”. The illustrated monitoring device 70′ includes an outer layer or body portion 72 and an inner layer or body portion 74 secured together, as illustrated. The outer body portion may be formed from virtually any type of material and may have an ornamental configuration. In some embodiments, the outer body portion 72 may include a flex circuit containing various electronic components, such as a microprocessor, D/A converter, power source, power regulator, and the like. However, in some embodiments, the outer body portion 72 may not be required and the monitoring device 70′ includes only the inner body portion 74 secured to the base 50 (described below). LeBoeuf at [0164]

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	LeBoeuf discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. A monitoring device configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the device at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at [Abstract] In some embodiments, the headset may include various electronic components secured to the base. For example, the headset may include one or more environmental sensors configured to detect and/or measure environmental conditions in a vicinity of the headset. The headset may include a signal processor configured to receive and process signals produced by the optical detector. For example, in some embodiments, a signal processor may be configured to extract secondary optical energy and remove optical noise or environmental noise. The headset may include a signal processor configured to receive and process signals produced by the one or more environmental sensors. In addition, the headset may include a transmitter configured to transmit signals processed by the signal processor to a remote device in real time. Headsets according to embodiments of the present invention may utilize, for example, Bluetooth®, Wi-Fi, ZigBee, or other wireless transmitters. LeBoeuf at [0007]

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	The physiological sensors of the sensor module may generate a signal that includes physiological information plus noise information. The noise may be removed by combining the physiological information and noise information from the sensor module with noise information from the noise source of the sensor module via an electronic filtering method, such as a signal processing technique. Specific examples of such signal processing techniques include FIR (Finite Impulse Response), IIR (Infinite Impulse Response), informatics, machine learning, and adaptive filter methods. The output of the adaptive filter may be a physiological signal that is wholly or partially free of noise. In some embodiments, motion-related noise from a subject activity such as running may be removed from the physiological plus noise signal generated by a photoplethysmography (PPG) sensor for measuring blood constituent levels or blood flow properties, such as blood oxygen level, VO2, or heart rate. LeBoeuf at [0022] Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, optical emitter 24, optical detectors 26, and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, optical emitter 24, optical detectors 26, and thermopile 28. Collectively, the earbud housing 16, cover 18, and various electronic components (e.g., speaker 22, optical emitter 24, optical detectors 26, thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30. The headset housing 14 is secured to the base 12 and is configured to enclose and protect the various electronic components mounted to the base (e.g., main circuit board 20 and components secured thereto, etc.) from ambient interference (air, humidity, particulates, electromagnetic interference, etc). LeBoeuf at [0091]

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	 FIG. 1 LeBoeuf at Fig. 1 In some embodiments, the light transmissive material in the light-guiding region 19 may include a lens (e.g., lens 18L illustrated in FIG. 6). The lens 18L is in optical communication with the optical emitter 24 and/or with the optical detectors 26. For example, a lens 18L may be configured to focus light emitted by the optical emitter 24 onto one or more portions of an ear and/or to focus collected light on the light detectors 26. Lenses are described below with respect to FIGS. 5-6. LeBoeuf at [0097] The optical detectors 26 positioned outside the earbud housing 16 of the earbud 30 of FIGS. 7A-7B collect scattered light from an ear originating from inspection light 111 generated by the flexible optical emitter 24. The flexible optical emitter 24 may be mounted to the earbud base 50 through one or more electrical connectors 24 a. In some embodiments, these may be soldered, wired, or detachable connectors. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical emitters and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning

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	electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. For example, these flexible devices may include an organic LED (OLED) and an organic optical detector circuit. This embodiment may be useful for generating a diffuse light beam towards the ear region and for detecting a diffuse optical scatter response from the ear region. In some embodiments, the emitter and detector on the flexible optical emitter 24 may be a traditional light-emitting diode (LED) and photodetector (PD) integrated onto a flexible printed circuit board. In other embodiments, transparent solid state optical emitters, detectors, or switches may be used. For example, an electrically controlled liquid crystal matrix may be embedded within an earbud, covering the flexible optical emitter 24. This may allow localized control of light flow to selected areas from/to the earbud going towards/away-from the ear. Additionally, this may allow localized control of light wavelength to selected areas. LeBeouf at [0122] If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] A sensor module 70 is located near the earbud periphery, as illustrated. This sensor module 70 is shown in more detail in FIGS. 12 a-12B, and is described below. Three benefits of locating the sensor module 70 near the periphery of the light-guiding earbud 30 are: 1) PPG signals near the antitragus are less corrupted by motion artifacts than are PPG signals in other blood-vessel-rich regions of the ear; 2) the sensor module 70 may be designed somewhat independently of the earbud 30, liberating earbud comfort maximization from PPG signal maximization; and 3) because design constraints may be liberated, sensors need not be located in the acoustic cavity (i.e., within the earbud housing 16), allowing sound to pass through the acoustic orifices 34 a, 34 b with minimal interference. In this embodiment, it may be beneficial to incorporate lenses within the cover 18, similar to the lenses 18L of FIG. 6. It may be beneficial to extend the light-guiding region 19 of the cover 18 near the location where the earbud 30 rests near the antitragus. This light-guide extension 19 a serves as an additional light-coupling region and may improve optical coupling from the light-guiding region 19 to an ear region and/or improve

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	optical coupling from an ear region to the light-guiding region 19, including the antitragus and portions of the acoustic meatus. This is because this extended light-guiding region 19 a may provide skin contact between the light guiding layer 19 and the skin, providing better optomechanical stability and optical coupling. In this embodiment, light may couple into the extended light-guiding region 19 a, from an optical emitter 24, and into the ear region. Similarly, light may couple from the ear region, into the extended light-guiding region 19 a, and to the optical detector 26. This extended light-guiding region 19 a may appear as a bulb or lens near the bottom of the earbud cover 18. LeBoeuf at [0135] Thus, the optical scatter signal collected by the detectors 27 d may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). In the same token, the scattered light reaching the optical detectors 27 d may be used to generate a measure of activity. The intensity, phase, and frequency of this scattered light may be related to physical activity. Sinusoidal variations of the heart rate waveform may be counted digitally, by identifying and counting crests and peaks in the waveform, to generate an effective step count. Embodiments of the present invention, however, are not limited to the illustrated location of components in the sensor module 70. Various types and orientations of components may be utilized without limitation. LeBeouf at [0139] As previously described, the optical scatter signal collected by the detectors 27 *d* may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). This is because light detected by these detectors would come from light that has not been scattered by a physiological region but rather light that has been scattered from a region of the associated earpiece that may move along with the ear. Thus, the scattered light reaching the optical detectors 27 *d* may be used to generate a measure of activity. LeBoeuf at [0142] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	LeBoeuf discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. In some embodiments, the headset may include various electronic components secured to the base. For example, the headset may include one or more environmental sensors configured to detect and/or measure environmental conditions in a vicinity of the headset. The headset may include a signal processor configured to receive and process signals produced by the optical detector. For example, in some embodiments, a signal processor may be configured to extract secondary optical energy and remove optical noise or environmental noise. The headset may include a signal processor configured to receive and process signals produced by the one or more environmental sensors. In addition, the headset may include a transmitter configured to transmit signals processed by the signal processor to a remote device in real time. Headsets according to embodiments of the present invention may utilize, for example, Bluetooth®, Wi-Fi, ZigBee, or other wireless transmitters. LeBoeuf at [0007] The physiological sensors of the sensor module may generate a signal that includes physiological information plus noise information. The noise may be removed by combining the physiological information and noise information from the sensor module with noise information from the noise source of the sensor module via an electronic filtering method, such as a signal processing technique. Specific examples of such signal processing techniques include FIR (Finite Impulse Response), IIR (Infinite Impulse Response), informatics, machine learning, and adaptive filter methods. The output of the adaptive filter may be a physiological signal that is wholly or partially free of noise. In some embodiments, motion-related noise from a subject activity such as running may be removed from the physiological plus noise signal generated by a photoplethysmography (PPG) sensor for measuring blood constituent levels or blood flow properties, such as blood oxygen level, VO2, or heart rate. LeBoeuf at [0022]

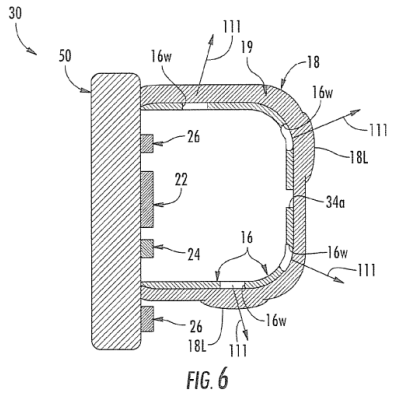
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	The optical detectors 26 positioned outside the earbud housing 16 of the earbud 30 of FIGS. 7A-7B collect scattered light from an ear originating from inspection light 111 generated by the flexible optical emitter 24. The flexible optical emitter 24 may be mounted to the earbud base 50 through one or more electrical connectors 24 a. In some embodiments, these may be soldered, wired, or detachable connectors. In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical emitters and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. For example, these flexible devices may include an organic LED (OLED) and an organic optical detector circuit. This embodiment may be useful for generating a diffuse light beam towards the ear region and for detecting a diffuse optical scatter response from the ear region. In some embodiments, the emitter and detector on the flexible optical emitter 24 may be a traditional light-emitting diode (LED) and photodetector (PD) integrated onto a flexible printed circuit board. In other embodiments, transparent solid state optical emitters, detectors, or switches may be used. For example, an electrically controlled liquid crystal matrix may be embedded within an earbud, covering the flexible optical emitter 24. This may allow localized control of light flow to selected areas from/to the earbud going towards/away-from the ear. Additionally, this may allow localized control of light wavelength to selected areas. LeBeouf at [0122] In some embodiments, as illustrated in FIG. 8D, the earbud housing 16 may contain a material that reflects one or more wavelengths of light and transmits one or more wavelengths of light. For example, the earbud housing 16 may be comprised of a polymer, plastic, glass, composite material, or resin that reflects visible wavelengths and transmits IR wavelengths. Exemplary materials include color absorbing materials, such as organic dyes, found in photographic film. Alternatively, the earbud housing 16 may include an optical filter region, such as a Bragg filter or other optical filter layer deposited on one or more sides of the housing region. If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBeouf at [0126]

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	The earbud-facing side (FIG. 12B) of the sensor module 70 may include sensors that do not need to be located on the antitragus-facing side of the sensor module. For example, one or more inertial sensors 27 c may be located on the earbud-facing side (FIG. 12B) of the sensor module 70. In a particular embodiment, the inertial sensor 27 c may be a 3-axis accelerometer, and because this sensor does not need to optically couple with the ear region, a better use of sensor real estate may be to locate this sensor on the earbud-facing side of the sensor module 70. Additional optical emitters 24 a, 24 b may be located on the earbud-facing side to facilitate an optical noise reference. Namely, as the person wearing the earbud module 30 moves around, the interrogation light generated by the optical emitters 24 a, 24 b may be scattered off the earbud and be detected by optical detectors 27 d. This scattered light intensity, phase, and/or frequency due to body motion may be proportional to the motion-related component of the scattered light intensity from the ear region. The motion-related component is the component due to the physical motion of the ear and not the component related to blood flow. Thus, the optical scatter signal collected by the detectors 27 d may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). In the same token, the scattered light reaching the optical detectors 27 d may be used to generate a measure of activity. The intensity, phase, and frequency of this scattered light may be related to physical activity. Sinusoidal variations of the heart rate waveform may be counted digitally, by identifying and counting crests and peaks in the waveform, to generate an effective step count. Embodiments of the present invention, however, are not limited to the illustrated location of components in the sensor module 70. Various types and orientations of components may be utilized without limitation. LeBoeuf at [0139] FIG. 13 illustrates the basic configuration of an adaptive noise cancellation scheme 200 for extracting a physiological signal from noise. The two types of sensor inputs are represented by the terms “Channel A” and “Channel B”. Channel A refers to inputs from sensors that collect physiological information plus noise information, and Channel B refers to inputs from sensors that collect primarily (or substantially) noise information. Channel B information is passed through an electronic filter 203 whose properties are updated adaptively and dynamically. The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated. It is important to note that the Channel A information can still be useful

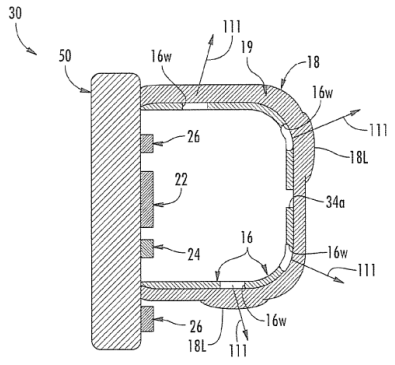
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	despite the presence of noise, and the noise information may still be utilized for the computation of relevant parameters. For instance, the residual noise information in Channel A may be extracted by a parameter estimator 201 and the output in Channel D may be one or more activity assessments or the like. Similarly, the raw noise channel, Channel B, may be post-processed by a parameter estimator 205 to extract activity assessments for Channel E. Activity assessments may include exertion, activity level, distance traveled, speed, step count, pace, limb motion, poise, performance of an activity, mastication rate, intensity, or volume, and the like. The noise cancellation scheme 200 may be integrated into the firmware of a microprocessor or the like. LeBoeuf at [0143] Although the embodiment of FIG. 13 for cancelling motion noise has been presented for an earbud configuration, this does not limit the invention to earbuds. An element of the adaptive noise cancellation scheme 200 for cancelling motion noise with an optical noise source may be that the optical detectors (such as 27 d) are configured such that they do not receive scattered light from a physiological region while the detectors are simultaneously receiving scattered light from a region that is moving in synchronization with the physiological region. Even the slightest physiological signal existing in the optical noise reference of Channel B may prevent the adaptive filter from working properly such that the physiological signal may inadvertently be removed altogether by the filter 203. Furthermore, although the noise source Channel B is described as an optical noise source, other forms of energy may be used in this invention. Namely, any inertial sensor input may constitute the input for Channel B. More specifically, a sensor for measuring changes in capacitance along the earbud with respect to the ear may provide an inertial noise reference without also measuring physiological information. Similarly, an accelerometer may provide an inertial noise reference without also measuring physiological information. An inductive sensor may also provide an inertial noise reference without also measuring physiological information. For each noise source, a defining element may be that the noise source may be configured to measure physical motion only (or mostly) and not physiological information (such as blood flow, blood oxygen, blood pressure, and the like). The utility of an optical noise source is that because the optical signal Channel A and the optical noise Channel B have the same linearity response, the adaptive filter scheme 200 may be more effective than the case where the signal and noise channels operate via different forms of sensed energy. For example, the response linearity characteristics of an accelerometer sensor in response to inertial changes may not be the same as the response linearity characteristics of an optical sensor. LeBoeuf at [0144]

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	The adaptive noise cancellation scheme 200 for cancelling motion noise with an optical source (specifically an infrared LED) has been demonstrated in the laboratory, with a human wearing a light-guiding earbud while resting, jogging, and running over a treadmill, and various data summaries 300 a-300 d are presented in FIGS. 14A-14D. LeBoeuf at [0145] In some cases, it may be important to remove the effects of ambient optical noise from the physiological signal of a light-guiding earbud 30. In such cases, one or more optical detectors 26 may be configured to measure outdoor or ambient lighting, and this information may be fed back into the processor 602 (FIG. 17) to extract external optical noise from the physiological signal. For example, some optical detectors may be configured to measure light from the ear, whereas others may be configured to measure light from the ambient environment, such as sunlight, room light, headlights, or the like. This may be achieved by directing the optical detectors towards and away from the ear, respectively. In a specific example, the ambient light reaching the optical detectors 26 may generate an undesirable sinusoidal response on an optical detector that is configured to measure light from the ear. This undesirable sinusoidal noise response may be generated as an earbud user moves their head from side to side while running. Thus, Channel A of the adaptive filter 200 (FIG. 13) may include physiological information plus undesired ambient optical noise information. To remove this noise from the final output Channel C, the output of the optical detector configured to measure ambient optical noise may be an input (Channel B of FIG. 13) into the adaptive filter 200. In this way, ambient noise from Channel A may be removed to generate a mostly physiological signal in Channel C. LeBoeuf at [0152] In some embodiments, multiple light emitters 24 may be utilized. For example, light emitters of different wavelengths may be utilized. In some embodiments, multiple light detectors may be utilized that are configured to measure light at different wavelengths (e.g., light detectors 26 and 26′ may be configured to measure light at different wavelengths). In this way, either optical detector may be configured to measure light mostly due to motion (such as finger motion) or to measure light mostly due to physiological processes and motion. For example, if the windows 74 w incorporate IR-pass filters, visible light will not pass through the windows 74 w and the light will be scattered to the photodetectors 26 and 26′. Or, if the two illustrated blocking regions 80 are in place, and if photodetector 26′ is configured to measure only visible light and photodetector 26 is configured to measure only IR light, then only the

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	photodetector 26′ will detect scattered visible light. As this visible scattered light cannot reach the finger, the scatter intensity measured by optical detector 26′ may be indicative of motion and not physiological activity. LeBoeuf at [0163] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	LeBoeuf discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user. In some embodiments of the present invention, the light-guiding cover may include a lens that is in optical communication with the optical emitter and/or optical detector. The lens may be configured to focus light emitted by the optical emitter and/or to focus collected light toward the optical detector. In some embodiments, multiple lenses may be incorporated into a light-guiding cover. LeBoeuf at [0011] In some embodiments, the circular band includes a lens region in optical communication with the optical emitter that focuses light emitted by the optical emitter and/or that collects light reflected from a finger. In some embodiments the circular band includes a phosphor-containing region in optical communication with the light Transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. LeBoeuf at [0031]

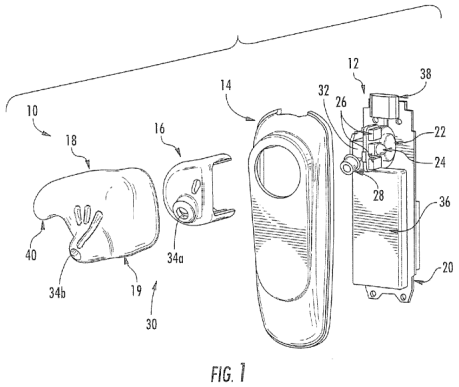
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	The cover 18 includes light Transmissive material in a portion 19 thereof that is referred to as a light-guiding region. The light Transmissive material in light-guiding region 19 is in optical communication with the optical emitter 24 and detectors 26. The light Transmissive material in light-guiding region 19 is configured to deliver light from the optical emitter 24 into an ear canal of the subject at one or more predetermined locations and to collect light external to the earbud 30 and deliver the collected light to the optical detectors 26. As such, the earbud 30 of the illustrated headset 10 is referred to as a “light-guiding” earbud 30. LeBoeuf at [0096] In some embodiments, the light Transmissive material in the light-guiding region 19 may include a lens (e.g., lens 18L illustrated in FIG. 6). The lens 18L is in optical communication with the optical emitter 24 and/or with the optical detectors 26. For example, a lens 18L may be configured to focus light emitted by the optical emitter 24 onto one or more portions of an ear and/or to focus collected light on the light detectors 26. Lenses are described below with respect to FIGS. 5-6. LeBoeuf at [0097]  FIG. 6 LeBoeuf at Fig. 6 It may be beneficial to extend the light-guiding region 19 of the cover 18 near the location where the earbud 30 rests near the antitragus. This light-guide extension 19 a serves as an additional light-coupling region and may improve optical coupling from the light-guiding region 19 to an ear region and/or

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	improve optical coupling from an ear region to the light-guiding region 19, including the antitragus and portions of the acoustic meatus. This is because this extended light-guiding region 19 a may provide skin contact between the light guiding layer 19 and the skin, providing better optomechanical stability and optical coupling. In this embodiment, light may couple into the extended light-guiding region 19 a, from an optical emitter 24, and into the ear region. Similarly, light may couple from the ear region, into the extended light-guiding region 19 a, and to the optical detector 26. This extended light-guiding region 19 a may appear as a bulb or lens near the bottom of the earbud cover 18. LeBoeuf at [0135] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.	LeBoeuf discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user. In some embodiments of the present invention, the light-guiding cover may include a lens that is in optical communication with the optical emitter and/or optical detector. The lens may be configured to focus light emitted by the optical emitter and/or to focus collected light toward the optical detector. In some embodiments, multiple lenses may be incorporated into a light-guiding cover. LeBoeuf at [0011] In some embodiments, the circular band includes a lens region in optical communication with the optical emitter that focuses light emitted by the optical emitter and/or that collects light reflected from a finger. In some embodiments the circular band includes a phosphor-containing region in optical communication with the light Transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. LeBoeuf at [0031]

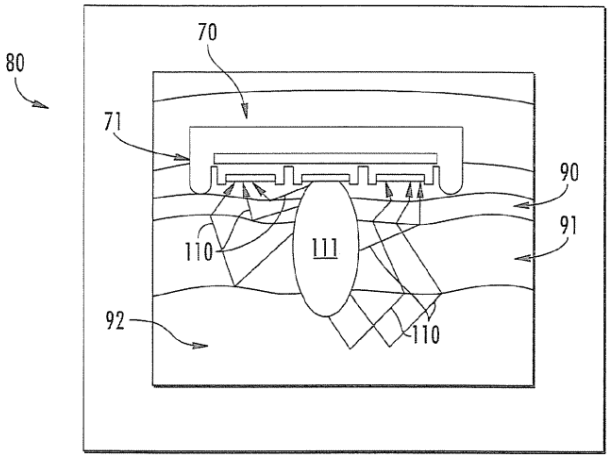
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	The cover 18 includes light Transmissive material in a portion 19 thereof that is referred to as a light-guiding region. The light Transmissive material in light-guiding region 19 is in optical communication with the optical emitter 24 and detectors 26. The light Transmissive material in light-guiding region 19 is configured to deliver light from the optical emitter 24 into an ear canal of the subject at one or more predetermined locations and to collect light external to the earbud 30 and deliver the collected light to the optical detectors 26. As such, the earbud 30 of the illustrated headset 10 is referred to as a “light-guiding” earbud 30. LeBoeuf at [0096] In some embodiments, the light Transmissive material in the light-guiding region 19 may include a lens (e.g., lens 18L illustrated in FIG. 6). The lens 18L is in optical communication with the optical emitter 24 and/or with the optical detectors 26. For example, a lens 18L may be configured to focus light emitted by the optical emitter 24 onto one or more portions of an ear and/or to focus collected light on the light detectors 26. Lenses are described below with respect to FIGS. 5-6. LeBoeuf at [0097]  FIG. 6 LeBoeuf at Fig. 6 It may be beneficial to extend the light-guiding region 19 of the cover 18 near the location where the earbud 30 rests near the antitragus. This light-guide extension 19 a serves as an additional light-coupling

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	region and may improve optical coupling from the light-guiding region 19 to an ear region and/or improve optical coupling from an ear region to the light-guiding region 19, including the antitragus and portions of the acoustic meatus. This is because this extended light-guiding region 19 a may provide skin contact between the light guiding layer 19 and the skin, providing better optomechanical stability and optical coupling. In this embodiment, light may couple into the extended light-guiding region 19 a, from an optical emitter 24, and into the ear region. Similarly, light may couple from the ear region, into the extended light-guiding region 19 a, and to the optical detector 26. This extended light-guiding region 19 a may appear as a bulb or lens near the bottom of the earbud cover 18. LeBoeuf at [0135] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. LeBoeuf discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. A monitoring device configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light Transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the device at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. LeBoeuf at [Abstract]

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	According to some embodiments of the present invention, a headset configured to be attached to the ear of a person includes a base, an earbud housing extending outwardly from the base that is configured to be positioned within an ear of a subject, and a cover surrounding the earbud housing. The base includes a speaker, an optical emitter, and an optical detector. The cover includes light Transmissive material that is in optical communication with the optical emitter and the optical detector and serves as a light guide to deliver light from the optical emitter into the ear canal of the subject wearing the headset at one or more predetermined locations and to collect light external to the earbud housing and deliver the collected light to the optical detector. The optical emitter, via the light-guiding cover, directs optical energy towards a particular region of ear and the optical detector detects secondary optical energy emanating from the ear region. In some embodiments, the optical detector may include an optical filter configured to pass secondary optical energy at selective wavelengths. In some embodiments, the light Transmissive material of the cover may be configured, for example via the use of cladding and/or light reflective material, such that the cover serves as a light guide that is coupled in parallel to the optical emitter and detector. In some embodiments, the light Transmissive material of the cover may be configured, for example via the use of cladding and/or light reflective material, such that the cover serves as a light guide that is coupled perpendicular to the optical emitter and detector. LeBoeuf at [0006] In some embodiments, the circular band includes a lens region in optical communication with the optical emitter that focuses light emitted by the optical emitter and/or that collects light reflected from a finger. In some embodiments the circular band includes a phosphor-containing region in optical communication with the light Transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. LeBoeuf at [0031] Referring to FIG. 1, a headset 10 according to some embodiments of the present invention is illustrated. The illustrated headset 10 includes a base 12, a headset housing 14, an earbud housing 16, and a cover 18 that surrounds the earbud housing 16. The base 12 includes a main circuit board 20 that supports and/or is connected to various electronic components. In the illustrated embodiment, a speaker 22, optical emitter 24, optical detectors 26, and thermopile 28 (described below) are mounted onto a secondary circuit board 32 which is secured to the main circuit board 20. The earbud housing surrounds the speaker 22, optical emitter 24, optical detectors 26, and thermopile 28. Collectively, the earbud housing 16, cover

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	18, and various electronic components (e.g., speaker 22, optical emitter 24, optical detectors 26, thermopile 28) located within the earbud housing 16 of the illustrated headset 10 may be referred to as an earbud 30. The headset housing 14 is secured to the base 12 and is configured to enclose and protect the various electronic components mounted to the base (e.g., main circuit board 20 and components secured thereto, etc.) from ambient interference (air, humidity, particulates, electromagnetic interference, etc). LeBoeuf at [0091]  FIG. 1 LeBoeuf at Fig. 1 In the embodiments of FIGS. 4B-4D, the optical energy 110 coming from the ear may include optical wavelengths, such as IR wavelengths, emitting from the tympanic membrane due to black body radiation. If the optical detector 26 is configured to measure this black body radiation, then the earbud can be used to measure tympanic temperature, blood analyte levels, neurological, electrical activity, or metabolic activity of the earbud wearer. LeBoeuf at [0112] In some embodiments, as illustrated in FIG. 8D, the earbud housing 16 may contain a material that reflects one or more wavelengths of light and transmits one or more wavelengths of light. For example, the earbud housing 16 may be comprised of a polymer, plastic, glass, composite material, or resin that reflects visible wavelengths and transmits IR wavelengths. Exemplary materials include color absorbing materials, such as organic dyes, found in photographic film. Alternatively, the earbud housing

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	16 may include an optical filter region, such as a Bragg filter or other optical filter layer deposited on one or more sides of the housing region. If an optical detector 26′ is configured to measure visible wavelengths only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring Transmitted wavelengths. The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains one or more optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140]

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	 FIG. 19 LeBoeuf at Fig. 19 The optical detectors 26 and emitters 24 may be of multiple wavelengths, with the goal of providing specialized physiological information for each wavelength. Referring to FIG. 19, for example, violet or UV light may be used to measure motion-related aspects of the ear, as violet and UV light may not penetrate greatly through the skin of the ear. Green, red, and IR wavelengths may have deeper penetration and provide information on the blood vessels and blood analyte levels. Blue wavelengths may be particularly useful for gauging changes in the size of the blood vessels. LeBoeuf at [0153] In the illustrated embodiment, windows 74 w are formed in the cladding material 21 and serve as light-guiding interfaces to the finger F. There may be any number of these windows, as may be required for sufficient optical coupling, and the windows 74 w may include lenses such as those described above (e.g., lens 18L illustrated in FIG. 6), to focus light emitted by the optical emitter 24 onto one or more portions of a finger F and/or to focus collected light on the light detectors 26, 26′. Similarly, the windows 74 w may include optical filters to selectively pass one or more optical wavelengths and reflect and/or absorb other optical wavelengths.

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	LeBoeuf at [0161] In some embodiments, multiple light emitters 24 may be utilized. For example, light emitters of different wavelengths may be utilized. In some embodiments, multiple light detectors may be utilized that are configured to measure light at different wavelengths (e.g., light detectors 26 and 26′ may be configured to measure light at different wavelengths). LeBoeuf at [0163] In the illustrated embodiment, windows 74 w are formed in the cladding material 21 and serve as light-guiding interfaces to the body of a subject. There may be any number of these windows, as may be required for sufficient optical coupling, and the windows 74 w may include lenses such as those described above (e.g., lens 18L illustrated in FIG. 6), to focus light emitted by the optical emitter 24 onto one or more portions of the body of a subject and/or to focus collected light on the light detectors 26, 26′. Similarly, the windows 74 w may include optical filters to selectively pass one or more optical wavelengths and reflect and/or absorb other optical wavelengths. LeBoeuf at [0168] In the illustrated embodiment, the light-guiding region 19 includes a light blocking member 80 that isolates light emitter 24 and light detector 26 from each other. In some embodiments, multiple light emitters 24 may be utilized. For example, light emitters of different wavelengths may be utilized. In some embodiments, multiple light detectors may be utilized that are configured to measure light at different wavelengths (e.g., light detectors 26 and 26′ may be configured to measure light at different wavelengths). LeBoeuf at [0169] 36. The device of claim 33, wherein the circular band comprises a phosphor-containing region in optical communication with the light transmissive material, wherein the phosphor-containing region receives light emitted by the optical emitter and converts at least a portion of the received light to light having a different wavelength from the received light. LeBoeuf at Claim 36

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. LeBoeuf discloses or renders obvious the physiological parameter of the user is associated with a blood constituent or a blood flow of the user. In some embodiments, the headset may include various electronic components secured to the base. For example, the headset may include one or more environmental sensors configured to detect and/or measure environmental conditions in a vicinity of the headset. The headset may include a signal processor configured to receive and process signals produced by the optical detector. For example, in some embodiments, a signal processor may be configured to extract secondary optical energy and remove optical noise or environmental noise. The headset may include a signal processor configured to receive and process signals produced by the one or more environmental sensors. In addition, the headset may include a Transmitter configured to Transmit signals processed by the signal processor to a remote device in real time. Headsets according to embodiments of the present invention may utilize, for example, Bluetooth®, Wi-Fi, ZigBee, or other wireless Transmitters. LeBoeuf at [0007] Light directed into the ear of a subject from a light emitter and the subsequent collection of light at a light detector, according to embodiments of the present invention, may be utilized for detecting and/or measuring, among other things, body temperature, skin temperature, blood gas levels, muscle tension, heart rate, blood flow, cardiopulmonary functions, etc. LeBoeuf at [0010] In some embodiments of the present invention, an earbud may integrate a sensor module containing a plurality of sensor elements for measuring physiological information and at least one noise source for

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	measuring noise information. A “noise source”, as used herein, refers to a sensor, such as an optical sensor, inertial sensor, electrically conductive sensor, capacitive sensor, inductive sensor, etc., and derives it name from the fact that it is a source of input to a filter, such as an adaptive filter described below. LeBoeuf at [0021] The physiological sensors of the sensor module may generate a signal that includes physiological information plus noise information. The noise may be removed by combining the physiological information and noise information from the sensor module with noise information from the noise source of the sensor module via an electronic filtering method, such as a signal processing technique. Specific examples of such signal processing techniques include FIR (Finite Impulse Response), IIR (Infinite Impulse Response), informatics, machine learning, and adaptive filter methods. The output of the adaptive filter may be a physiological signal that is wholly or partially free of noise. In some embodiments, motion-related noise from a subject activity such as running may be removed from the physiological plus noise signal generated by a photoplethysmography (PPG) sensor for measuring blood constituent levels or blood flow properties, such as blood oxygen level, VO2, or heart rate. LeBoeuf at [0022] Physiological sensors that may be incorporated into headsets and/or earbuds, according to some embodiments of the present invention, may be configured to detect and/or measure one or more of the following types of physiological information: heart rate, pulse rate, breathing rate, blood flow, VO2, VO2max, heartbeat signatures, cardio-pulmonary health, organ health, metabolism, electrolyte type and/or concentration, physical activity, caloric intake, caloric metabolism, blood metabolite levels or ratios, blood pH level, physical and/or psychological stress levels and/or stress level indicators, drug dosage and/or dosimetry, physiological drug reactions, drug chemistry, biochemistry, position and/or balance, body strain, neurological functioning, brain activity, brain waves, blood pressure, cranial pressure, hydration level, auscultatory information, auscultatory signals associated with pregnancy, physiological response to infection, skin and/or core body temperature, eye muscle movement, blood volume, inhaled and/or exhaled breath volume, physical exertion, exhaled breath physical and/or chemical composition, the presence and/or identity and/or concentration of viruses and/or bacteria, foreign matter in the body, internal toxins, heavy metals in the body, anxiety, fertility, ovulation, sex hormones, psychological mood, sleep patterns, hunger and/or thirst, hormone type and/or concentration, cholesterol, lipids, blood panel, bone density, organ and/or body weight, reflex response, sexual arousal,

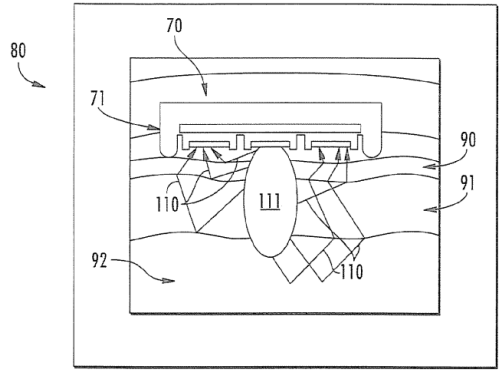
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	mental and/or physical alertness, sleepiness, auscultatory information, response to external stimuli, swallowing volume, swallowing rate, sickness, voice characteristics, voice tone, voice pitch, voice volume, vital signs, head tilt, allergic reactions, inflammation response, auto-immune response, mutagenic response, DNA, proteins, protein levels in the blood, water content of the blood, pheromones, internal body sounds, digestive system functioning, cellular regeneration response, healing response, stem cell regeneration response, etc. LeBoeuf at [0026] Accordingly, some embodiments of the present invention combine a personal communications headset device with one or more physiological and/or environmental sensors. Other embodiments may combine physiological and/or environmental sensors into a headset device. LeBoeuf at [0088] The main circuit board 20 and secondary circuit board 32 may also support one or more sensor modules (not shown) that contain various physiological and/or environmental sensors. For example, a sensor module, such as sensor module 70 illustrated in FIGS. 12A-12B, may be attached to the circuit boards 20, 32. The circuit boards 20, 32 also may include at least one signal processor (not shown), at least one wireless module (not shown) for communicating with a remote device, and/or at least one memory storage device (not shown). An exemplary wireless module may include a wireless chip, antenna, or RFID tag. In some embodiments, the wireless module may include a low-range wireless chip or chipset, such as a Bluetooth® or ZigBee chip. These electronic components may be located on the main circuit board 20, or on another circuit board, such as the secondary circuit board 32, attached to the main circuit board. LeBoeuf at [0093] In some embodiments, as illustrated in FIG. 8D, the earbud housing 16 may contain a material that reflects one or more wavelengths of light and transmits one or more wavelengths of light. For example, the earbud housing 16 may be comprised of a polymer, plastic, glass, composite material, or resin that reflects visible wavelengths and transmits IR wavelengths. Exemplary materials include color absorbing materials, such as organic dyes, found in photographic film. Alternatively, the earbud housing 16 may include an optical filter region, such as a Bragg filter or other optical filter layer deposited on one or more sides of the housing region. If an optical detector 26′ is configured to measure visible wavelengths

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	only, then the optical energy detected by optical detector 26′ may consist primarily of optical energy scattered from the earbud housing 16, and the optical energy detected by the optical detectors 26 may consist of optical energy scattered from the ear region. This configuration may be useful because the signal from the optical detector 26′ may represent motion noise which may be removed from the signal derived from the optical detectors 26, which may contain physiological information and motion noise. LeBoeuf at [0126] The optical energy generated by these optical emitters 24 a, 24 b may be scattered by blood vessels in the ear. This scattered light may be at least partially captured by the optical detectors 26. This light may be digitized by an optical detector 26 itself or with other circuitry on the sensor module circuit board 70 c. The light-guiding design of the aforementioned light-guiding earbuds 30 may direct light towards each of these detectors 26. For example, this may be accomplished via the light-guiding earbud 30, wherein a lens (e.g., 18L, FIG. 6) facilitates inspection light coupling from the optical emitters 24 into the ear region and facilitates scattered light coupling to the optical detectors 26 from the ear region. Additional sensor components 27 a, 27 b may be used to measure an orthogonal energy component, facilitate sensor analysis, and thus help generate physiological assessments. For example, sensor components 27 a, 27 b may be thermal sensors for measuring the temperature of the inner ear (using the thermal sensors 27 a facing the ear region) with respect to the outer ear (using the thermal sensor 27 b facing away from the ear region). By subtracting the two measured digitized temperatures from these two sensors 27 a, 27 b, an indication of heat flow from the ear can be generated. This temperature differential may be mathematically related to metabolic rate. For example, this temperature differential may be directly proportional metabolic rate. These temperature sensors may include thermistors, thermopiles, thermocouples, solid state sensors, or the like. They may be designed to measure thermal conduction, convection, radiation, or a combination of these temperature components. LeBoeuf at [0138] Thus, the optical scatter signal collected by the detectors 27 d may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). In the same token, the scattered light reaching the optical detectors 27 d may be used to generate a measure of activity. The intensity, phase, and frequency of this scattered light may be related to physical activity. Sinusoidal variations of the heart rate waveform may be counted digitally, by identifying and counting crests and peaks in the waveform, to generate an effective step count. Embodiments of the present invention,

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	however, are not limited to the illustrated location of components in the sensor module 70. Various types and orientations of components may be utilized without limitation. LeBeouf at [0139] As previously described, the optical scatter signal collected by the detectors 27 *d* may provide a suitable noise reference for an adaptive filter to remove motion artifacts from the scattered light from the ear region, generating an output signal that is primarily related to blood flow (which may be the desired signal). This is because light detected by these detectors would come from light that has not been scattered by a physiological region but rather light that has been scattered from a region of the associated earpiece that may move along with the ear. Thus, the scattered light reaching the optical detectors 27 *d* may be used to generate a measure of activity. LeBoeuf at [0142] The filter 203 properties are updated to minimize the difference between Channel A and the post-processed Channel B, denoted as $\hat{B}$. In this way, noise is removed from Channel A and Channel C contains predominantly physiological information from which parameters such as blood flow, heart rate, blood analyte levels, breathing rate or volume, blood oxygen levels, and the like may be calculated. It is important to note that the Channel A information can still be useful despite the presence of noise, and the noise information may still be utilized for the computation of relevant parameters. LeBoeuf at [0143] FIG. 15 is a graph of processed physiological signal data from a headset having one or more light-guiding earbuds 30, according to some embodiments of the present invention. Specifically, FIG. 15 shows the analysis results 400 of the data summaries 300 a-300 d presented in FIGS. 14A-14D of blood flow (y-axis) versus time (x-axis) following two data processing sequences to extract heart rate. One sequence incorporated the adaptive filtering process 200 of FIG. 13 as well as a beat finder processing step. The second sequence incorporated the beat finder processing step without the adaptive filtering process 200 of FIG. 13. The beat finder process counts each heart beat by monitoring the peaks and valleys of each pulse, such as the peaks and valleys shown in the graph 300 a of FIG. 14A. As shown in FIG. 15, the beat finder was effective at measuring heart rate during resting and jogging. However, the beat finder alone was not sufficient for monitoring heart rate during running. This is because at high motion, the signal 300 d (FIG. 14D) associated with footsteps is strong enough to overwhelm the smaller signal

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	associated with heart rate, and so the motion-related contribution dominated the overall signal 300 d. Thus, the beat finder cannot distinguish heart beats from footsteps. By employing the adaptive filtering process 200 (FIG. 13) before the beat finder process, the footstep motion artifacts during running were effectively removed from the sensor signal (Channel A of FIG. 13) such that the output signal (Channel C of FIG. 13) contained blood flow information with minimal motion artifacts. Thus, this output signal contained blood flow pulse signals that could then be "counted" by the beat finder to generate an accurate heart rate assessment. LeBoeuf at [0147] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	See claim 8 above. LeBoeuf discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency. Each optical detector 26 may be a photodiode, photodetector, phototransistor, thyristor, solid state device, optical chipset, or the like. The optical emitter 24 may be a light-emitting diode (LED), laser diode (LD), compact incandescent bulb, micro-plasma emitter, IR blackbody source, or the like. The speaker 22 may be a compact speaker, such as an inductive speaker, piezoelectric speaker, electrostatic speaker, or the like. One or more microphones, such as electrets, MEMS, acoustic transducers, or the like, may also be located within the headset housing or earbud housing to pick up speech, physiological sounds, and/or environmental sounds. LeBoeuf at [0092] In some embodiments, the light transmissive material in the light-guiding region 19 may include a lens (e.g., lens 18L illustrated in FIG. 6). The lens 18L is in optical communication with the optical emitter

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	24 and/or with the optical detectors 26. For example, a lens 18L may be configured to focus light emitted by the optical emitter 24 onto one or more portions of an ear and/or to focus collected light on the light detectors 26. Lenses are described below with respect to FIGS. 5-6. LeBoeuf at [0097] The illustrated cover 18 of FIG. 1 includes an alignment member 40 (also referred to as a stabilization arm) that facilitates alignment of the earbud 30 within an ear canal of a subject. The alignment member 40 may facilitate stable measurements of optical scattered light from the ear region, which can be important for PPG measurements and tympanic temperature measurements. LeBoeuf at [0099] The optical emitter 24 generates inspection light 111 and the light-guiding region 19 of the light guide 18 directs the inspection light 111 towards an ear region. This light is called inspection light because it interrogates the surface of the ear, penetrates the skin of the ear, and generates a scattered light response 110 which may effectively inspect blood vessels within the ear region. The optical detector 26 detects scattered light 110 from an ear region and the light-guiding region 19 of the light guide 18 guides the light to the optical detector 26 through the light-guiding region 19, as illustrated. LeBoeuf at [0105] In the embodiment of FIG. 3, the light-guiding earbud 30 is configured for optical coupling that is parallel to the light guide (i.e., cover 18). The optical detector 26 and optical emitter 24 are configured to detect and generate light substantially parallel to the light-guiding region 19 of the light guide 18. For example, the light guide 18 defines an axial direction A1. The optical emitter 24 and optical detector 26 are each oriented such that their respective primary emitting and detecting planes P1, P2 are each facing a respective direction A3, A2 that is substantially parallel with direction A1. LeBoeuf at [0106]

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	 FIG. 19 LeBoeuf at Fig. 19 In some embodiments, the flexible optical emitter 24 may include a flexible optical detector. In some embodiments, the flexible optical emitter 24 may be part of a flexible optical circuit comprising the form-factor of 24 shown in FIGS. 7A-7B, where the flexible optical circuit may include one or more optical emitters and detectors as well as amplifiers, microprocessors, wireless circuitry, and signal conditioning electronics. In some embodiments, the flexible optical circuit may include a complete chipset for physiological and environmental detection and for wired/wireless transfer of data to a remote location. For example, these flexible devices may include an organic LED (OLED) and an organic optical detector circuit. LeBoeuf at [0122] FIG. 19 illustrates the optical interaction between the sensor module 70 of FIGS. 12A-12B and the skin of a subject. The sensor module 70 is shown in a reflective pulse oximetry setup 80 where reflected wavelengths 110 are measured, as opposed to measuring transmitted wavelengths. The optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include ultraviolet, visible, and infrared wavelengths. In the illustrated embodiment, an optical source-detector assembly 71 is integrated into sensor module 70 to generate optical wavelengths 111 and monitor the resulting scattered optical energy 110. The optical source-detector assembly 71 contains one or more

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	optical sources emitting one or more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. LeBoeuf at [0140] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBoeuf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading

U.S. Pat. No. 12,268,475 in view of U.S. Pat. No. 8,108,036 to Bao Tran ("Tran")

As described in detail below, Tran (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

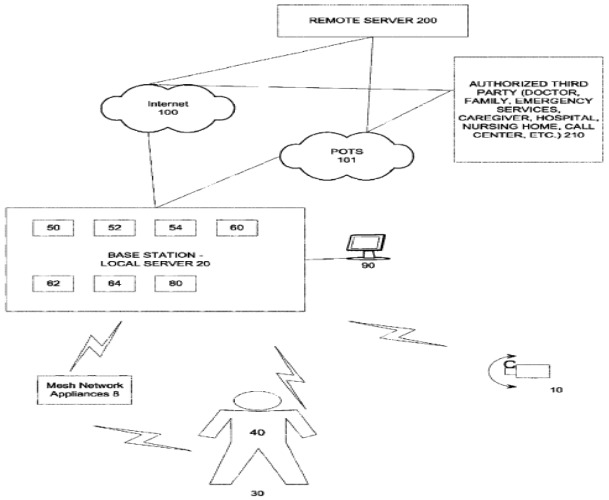
The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Tran. The cited portions of Tran are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Tran. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Tran "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Tran does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Tran (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Tran anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

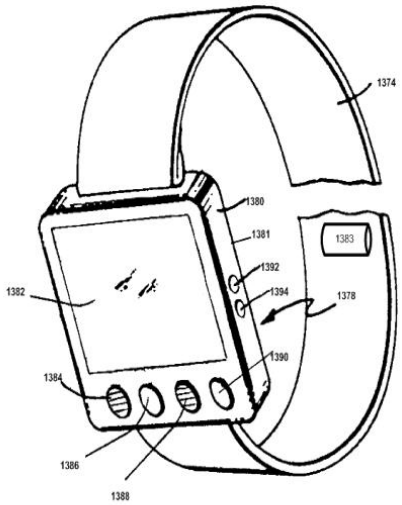
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

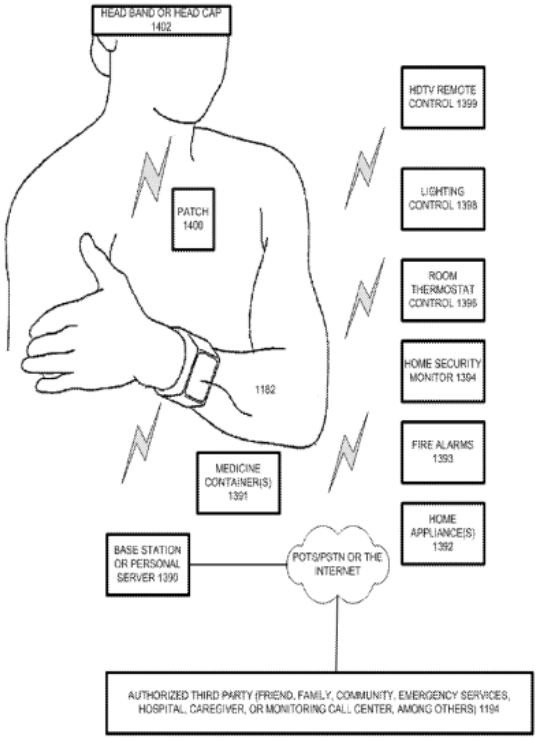
’475 Patent	Tran
Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Tran discloses or renders obvious An apparatus adapted to be worn by a user comprising. A heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at [Abstract] In another aspect, heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at 3:6-13 In another aspect, a health care monitoring system for a person includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a sound transducer coupled to the wireless transceiver; and a bioelectric impedance (BI) sensor coupled to the wireless mesh network to communicate BI data over the wireless mesh network. In a further aspect, a heart monitoring system for a person includes one or more wireless nodes forming a wireless mesh network and a wearable appliance having a sound transducer coupled to the wireless transceiver; and a heart disease recognizer coupled to the sound transducer to determine cardiovascular health and to transmit heart sound over the wireless mesh network to a remote listener if the recognizer identifies a cardiovascular problem. The heart sound being transmitted may be compressed to save transmission bandwidth. Tran at 3:18-33 In yet another aspect, a monitoring system for a person includes one or more wireless nodes forming a wireless mesh network; and a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a heartbeat detector coupled to the wireless transceiver. The

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	system may also include an accelerometer to detect a dangerous condition such as a falling condition and to generate a warning when the dangerous condition is detected. Tran at 3:40-47 The wearable appliance is small, easily worn by the patient during periods of exercise or day-to-day activities, and noninvasively measures blood pressure can be done in a matter of seconds without affecting the patient. An on-board or remote processor can analyze the time-dependent measurements to generate statistics on a patient's blood pressure (e.g., average pressures, standard deviation, beat-to-beat pressure variations) that are not available with conventional devices that only measure systolic and diastolic blood pressure at isolated times. The wearable appliance provides an in-depth, cost-effective mechanism to evaluate a patient's cardiac condition. Certain cardiac conditions can be controlled, and in some cases predicted, before they actually occur. Moreover, data from the patient can be collected and analyzed while the patient participates in their normal, day-to-day activities. Tran at 4:62-5:10 In yet another embodiment, a wireless housing provides one or more bioelectric contacts conveniently positioned to collect bioelectric patient data. The housing can be a patch, a wristwatch, a band, a wristband, a chest band, a leg band, a sock, a glove, a foot pad, a head-band, an ear-clip, an ear 35 phone, a shower-cap, an armband, an ear-ring, eye-glasses, sun-glasses, a belt, a sock, a shirt, a garment, a jewelry, a bed spread, a pillow cover, a pillow, a mattress, a blanket or a sleeping garment such as a pajama. Tran at 7:31-39 FIG. 1 shows an exemplary patient monitoring system. The system can operate in a home, a nursing home, or a hospital. In this system, one or more mesh network appliances 8 are provided to enable wireless communication in the home monitoring system. Appliances 8 in the mesh network can include home security monitoring devices, door alarm, window alarm, home temperature control devices, fire alarm devices, among others. Appliances 8 in the mesh network can be one of multiple portable physiological transducer, such as a blood pressure monitor, heart rate monitor, weight scale, thermometer, spirometer, single or multiple lead electrocardiograph (ECG), a pulse oxymeter, a body fat monitor, a cholesterol monitor, a signal from a medicine cabinet, a signal from a drug container, a signal from a commonly used appliance such as a refrigerator/stove/oven/washer, or a signal from an exercise machine, such as a heart rate. As will be discussed in more detail below, one appliance is a patient monitoring device that can be worn by the patient and includes a single or bi-directional wireless

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	communication link, generally identified by the bolt symbol in FIG. 1, for transmitting data from the appliances 8 to the local hub or receiving station or base station server 20 by way of a wireless radio frequency (RF) link using a proprietary or non-proprietary protocol. For example, within a house, a user may have mesh network appliances that detect window and door contacts, smoke detectors and motion sensors, video cameras, key chain control, temperature monitors, CO and other gas detectors, vibration sensors, and others. A user may have flood sensors and other detectors on a boat. An individual, such as an ill or elderly grandparent, may have access to a panic transmitter or other alarm transmitter. Other sensors and/or detectors may also be included. The user may register these appliances on a central security network by entering the identification code for each registered appliance/device and/or system. The mesh network can be Zigbee network or 802.15 network. More details of the mesh network is shown in FIG. 7 and discussed in more detail below. Tran at 8:29-65 The patient 30 may wear one or more wearable patient monitoring appliances such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance such as a wrist-watch includes sensors 40, for example devices for sensing ECG, EKG, blood pressure, sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient's wrist (such as a wristwatch sensor) and other convenient anatomical locations. Exemplary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascular system (ECG). Tran at 9:23-34

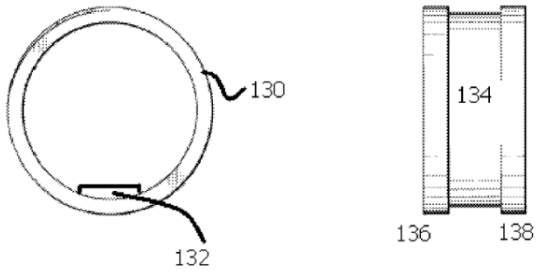
’475 Patent	Tran
	 FIG. 1 Tran at Fig. 1 The wearable appliance is small, easily worn by the patient during periods of exercise or day-to-day activities, and noninvasively measures blood pressure can be done in a matter of seconds without affecting the patient. An on-board or remote processor can analyze the time-dependent measurements to generate statistics on a patient's blood pressure (e.g., average pressures, standard deviation, beat-to-beat pressure variations) that are not available with conventional devices that only measure systolic and diastolic blood pressure at isolated times. The wearable appliance provides an in-depth, cost-effective mechanism to evaluate a patient's health condition. Certain cardiac conditions can be controlled, and in some cases predicted, before they actually occur. Moreover, data from the patient can be collected and analyzed while the patient participates in their normal, day-to-day activities. Tran at 25:20-35 The wearable appliance has an indoor positioning system and processes these signals to determine a location (e.g., latitude, longitude, and altitude) of the monitor and, presumably, the patient. This location could be plotted on a map by the server, and used to locate a patient during an emergency, e.g. to dispatch an ambulance.

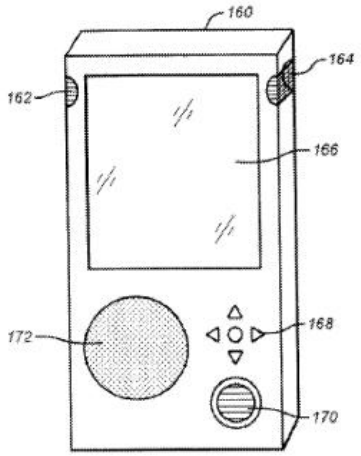
’475 Patent	Tran
	Tran at 26:11-16 The base station 20 frequently collects and synchronizes data from the appliances 8. The base station 20 may use one of various transportation methods to connect to the repository on the server 200 using a PC as conduit or through a connection established using an embedded modem (connected to a phone line), a wireless router (DSL or cable wireless router), a cellular modem, or another network-connected appliance (such as, but not limited to, a web-phone, video-phone, embedded computer, PDA or handheld computer). Tran at 27:9-17  FIG. 6A Tran at Fig. 6a FIG. 6A shows a portable embodiment of the present invention where the voice recognizer is housed in a wrist-watch. As shown in FIG. 6, the device includes a wrist-watch sized case 1380 supported on a wrist band 1374. The case 1380 may be of a number of variations of shape but can be conveniently made a rectangular, approaching a box-like configuration. The wrist-band 1374 can be an expansion band or a

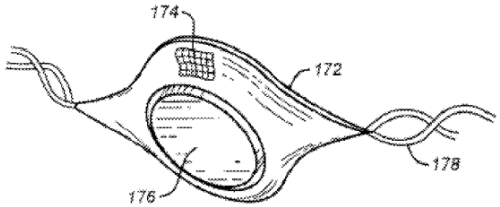
’475 Patent	Tran
	wristwatch strap of plastic, leather or woven material. The processor or CPU of the wearable appliance is connected to a radio frequency (RF) transmitter/receiver (such as a Bluetooth device, a Zigbee device, a WiFi device, a WiMAX device, or an 802.X transceiver, among others. Tran at 34:41-52  FIG. 6B Tran at Fig. 6b FIG. 6B shows an exemplary mesh network working with the wearable appliance of FIG. 6A. Data collected and communicated on the display 1382 of the watch as well as voice is transmitted to a base station 1390 for communicating over a network to an authorized party 1394. The watch and the base

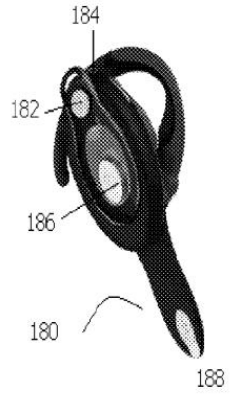
’475 Patent	Tran
	station is part of a mesh network that may communicate with a medicine cabinet to detect opening or to each medicine container 1391 to detect medication compliance. Other devices include mesh network thermometers, scales, or exercise devices. The mesh network also includes a plurality of home/room appliances 1392-1399. The ability to transmit voice is useful in the case the patient has fallen down and cannot walk to the base station 1390 to request help. Hence, in one embodiment, the watch captures voice from the user and transmits the voice over the Zigbee mesh network to the base station 1390. The base station 1390 in turn dials out to an authorized third party to allow voice communication and at the same time transmits the collected patient vital parameter data and identifying information so that help can be dispatched quickly, efficiently and error-free. In one embodiment, the base station 1390 is a POTS telephone base station connected to the wired phone network. In a second embodiment, the base station 1390 can be a cellular telephone connected to a cellular network for voice and data transmission. In a third embodiment, the base station 1390 can be a WiMAX or 802.16 standard base station that can communicate VOIP and data over a wide area network. In one implementation, Zigbee or 802.15 appliances communicate locally and then transmits to the wide area network (WAN) such as the Internet over WiFi or WiMAX. Alternatively, the base station can communicate with the WAN over POTS and a wireless network such as cellular or WiMAX or both. Tran at 42:15-47 In a tetrapolar implementation, two electrodes on the wrist watch or wrist band are used to apply AC or DC constant current into the body or body segment. The voltage signal from the surface of the body is measured in terms of impedance using the same or an additional two electrodes on the watch or wrist band. In a bipolar implementation, one electrode on the wrist watch or wrist band is used to apply AC or DC constant current into the body or body segment. The voltage signal from the surface of the body is measured in terms of impedance using the same or an alternative electrode on the watch or wrist band. The system of FIG. 6B may include a BI patch 1400 that wirelessly communicates BI information with the wrist watch. Other patches 1400 can be used to collect other medical information or vital parameter and communicate with the wrist watch or base station or the information could be relayed through each wireless node or appliance to reach a destination appliance such as the base station, for example. Tran at 43:4-20 In one embodiment, the sensors are mounted on the patient's wrist (such as a wristwatch sensor) and other convenient anatomical locations. Tran at 58:60-62

’475 Patent	Tran
	In one embodiment, the sensors for monitoring vital signs are enclosed in a wrist-watch sized case supported on a wrist band. The sensors can be attached to the back of the case. For example, in one embodiment, Cygnus' AutoSensor (Redwood City, Calif.) is used as a glucose sensor. A low electric current pulls glucose through the skin. Glucose is accumulated in two gel collection discs in the AutoSensor. The AutoSensor measures the glucose and a reading is displayed by the watch. Tran at 59:16-26 In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. Tran at 60:58-62 In an ultrasonic embodiment, a piezo film sensor element is placed on the wristwatch band. Tran at 61:39-40 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40

’475 Patent	Tran
	 FIG. 8 Tan at Fig.8 FIGS. 11 and 12 show two additional embodiments of the monitoring device. In FIG. 11, a wearable monitoring device is shown. The monitoring device has a body 160 comprising microphone ports 162, 164 and 170 arranged in a first order noise cancelling microphone arrangement. The microphones 162 and 164 are configured to optimally receive distant noises, while the microphone 170 is optimized for capturing the user's speech. A touch sensitive display 166 and a plurality of keys 168 are provided to capture hand inputs. Further, a speaker 172 is provided to generate a verbal feedback to the user. Tran at 68:3-13

’475 Patent	Tran
	 FIG. 11 Tran at fig. 11 Turning now to FIG. 12, a jewelry-sized monitoring device is illustrated. In this embodiment, a body 172 houses a microphone port 174 and a speaker port 176. The body 172 is coupled to the user via the necklace 178 so as to provide a personal, highly accessible personal computer. Due to space limitations, voice input/output is an important user interface of the jewelry-sized computer. Although a necklace is disclosed, one skilled in the art can use a number of other substitutes such as a belt, a brace, a ring, or a band to secure the jewelry-sized computer to the user. Tran at 68:14-23

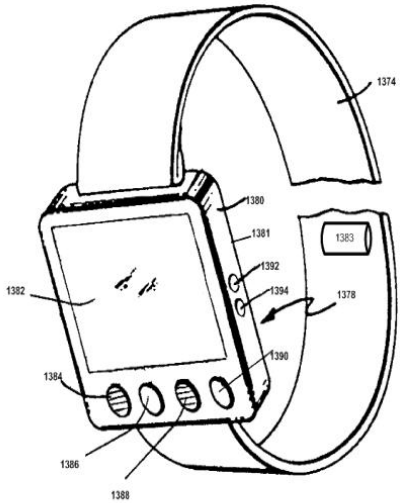
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	 FIG. 12 Tran at fig. 12 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38

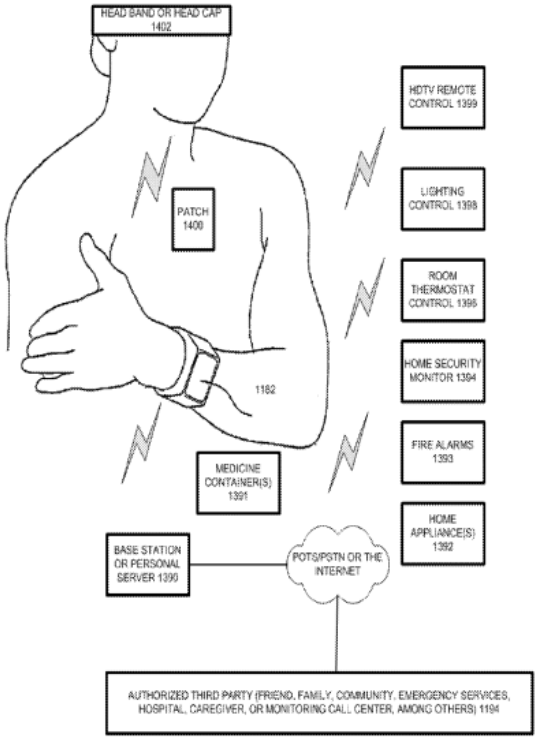
’475 Patent	Tran
	 FIG. 13 Tran at fig. 13 FIG. 14B shows a sunglass or eyeglass embodiment which contains electronics for communicating with the mesh network and for sensing acceleration and bioimpedance, EKG/ ECG, EMG, heart sound, microphone, optical sensor, or ultrasonic sensor in contacts with a wearer's skin. In one embodiment, the ear module 310 contains optical sensors to detect temperature, blood flow and blood oxygen level as well as a speaker to provide wireless communication or hearing aid. Tran at 69:16-24 In one embodiment, the eye wear device of FIG. 14B can provide a data port, wherein the data port is carried by the ear stem. The data port may be a mini-USB connector, a FIREWIRE connector, an IEEE 1394 cable connector, an RS232 connector, a JTAB connector, an antenna, a wireless receiver, a radio, an RF receiver, or a Bluetooth receiver. In another embodiment, the wearable device is removably connectable to a computing device. The wearable wireless audio device may be removably connectable to a computing device with a data port, wherein said data port is mounted to said wearable wireless audio device. In another embodiment, projectors can project images on the glasses to provide headmounted display on the eye wear device. The processor can display fact, figure, to do list, and reminders need in front of the user's eyes. Tran at 69:66-70:13

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	In one embodiment, to determine blood flow velocity, acoustic pulses are generated and transmitted into the artery using an ultrasonic transducer positioned near a wrist artery. Tran at 74:11-13 In one embodiment, a housing (such as a strap, a wristband, or a patch) provides a plurality of sensor contacts for EKG and/or EMG. The same contacts can be used for detecting EKG or EMG and can be placed as two parallel contacts (linear or spot shape) on opposite sides of the band, two adjacent parallel contacts on the inner surface of the band, two parallel adjacent contacts on the back of the wrist-watch, or alternatively one contact on the back of the watch and one contact on the wrist-band. Tran at 92:41-49 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading..
1[a]. one or more biosensors adapted to be placed on the user,	Tran discloses or renders obvious one or more biosensors adapted to be placed on the user, wherein one or more physiological parameters are measured. A heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at [Abstract] In another aspect, heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the

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	statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at 3:6-13 In another aspect, a health care monitoring system for a person includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a sound transducer coupled to the wireless transceiver; and a bioelectric impedance (BI) sensor coupled to the wireless mesh network to communicate BI data over the wireless mesh network. In a further aspect, a heart monitoring system for a person includes one or more wireless nodes forming a wireless mesh network and a wearable appliance having a sound transducer coupled to the wireless transceiver; and a heart disease recognizer coupled to the sound transducer to determine cardiovascular health and to transmit heart sound over the wireless mesh network to a remote listener if the recognizer identifies a cardiovascular problem. The heart sound being transmitted may be compressed to save transmission bandwidth. Tran at 3:18-33 In yet another aspect, a monitoring system for a person includes one or more wireless nodes forming a wireless mesh network; and a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a heartbeat detector coupled to the wireless transceiver. The system may also include an accelerometer to detect a dangerous condition such as a falling condition and to generate a warning when the dangerous condition is detected. Tran at 3:40-47 The wearable appliance is small, easily worn by the patient during periods of exercise or day-to-day activities, and noninvasively measures blood pressure can be done in a matter of seconds without affecting the patient. An on-board or remote processor can analyze the time-dependent measurements to generate statistics on a patient's blood pressure (e.g., average pressures, standard deviation, beat-to-beat pressure variations) that are not available with conventional devices that only measure systolic and diastolic blood pressure at isolated times. The wearable appliance provides an in-depth, cost-effective mechanism to evaluate a patient's cardiac condition. Certain cardiac conditions can be controlled, and in some cases predicted, before they actually occur. Moreover, data from the patient can be collected and analyzed while the patient participates in their normal, day-to-day activities. Tran at 4:62-5:10

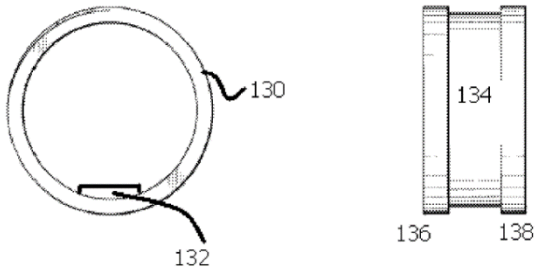
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	In yet another embodiment, a wireless housing provides one or more bioelectric contacts conveniently positioned to collect bioelectric patient data. The housing can be a patch, a wristwatch, a band, a wristband, a chest band, a leg band, a sock, a glove, a foot pad, a head-band, an ear-clip, an ear 35 phone, a shower-cap, an armband, an ear-ring, eye-glasses, sun-glasses, a belt, a sock, a shirt, a garment, a jewelry, a bed spread, a pillow cover, a pillow, a mattress, a blanket or a sleeping garment such as a pajama. Tran at 7:31-39 FIG. 1 shows an exemplary patient monitoring system. The system can operate in a home, a nursing home, or a hospital. In this system, one or more mesh network appliances 8 are provided to enable wireless communication in the home monitoring system. Appliances 8 in the mesh network can include home security monitoring devices, door alarm, window alarm, home temperature control devices, fire alarm devices, among others. Appliances 8 in the mesh network can be one of multiple portable physiological transducer, such as a blood pressure monitor, heart rate monitor, weight scale, thermometer, spirometer, single or multiple lead electrocardiograph (ECG), a pulse oxymeter, a body fat monitor, a cholesterol monitor, a signal from a medicine cabinet, a signal from a drug container, a signal from a commonly used appliance such as a refrigerator/stove/oven/washer, or a signal from an exercise machine, such as a heart rate. As will be discussed in more detail below, one appliance is a patient monitoring device that can be worn by the patient and includes a single or bi-directional wireless communication link, generally identified by the bolt symbol in FIG. 1, for transmitting data from the appliances 8 to the local hub or receiving station or base station server 20 by way of a wireless radio frequency (RF) link using a proprietary or non-proprietary protocol. For example, within a house, a user may have mesh network appliances that detect window and door contacts, smoke detectors and motion sensors, video cameras, key chain control, temperature monitors, CO and other gas detectors, vibration sensors, and others. A user may have flood sensors and other detectors on a boat. An individual, such as an ill or elderly grandparent, may have access to a panic transmitter or other alarm transmitter. Other sensors and/or detectors may also be included. The user may register these appliances on a central security network by entering the identification code for each registered appliance/device and/or system. The mesh network can be Zigbee network or 802.15 network. More details of the mesh network is shown in FIG. 7 and discussed in more detail below. Tran at 8:29-65 The patient 30 may wear one or more wearable patient monitoring appliances such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance such as a wrist-

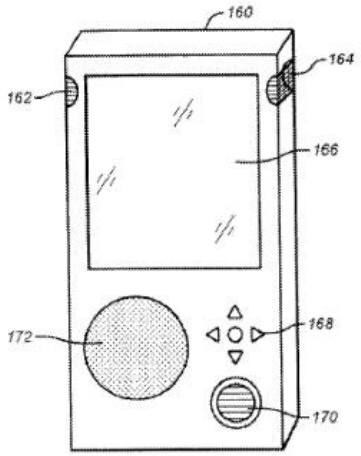
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	watch includes sensors 40, for example devices for sensing ECG, EKG, blood pressure, sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient's wrist (such as a wristwatch sensor) and other convenient anatomical locations. Exemplary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascular system (ECG). Tran at 9:23-34 The base station 20 frequently collects and synchronizes data from the appliances 8. The base station 20 may use one of various transportation methods to connect to the repository on the server 200 using a PC as conduit or through a connection established using an embedded modem (connected to a phone line), a wireless router (DSL or cable wireless router), a cellular modem, or another network-connected appliance (such as, but not limited to, a web-phone, video-phone, embedded computer, PDA or handheld computer). Tran at 27:9-17  FIG. 6A Tran at Fig. 6a

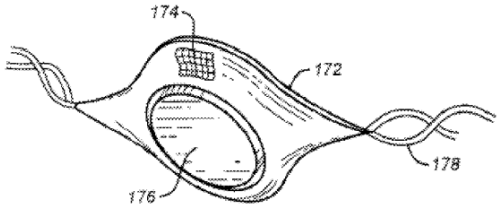
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	FIG. 6A shows a portable embodiment of the present invention where the voice recognizer is housed in a wrist-watch. As shown in FIG. 6, the device includes a wrist-watch sized case 1380 supported on a wrist band 1374. The case 1380 may be of a number of variations of shape but can be conveniently made a rectangular, approaching a box-like configuration. The wrist-band 1374 can be an expansion band or a wristwatch strap of plastic, leather or woven material. The processor or CPU of the wearable appliance is connected to a radio frequency (RF) transmitter/receiver (such as a Bluetooth device, a Zigbee device, a WiFi device, a WiMAX device, or an 802.X transceiver, among others. Tran at 34:41-52  FIG. 6B

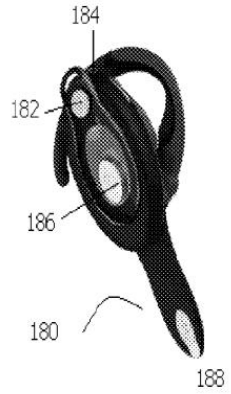
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	Tran at Fig. 6b FIG. 6B shows an exemplary mesh network working with the wearable appliance of FIG. 6A. Data collected and communicated on the display 1382 of the watch as well as voice is transmitted to a base station 1390 for communicating over a network to an authorized party 1394. The watch and the base station is part of a mesh network that may communicate with a medicine cabinet to detect opening or to each medicine container 1391 to detect medication compliance. Other devices include mesh network thermometers, scales, or exercise devices. The mesh network also includes a plurality of home/room appliances 1392-1399. The ability to transmit voice is useful in the case the patient has fallen down and cannot walk to the base station 1390 to request help. Hence, in one embodiment, the watch captures voice from the user and transmits the voice over the Zigbee mesh network to the base station 1390. The base station 1390 in turn dials out to an authorized third party to allow voice communication and at the same time transmits the collected patient vital parameter data and identifying information so that help can be dispatched quickly, efficiently and error-free. In one embodiment, the base station 1390 is a POTS telephone base station connected to the wired phone network. In a second embodiment, the base station 1390 can be a cellular telephone connected to a cellular network for voice and data transmission. In a third embodiment, the base station 1390 can be a WiMAX or 802.16 standard base station that can communicate VOIP and data over a wide area network. In one implementation, Zigbee or 802.15 appliances communicate locally and then transmits to the wide area network (WAN) such as the Internet over WiFi or WiMAX. Alternatively, the base station can communicate with the WAN over POTS and a wireless network such as cellular or WiMAX or both. Tran at 42:15-47 In a tetrapolar implementation, two electrodes on the wrist watch or wrist band are used to apply AC or DC constant current into the body or body segment. The voltage signal from the surface of the body is measured in terms of impedance using the same or an additional two electrodes on the watch or wrist band. In a bipolar implementation, one electrode on the wrist watch or wrist band is used to apply AC or DC constant current into the body or body segment. The voltage signal from the surface of the body is measured in terms of impedance using the same or an alternative electrode on the watch or wrist band. The system of FIG. 6B may include a BI patch 1400 that wirelessly communicates BI information with the wrist watch. Other patches 1400 can be used to collect other medical information or vital parameter and communicate with the wrist watch or base station or the information could be relayed through each wireless node or appliance to reach a destination appliance such as the base station, for example.

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	Tran at 43:4-20 In one embodiment, the sensors are mounted on the patient's wrist (such as a wristwatch sensor) and other convenient anatomical locations. Tran at 58:60-62 In one embodiment, the sensors for monitoring vital signs are enclosed in a wrist-watch sized case supported on a wrist band. The sensors can be attached to the back of the case. For example, in one embodiment, Cygnus' AutoSensor (Redwood City, Calif.) is used as a glucose sensor. A low electric current pulls glucose through the skin. Glucose is accumulated in two gel collection discs in the AutoSensor. The AutoSensor measures the glucose and a reading is displayed by the watch. Tran at 59:16-26 In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. Tran at 60:58-62 In an ultrasonic embodiment, a piezo film sensor element is placed on the wristwatch band. Tran at 61:39-40 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40

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	 FIG. 8 Tan at Fig.8 FIGS. 11 and 12 show two additional embodiments of the monitoring device. In FIG. 11, a wearable monitoring device is shown. The monitoring device has a body 160 comprising microphone ports 162, 164 and 170 arranged in a first order noise cancelling microphone arrangement. The microphones 162 and 164 are configured to optimally receive distant noises, while the microphone 170 is optimized for capturing the user's speech. A touch sensitive display 166 and a plurality of keys 168 are provided to capture hand inputs. Further, a speaker 172 is provided to generate a verbal feedback to the user. Tran at 68:3-13

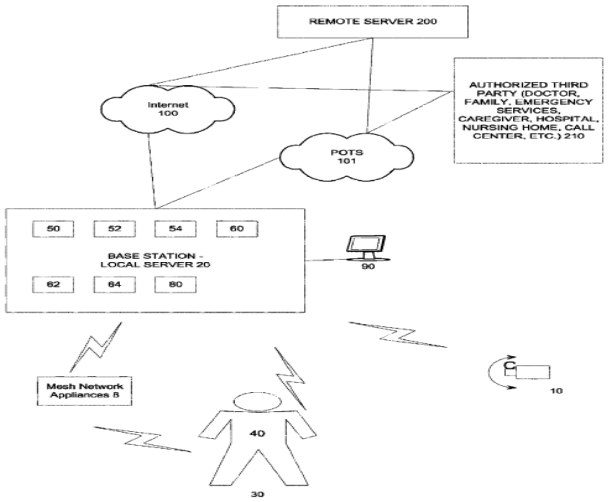
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	 FIG. 11 Tran at fig. 11 Turning now to FIG. 12, a jewelry-sized monitoring device is illustrated. In this embodiment, a body 172 houses a microphone port 174 and a speaker port 176. The body 172 is coupled to the user via the necklace 178 so as to provide a personal, highly accessible personal computer. Due to space limitations, voice input/output is an important user interface of the jewelry-sized computer. Although a necklace is disclosed, one skilled in the art can use a number of other substitutes such as a belt, a brace, a ring, or a band to secure the jewelry-sized computer to the user. Tran at 68:14-23

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	 FIG. 12 Tran at fig. 12 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38

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	 FIG. 13 Tran at fig. 13 FIG. 14B shows a sunglass or eyeglass embodiment which contains electronics for communicating with the mesh network and for sensing acceleration and bioimpedance, EKG/ ECG, EMG, heart sound, microphone, optical sensor, or ultrasonic sensor in contacts with a wearer's skin. In one embodiment, the ear module 310 contains optical sensors to detect temperature, blood flow and blood oxygen level as well as a speaker to provide wireless communication or hearing aid. Tran at 69:16-24 In one embodiment, the eye wear device of FIG. 14B can provide a data port, wherein the data port is carried by the ear stem. The data port may be a mini-USB connector, a FIREWIRE connector, an IEEE 1394 cable connector, an RS232 connector, a JTAB connector, an antenna, a wireless receiver, a radio, an RF receiver, or a Bluetooth receiver. In another embodiment, the wearable device is removably connectable to a computing device. The wearable wireless audio device may be removably connectable to a computing device with a data port, wherein said data port is mounted to said wearable wireless audio device. In another embodiment, projectors can project images on the glasses to provide headmounted display on the eye wear device. The processor can display fact, figure, to do list, and reminders need in front of the user's eyes. Tran at 69:66-70:13

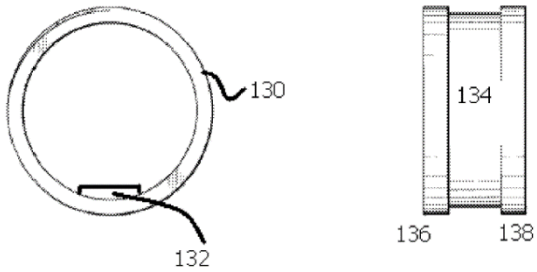
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	In one embodiment, to determine blood flow velocity, acoustic pulses are generated and transmitted into the artery using an ultrasonic transducer positioned near a wrist artery. Tran at 74:11-13 In one embodiment, a housing (such as a strap, a wristband, or a patch) provides a plurality of sensor contacts for EKG and/or EMG. The same contacts can be used for detecting EKG or EMG and can be placed as two parallel contacts (linear or spot shape) on opposite sides of the band, two adjacent parallel contacts on the inner surface of the band, two parallel adjacent contacts on the back of the wrist-watch, or alternatively one contact on the back of the watch and one contact on the wrist-band. Tran at 92:41-49 17. The system of claim 1, comprising a housing having one or more bioelectric contacts coupleable to the patient, the housing selected from one of: a patch, a wristwatch, a band, a wristband, a chest band, a leg band, a sock, a glove, a foot pad, a head-band, an ear-clip, an ear phone, a shower-cap, an armband, an ear-ring, eye-glasses, sun-glasses, a belt, a sock, a shirt, a garment, a jewelry, a bed spread, a pillow cover, a pillow, a mattress, a blanket, each having one or more sensors in communication with the wireless mesh network. Tran at Claim 17 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a	Tran discloses or renders obvious one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. See elements 1[h], 1[j]-1[l], below.

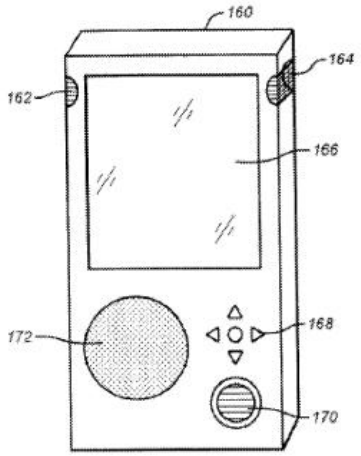
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differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	A heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at [Abstract] FIG. 1 shows an exemplary patient monitoring system. The system can operate in a home, a nursing home, or a hospital. In this system, one or more mesh network appliances 8 are provided to enable wireless communication in the home monitoring system. Appliances 8 in the mesh network can include home security monitoring devices, door alarm, window alarm, home temperature control devices, fire alarm devices, among others. Appliances 8 in the mesh network can be one of multiple portable physiological transducer, such as a blood pressure monitor, heart rate monitor, weight scale, thermometer, spirometer, single or multiple lead electrocardiograph (ECG), a pulse oxymeter, a body fat monitor, a cholesterol monitor, a signal from a medicine cabinet, a signal from a drug container, a signal from a commonly used appliance such as a refrigerator/stove/oven/washer, or a signal from an exercise machine, such as a heart rate. As will be discussed in more detail below, one appliance is a patient monitoring device that can be worn by the patient and includes a single or bi-directional wireless communication link, generally identified by the bolt symbol in FIG. 1, for transmitting data from the appliances 8 to the local hub or receiving station or base station server 20 by way of a wireless radio frequency (RF) link using a proprietary or non-proprietary protocol. For example, within a house, a user may have mesh network appliances that detect window and door contacts, smoke detectors and motion sensors, video cameras, key chain control, temperature monitors, CO and other gas detectors, vibration sensors, and others. A user may have flood sensors and other detectors on a boat. An individual, such as an ill or elderly grandparent, may have access to a panic transmitter or other alarm transmitter. Other sensors and/or detectors may also be included. The user may register these appliances on a central security network by entering the identification code for each registered appliance/device and/or system. The mesh network can be Zigbee network or 802.15 network. More details of the mesh network is shown in FIG. 7 and discussed in more detail below. Tran at 8:29-65 The wearable appliance is small, easily worn by the patient during periods of exercise or day-to-day activities, and non-invasively measures blood pressure can be done in a matter of seconds without

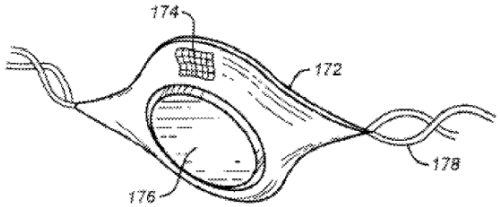
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	affecting the patient. An on-board or remote processor can analyze the time-dependent measurements to generate statistics on a patient's blood pressure (e.g., average pressures, standard deviation, beat-to-beat pressure variations) that are not available with conventional devices that only measure systolic and diastolic blood pressure at isolated times. Tran at 25:20-29  FIG. 1 Tran at Fig. 1 The base station 20 frequently collects and synchronizes data from the appliances 8. The base station 20 may use one of various transportation methods to connect to the repository on the server 200 using a PC as conduit or through a connection established using an embedded modem (connected to a phone line), a wireless router (DSL or cable wireless router), a cellular modem, or another network-connected appliance (such as, but not limited to, a web-phone, video-phone, embedded computer, PDA or handheld computer). Tran at 27:9-17

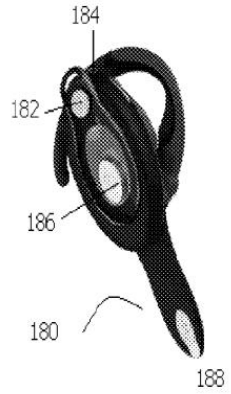
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	In another embodiment, the wireless node can be powered from thermal and/or kinetic energy. Temperature differentials between opposite segments of a conducting material result in heat flow and consequently charge flow, since mobile, high energy carriers diffuse from high to low concentration regions. Thermopiles consisting of n- and p-type materials electrically joined at the high-temperature junction are there fore constructed, allowing heat flow to carry the dominant charge carriers of each material to the low temperature end, establishing in the process a Voltage difference across the base electrodes. The generated Voltage and power is propor tional to the temperature differential and the Seebeck coeffi cient of the thermoelectric materials. Body heat from a user's wrist is captured by a thermoelectric element whose output is boosted and used to charge the a lithium ion rechargeable battery. The unit utilizes the Seeback Effect which describes the voltage created when a temperature difference exists across two different metals. The thermoelectric generator takes body heat and dissipates it to the ambient air, creating electricity in the process. Tran 40:18-37 The BI sensor can be a Series Model which assumes that there is one conductive path and that the body consists of a series of resistors. An electrical current, injected at a single frequency, is used to measure whole body impedance (i.e., wrist to ankle) for the purpose of estimating total body water and fat free mass. Alternatively, the BI instrument can be a Parallel BI Model In this model of impedance, the resistors and capacitors are oriented both in series and in parallel in the human body. Whole body BI can be used to estimate TBW and FFM in healthy subjects or to estimate intracellular water (ICW) and body cell mass (BCM). High-low BI can be used to estimate extracellular water (ECW) and total body water (TBW). Multi-frequency BI can be used to estimate ECW, ICW, and TBW: to monitor changes in the ECW/BCM and ECW/TBW ratios in clinical populations. The instrument can also be a segmental BI Model and can be used in the evalu tion of regional fluid changes and in monitoring extra cellular water in patients with abnormal fluid distribution, such as those undergoing hemodialysis. Segmental BI can be used to measure fluid distribution or regional fluid accumulation in clinical populations. Upper-body and Lower-body BI can be used to estimate percentage BF in healthy subjects with nor malhydration status and fluid distribution. The BI sensor can be used to detect acute dehydration, pulmonary edema (caused by mitral stenosis or left ventricular failure or con gestive heart failure, among others), or hyperhydration cause by kidney dialysis, for example. In one embodiment, the system determines the impedance of skin and Subcutaneous adipose tissue using tetrapolar and bipolar impedance mea Surements. In the bipolar arrangement the inner electrodes act both as the electrodes that send the current (outer electrodes in the tetrapolar arrangement) and as receiving electrodes. If the outer two electrodes

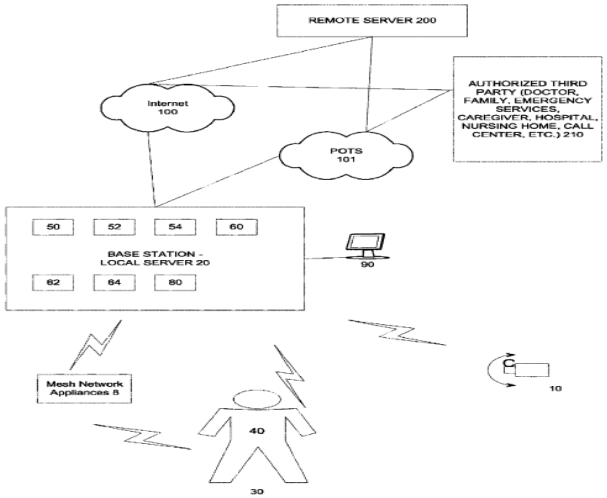
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	(electrodes sending current) are Super imposed onto the inner electrodes (receiving electrodes) then a bipolar BIA arrangement exists with the same electrodes acting as receiving and sending electrodes. The difference in impedance measurements between the tetrapolar and bipolar arrangement reflects the impedance of skin and Subcutaneous fat. The difference between the two impedance measure ments represents the combined impedance of skin and Sub cutaneous tissue at one or more sites. The system determines the resistivities of skin and Subcutaneous adipose tissue, and then calculates the skinfold thickness (mainly due to adipose tissue). Tran 43:53-44:28 The patient’s brain cell generates an electromagnetic field of positive or negative polarity, typically in the millivolt range. The sensor measures the electromagnetic field by detecting the difference in potential between one or more test electrodes and a reference electrode. The bio-potential sensor uses signal conditioners or processors to condition the poten tial signal. In one example, the test electrode and reference electrode are coupled to a signal conditioner/processor that includes a lowpass filter to remove undesired high frequency signal components. The electromagnetic field signal is typi cally a slowly varying DC voltage signal. The lowpass filter removes undesired alternating current components arising from static discharge, electromagnetic interference, and other sources. Tran 51:9-22 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40 FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending

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	the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. Tran 67:41-48  FIG. 8 Tran at Fig.8 FIGS. 11 and 12 show two additional embodiments of the monitoring device. In FIG. 11, a wearable monitoring device is shown. The monitoring device has a body 160 comprising microphone ports 162, 164 and 170 arranged in a first order noise cancelling microphone arrangement. The microphones 162 and 164 are configured to optimally receive distant noises, while the microphone 170 is optimized for capturing the user's speech. A touch sensitive display 166 and a plurality of keys 168 are provided to capture hand inputs. Further, a speaker 172 is provided to generate a verbal feedback to the user. Tran at 68:3-13

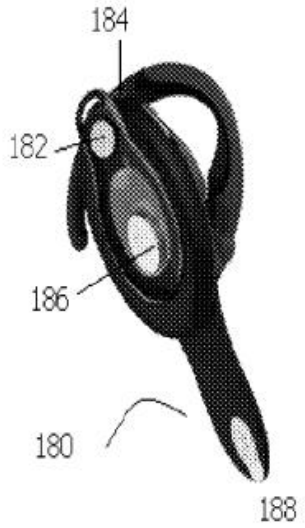
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	 FIG. 11 Tran at fig. 11 Turning now to FIG. 12, a jewelry-sized monitoring device is illustrated. In this embodiment, a body 172 houses a microphone port 174 and a speaker port 176. The body 172 is coupled to the user via the necklace 178 so as to provide a personal, highly accessible personal computer. Due to space limitations, voice input/output is an important user interface of the jewelry-sized computer. Although a necklace is disclosed, one skilled in the art can use a number of other substitutes such as a belt, a brace, a ring, or a band to secure the jewelry-sized computer to the user. Tran at 68:14-23

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	 FIG. 12 Tran at fig. 12 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38

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	 FIG. 13 Tran at fig. 13 FIG. 14B shows a sunglass or eyeglass embodiment which contains electronics for communicating with the mesh net work and for sensing acceleration and bioimpedance, EKG/ ECG, EMG, heart sound, microphone, optical sensor, or ultrasonic sensor in contacts with a wearer's skin. In one embodiment, the ear module 310 contains optical sensors to detect temperature, blood flow and blood oxygen level as well as a speaker to provide wireless communication or hearing aid. The blood flow or velocity information can be used to estimate blod pressure Tran 69:16-25 12. The system of claim 1, comprising a body impedance (BI) sensor to determine one of: total body water, compartmentalization of body fluids, cardiac monitoring, blood flow, skinfold thickness, dehydration, blood loss, wound monitoring, ulcer detection, deep vein thrombosis, hypovolemia, hemorrhage, blood loss, heart attack, stroke attack. Tran at Claim 12 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	Tran discloses or renders obvious a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. The patient 30 may wear one or more wearable patient monitoring appliances such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance such as a wrist-watch includes sensors 40, for example devices for sensing ECG, EKG, blood pressure, sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient's wrist (such as a wristwatch sensor) and other convenient anatomical locations. Exemplary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascular system (ECG). Tran at 9: 23-34  FIG. 1 Tran at Fig. 1

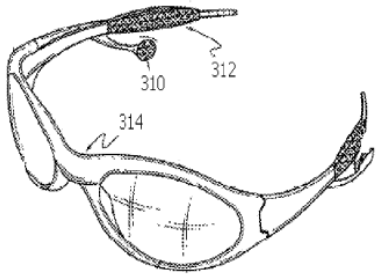
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	In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:13 A stimulus device may optionally be placed on each subject, such as an audio generator in the form of an ear plug, which produces a series of “click” sounds. The subject's brain waves are detected and converted into audio tones. The device may have an array of LED (Light Emitting Diodes) which blink depending on the power and frequency composition of the brain wave signal. Power ratios in the frequencies of audio or somatosensory stimuli are similarly encoded. The EEG can be transmitted to a remote physician or medical aide who is properly trained to determine whether the patient's brain function is abnormal and may evaluate the functional state of various levels of the patient's nervous system. Tran at 52:36-47 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical imple mentation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically mov able portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation Sweep to determine the arterial blood pressure. Tran at 67:28-40

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	 FIG. 13 Tran at Fig. 13 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	Tran discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin. The patient 30 may wear one or more wearable patient monitoring appliances such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance such as a wrist-watch includes sensors 40, for example devices for sensing ECG, EKG, blood pressure, sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient's wrist (such as a wristwatch sensor) and other convenient anatomical locations. Exemplary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascular system (ECG). Tran at 9:23-34 Bipolar or tetrapolar electrode systems can be used in the BI instruments. Of these, the tetrapolar system provides a uniform current density distribution in the body segment and measures impedance with less electrode interface artifact and impedance errors. In the tetrapolar system, a pair of surface electrodes (I1, I2) is used as current electrodes to introduce a low intensity constant current at high frequency into the body. A pair of electrodes (E1, E2) measures changes accompanying physiological events. Voltage measured across E1-E2 is directly proportional to the segment electrical impedance of the human subject. Circular flat electrodes as well as band type electrodes can be used. In one embodiment, the electrodes are in direct contact with the skin surface. In other embodiments, the voltage measurements may employ one or more contactless, voltage sensitive electrodes such as inductively or capacitively coupled electrodes. The current application and the voltage measurement electrodess in these embodiments can be the same, adjacent to one another, or at significantly different locations. The electrode(s) can apply current levels from 20 uA to 10 mA rms at a frequency range of 20-100 KHz. A constant current source and high input impedance circuit is used in conjunction with the tetrapolar electrode configuration to avoid the contact pressure effects at the electrode-skin interface.

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	Tran at 40:30-52 In one implementation, BIA measurements can be made using an array of bipolar or tetrapolar electrodes that deliver a constant alternating current at 50 KHz frequency. Whole body measurements can be done using standard right-sided. The ability of any biological tissue to resist a constant electric current depends on the relative proportions of water and electrolytes it contains, and is called resistivity (in Ohms/cm3). The measuring of bioimpedance to assess congestive heart failure employs the different bio-electric properties of blood and lung tissue to permit separate assessment of: (a) systemic venous congestion via a low frequency or direct current resistance measurement of the current path through the right ventricle, right atrium, superior vena cava, and subclavian vein, or by computing the real component of impedance at a high frequency, and (b) pulmonary congestion via a high frequency measurement of capacitive impedance of the lung. The resistance is impedance measured using direct current or alternating current (AC) which can flow through capacitors. Tran at 45:55-46:5 The heartbeat detector can be one of: EKG detector, ECG detector, optical detector, ultrasonic detector, or microphone/digital stethoscope for picking up heart sound. In one embodiment, one EKG/ECG contact point is provided on the back of the wrist watch case and one or more EKG/ECG contact points are provided on the surface of the watch so that when a user's finger or skin touches the contact points, an electrical signal indicative of heartbeat activity is generated. An electrocardiogram (ECG) or EKG is a graphic tracing of the voltage generated by the cardiac or heart muscle during a heartbeat. It provides very accurate evaluation of the performance of the heart. The heart generates an electrochemical impulse that spreads out in the heart in such a fashion as to cause the cells to contract and relax in a timely order and thus give the heart a pumping characteristic. This sequence is initiated by a group of nerve cells called the sinoatrial (SA) node resulting in a polarization and depolarization of the cells of the heart. Because this action is electrical in nature and because the body is conductive with its fluid content, this electrochemical action can be measured at the surface of the body. An actual voltage potential of approximately 1 mV develops between various body points. This can be measured by placing electrode contacts on the body. The four extremities and the chest wall have become standard sites for applying the electrodes. Standardizing electrocardiograms makes it possible to compare them as taken from person to person and from time to time from the same person. The normal electrocardiogram shows typical upward and downward deflections that reflect the alternate contraction of the atria (the two upper chambers) and of the ventricles (the two lower chambers) of the heart. The voltages produced represent pressures exerted by the heart muscles in one pumping cycle. The first upward deflection, P, is due to

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	atria contraction and is known as the atrial complex. The other deflections, Q, R, S, and T, are all due to the action of the ventricles and are known as the ventricular complexes. Any deviation from the norm in a particular electrocardiogram is indicative of a possible heart disorder. Tran at 59:38-60:8 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical imple mentation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically mov able portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation Sweep to determine the arterial blood pressure. Tran at 67:28-40 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38 FIG. 14A shows an exemplary adhesive patch embodi ment. The patch may be applied to a persons skin by anyone including the person themselves oran authorized person Such as a family member or physician. The adhesive patch is shown generally at 190 having a gauze pad 194 attached to one side of a backing 192, preferably of plastic, and wherein the pad can have an impermeable side 194 coating with backing 192 and a module 196 which contains electronics for communi cating with the mesh network and for sensing acceleration and bioimpedance, EKG/ECG, heart sound, microphone, optical sensor, or

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	ultrasonic sensorin contacts with a wearer's skin. In one embodiment, the module 196 has a skin side that may be coated with a conductive electrode lotion or gel to improve the contact. The entire patch described above may be covered with a plastic or foil strip to retain moisture and retard evaporation by a conductive electrode lotion or gel provided improve the electrode contact. In one embodiment, an acous tic sensor (microphone or piezoelectric sensor) and an elec trical sensor Such as EKG sensor contact the patient with a conductive gel material. The conductive gel material provides transmission characteristics So as to provide an effective acoustic impedance match to the skin in addition to providing electrical conductivity for the electrical sensor. The acoustic transducer can be directed mounted on the conductive gel material substantially with or without an intermediate air buffer. The entire patch is then packaged as sterile as are other over-the-counter adhesive bandages. When the patch is worn out, the module 196 may be removed and a new patchbacking 192 may be used in place of the old patch. One or more patches may be applied to the patient’s body and these patches may communicate wirelessly using the mesh network or alternatively they may communicate through a personal area network using the patient’s body as a communication medium. Tran: 68:39-69:5  FIG. 14B Tran at Fig.14B FIG. 14B shows a sunglass or eyeglass embodiment which contains electronics for communicating with the mesh network and for sensing acceleration and bioimpedance, EKG/ECG, EMG, heart sound, microphone, optical sensor, or ultrasonic sensor in contacts with a wearer's skin. In one embodiment, the ear module 310 contains optical sensors to detect temperature, blood flow and blood oxygen level

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	as well as a speaker to provide wireless communication or hearing aid. The blood flow or velocity information can be used to estimate blood pressure. The side module 312 can contain an array of bioimpedance sensors such as bipolar or tetrapolar bioimpedance probes to sense fluids in the brain. Additional bioimpedance electrodes can be positioned around the rim of the glasses as well as the glass handle or in any spots on the eyewear that contacts the user. The side module 312 or 314 can also contain one or more EKG electrodes to detect heart beat parameters and to detect heart problems. The side module 312 or 314 can also contain piezoelectric transducers or microphones to detect heart activities near the brain. The side module 312 or 314 can also contain ultrasound transmitter and receiver to create an ultrasound model of brain fluids. Tran at 69:16-36 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	Tran discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio. In yet another aspect, a monitoring system for a person includes one or more wireless nodes forming a wireless mesh network; and a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a heartbeat detector coupled to the wireless transceiver. The system may also include an accelerometer to detect a dangerous condition such as a falling condition and to generate a warning when the dangerous condition is detected. Tran at 3:40-47 An analog signal representative of the Doppler frequency of the echo is received by the transducer and converted to a digital representation by the ADC, and supplied to the CPU for signal processing. Within the CPU, the digitized Doppler frequency is scaled to compute the blood flow velocity within the artery based on the Doppler frequency. Based on the real time the blood flow velocity, the CPU applies the vital model to the corresponding blood flow velocity to produce the estimated blood pressure value.

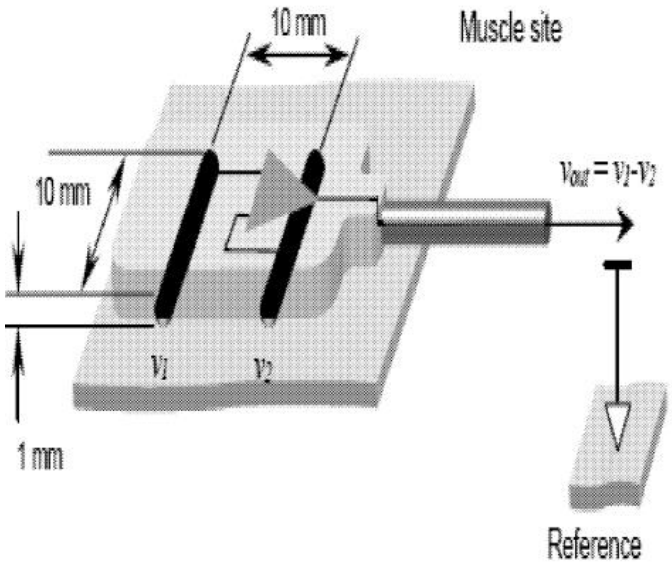
’475 Patent	Tran
	Tran at 35:57-65 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 In the electromagnetic sensor embodiment, the wrist band 1374 is a flexible plastic material incorporated with a flexible magnet. The magnet provides a magnetic field, and one or more electrodes similar to electrode 1383 are positioned on the wrist band to measure voltage drops which are proportional to the blood velocity. The electromagnetic embodiment may be mounted on the upper arm of the patient, on the ankle or on the neck where peripheral blood vessels pass through and their blood velocity may be measured with minimal interruptions. The flexible magnet produces a pseudo-uniform (non-gradient) magnetic field. The magnetic field can be normal to the blood flow direction when wrist band 1374 is mounted on the user's wrist or may be a rotative pseudo-uniform magnetic field so that the magnetic field is in a transversal direction in respect to the blood flow direction. The electrode output signals are processed to obtain a differential measurement enhancing the signal to noise ratio. The flow information is derived based on the periodicity of the signals. The decoded signal is filtered over several periods and then analyzed for changes used to estimate artery and vein blood flow. Systemic stroke volume and cardiac output may be calculated from the peripheral SV index value. Tran at 37:13-34 The electronic circuitry housed in the watch case 1380 detects adverse conditions such as falls or seizures. In one implementation, the circuitry can recognize speech, namely utterances of spoken words

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	by the user, and converting the utterances into digital signals. The circuitry for detecting and processing speech to be sent from the wristwatch to the base station 20 over the mesh network includes a central processing unit (CPU) connected to a ROM/RAM memory via a bus. The CPU is a preferably low power 16-bit or 32-bit microprocessor and the memory is preferably a high density, low-power RAM. The CPU is coupled via the bus to processor wake-up logic, one or more accelerometers to detect sudden movement in a patient, an ADC 102 which receives speech input from the microphone. The ADC converts the analog signal produced by the microphone into a sequence of digital values representing the amplitude of the signal produced by the microphone at a sequence of evenly spaced times. The CPU is also coupled to a digital to analog (D/A) converter, which drives the speaker to communicate with the user. Speech signals from the microphone are first amplified, pass through an antialiasing filter before being sampled. The front-end processing includes an amplifier, a bandpass filter to avoid antialiasing, and an analog-to-digital (A/D) converter or a CODEC. To minimize space, the ADC, the DAC and the interface for wireless transceiver and switches may be integrated into one integrated circuit to save space. In one embodiment, the wrist watch acts as a walkie-talkie so that voice is received over the mesh network by the base station 20 and then delivered to a call center over the POTS or PSTN network. In another embodiment, voice is provided to the call center using the Internet through suitable VOIP techniques. In one embodiment, speech recognition such as a speech recognizer is discussed in U.S. Pat. No. 6,070,140 by the inventor of the instant invention, the content of which is incorporated by reference. Tran at 37:51-38:18 In one implementation, BIA measurements can be made using an array of bipolar or tetrapolar electrodes that deliver a constant alternating current at 50 KHz frequency. Whole body measurements can be done using standard right-sided. The ability of any biological tissue to resist a constant electric current depends on the relative proportions of water and electrolytes it contains, and is called resistivity (in Ohms/cm3). The measuring of bioimpedance to assess congestive heart failure employs the different bio-electric properties of blood and lung tissue to permit separate assessment of: (a) systemic venous congestion via a low frequency or direct current resistance measurement of the current path through the right ventricle, right atrium, superior vena cava, and subclavian vein, or by computing the real component of impedance at a high frequency, and (b) pulmonary congestion via a high frequency measurement of capacitive impedance of the lung. The resistance is impedance measured using direct current or alternating current (AC) which can flow through capacitors. Tran at 45:55-46:5

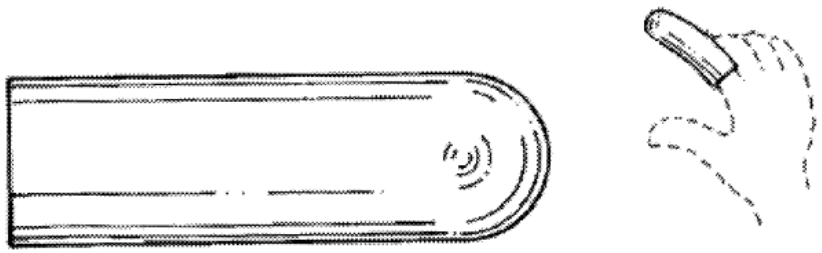
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	In one embodiment, an electrode array sensor can include impedance, bio-potential, or electromagnetic field tomography imaging of cranial tissue. The electrode array sensor can be a geometric array of discrete electrodes having an equallyspaced geometry of multiple nodes that are capable of functioning as sense and reference electrodes. In a typical tomography application the electrodes are equally-spaced in a circular configuration. Alternatively, the electrodes can have non-equal spacing and/or can be in rectangular or other configurations in one circuit or multiple circuits. Electrodes can be configured in concentric layers too. Points of extension form multiple nodes that are capable of functioning as an electrical reference. Data from the multiple reference points can be collected to generate a spectrographic composite for monitoring over time. Tran at 50:61-51:8 The heartbeat detector can be one of: EKG detector, ECG detector, optical detector, ultrasonic detector, or microphone/ digital stethoscope for picking up heart sound. In one embodi- 40 ment, one EKG/ECG contact point is provided on the back of the wrist watch case and one or more EKG/ECG contact points are provided on the surface of the watch so that when a user's finger or skin touches the contact points, an electrical signal indicative of heartbeat activity is generated. Tran at 59:38-45 In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, 60 wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implementation, a reflective sensor such as the Honeywell HLC1395 65 can be used. The device emits lights from a window in the infrared spectrum and receives reflected light in a second window. When the heart beats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, and the resulting optical waveform is captured by the CPU. Tran at 60:58-61:5 The output of the first receiver circuit is an analog signal representative of the Doppler frequency of the echo received by the transducer which is digitized and supplied to the CPU. Within the CPU, the digitized

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	Doppler frequency is scaled to compute the blood velocity within the artery based on the Doppler frequency. The time-frequency distribution of the blood velocity is then computed. Finally, the CPU maps in time the peak of the time-frequency distribution to the corresponding pressure waveform to produce the estimated mean arterial pressure (MAP). The output of the ultrasonic receiver circuit is an analog echo signal proportional to absorption of the transmitted frequencies by blood or tissue. This analog signal is digitized and process so that each group of echoes, generated for a different transversal position, is integrated to determine a mean value. Tran at 62:26-39 An in-door positioning system links one or more mesh network appliances to provide location information. Inside the home or office, the radio frequency signals have negligible multipath delay spread (for timing purposes) over short distances. Hence, radio strength can be used as a basis for determining position. Alternatively, time of arrival can be used to determine position, or a combination of radio signal strength and time of arrival can be used. Position estimates can also be achieved in an embodiment by beamforming, a method that exchanges time-stamped raw data among the nodes. While the processing is relatively more costly, it yields processed data with a higher signal to noise ratio (SNR) for subsequent classification decisions, and enables estimates of angles of arrival for targets that are outside the convex hull of the participating sensors. Two such clusters of ZigBee nodes can then provide for triangulation of distant targets. Further, beamforming enables suppression of interfering sources, by placing nulls in the synthetic beam pattern in their directions. Another use of beamforming is in self-location of nodes when the positions of only a very small number of nodes or appliances are known such as those sensors nearest the wireless stations. In one implementation where each node knows the distances to its neighbors due to their positions, and some small fraction of the nodes (such as those nearest a PC with GPS) of the network know their true locations. As part of the network-building procedure, estimates of the locations of the nodes that lie within or near the convex hull of the nodes with known position can be quickly generated. To start, the shortest distance (multihop) paths are determined between each reference node. All nodes on this path are assigned a location that is the simple linear average of the two reference locations, as if the path were a straight line. A node which lies on the intersection of two such paths is assigned the average of the two indicated locations. All nodes that have been assigned locations now serve as references. The shortest paths among these new reference nodes are computed, assigning locations to all intermediate nodes as before, and continuing these iterations until no further nodes get assigned locations. This will not assign initial position estimates to all sensors. The remainder can be assigned locations based on pairwise averages of distances to the nearest four original reference nodes.

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	Some consistency checks on location can be made using trigonometry and one further reference node to determine whether or not the node likely lies within the convex hull of the original four reference sensors. Tran at 66:8-52 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40 FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. Tran at 67: 41-48

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	 FIG. 17A Tran at Fig.17A As shown in FIG. 17A, to eliminate the potentially much greater noise signal from power line sources, a differential instrumentation amplifier is employed. Any signal that originates far away from the detection sites will appear as a common signal, whereas signals in the immediate vicinity of the detection surfaces will be different and consequently will be amplified. Thus, relatively distant power lines noise signals will be removed and relatively local EMG signals will be amplified. The source impedance at the junction of the skin and detection surface may range from several thousand ohms to several megohms for dry skin. In order to prevent attenuation and distortion of the detected signal due to the effects of input loading, the input impedance of the differential amplifier is as large as possible, without causing ancillary complications to the workings of the differential amplifier. The signal to noise ratio is increased by filtering between 20-500 Hz with a roll-off of 12 dB/octave. Tran at 91:12-28 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Tran discloses or renders obvious, the detection system is configured to be synchronized to the light source. In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12

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	 FIG. 9 Tran at Fig. 9 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67: 28-40 FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. Tran at 67:41-48

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	Tran discloses or renders obvious the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. In yet another aspect, a monitoring system for a person includes one or more wireless nodes forming a wireless mesh network; and a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a heartbeat detector coupled to the wireless transceiver. The system may also include an accelerometer to detect a dangerous condition such as a falling condition and to generate a warning when the dangerous condition is detected. Tran at 3:34-39 To view information sent from the blood-pressure monitor and fall detector on the wearable appliance, the patient or an authorized third party such as family members, emergency personnel, or medical professional accesses a patient user interface hosted on the web server 200 through the Internet 100 from a remote computer system. The patient interface displays vital information such as ambulation, blood pressure and related data measured from a single patient. The system may also include a call center, typically staffed with medical professionals such as doctors, nurses, or nurse practioners, whom access a care-provider interface hosted on the same website on the server 200. The care-provider interface displays vital data from multiple patients Tran at 25:65-26:10 The amplified EKG signal is internally fed to the on chip analog to digital converter. Tran at 35:8-9

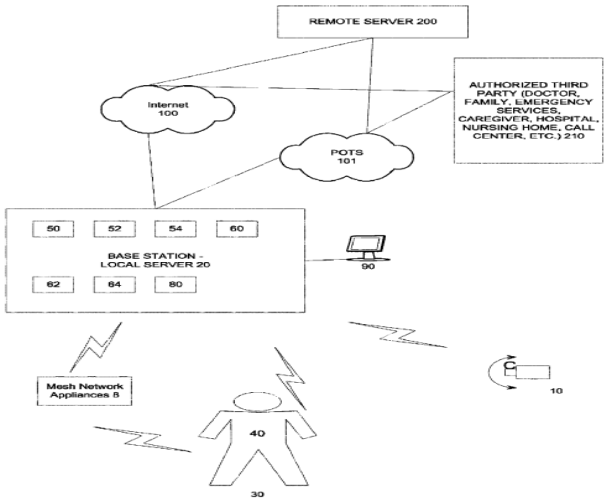
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	An analog signal representative of the Doppler frequency of the echo is received by the transducer and converted to a digital representation by the ADC, and supplied to the CPU for signal processing. Within the CPU, the digitized Doppler frequency is scaled to compute the blood flow velocity within the artery based on the Doppler frequency. Based on the real time the blood flow velocity, the CPU applies the vital model to the corresponding blood flow velocity to produce the estimated blood pressure value. Tran at 35:57-65 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 The electronic circuitry housed in the watch case 1380 detects adverse conditions such as falls or seizures. In one implementation, the circuitry can recognize speech, namely utterances of spoken words by the user, and converting the utterances into digital signals. The circuitry for detecting and processing speech to be sent from the wristwatch to the base station 20 over the mesh network includes a central processing unit (CPU) connected to a ROM/RAM memory via a bus. The CPU is a preferably low power 16-bit or 32-bit microprocessor and the memory is preferably a high density, low-power RAM. The CPU is coupled via the bus to processor wake-up logic, one or more accelerometers to detect sudden movement in a patient, an ADC 102 which receives speech input from the microphone. The ADC converts the analog signal produced by the microphone into a sequence of digital values representing the amplitude of the signal produced by the microphone at a sequence of evenly spaced times. The CPU is also coupled to a digital to analog (D/A) converter, which drives the speaker to communicate with the user. Speech signals from the microphone are first amplified, pass through an antialiasing filter before being sampled. The front-end processing includes an amplifier, a bandpass filter to avoid

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	antialiasing, and an analog-to-digital (A/D) converter or a CODEC. To minimize space, the ADC, the DAC and the interface for wireless transceiver and switches may be integrated into one integrated circuit to save space. In one embodiment, the wrist watch acts as a walkie-talkie so that voice is received over the mesh network by the base station 20 and then delivered to a call center over the POTS or PSTN network. In another embodiment, voice is provided to the call center using the Internet through suitable VOIP techniques. In one embodiment, speech recognition such as a speech recognizer is discussed in U.S. Pat. No. 6,070,140 by the inventor of the instant invention, the content of which is incorporated by reference. Tran at 37:51-38:18 In one embodiment, an electrode array sensor can include impedance, bio-potential, or electromagnetic field tomography imaging of cranial tissue. The electrode array sensor can be a geometric array of discrete electrodes having an equallyspaced geometry of multiple nodes that are capable of functioning as sense and reference electrodes. In a typical tomography application the electrodes are equally-spaced in a circular configuration. Alternatively, the electrodes can have non-equal spacing and/or can be in rectangular or other configurations in one circuit or multiple circuits. Electrodes can be configured in concentric layers too. Points of extension form multiple nodes that are capable of functioning as an electrical reference. Data from the multiple reference points can be collected to generate a spectrographic composite for monitoring over time. Tran at 50:61-51:8 The heartbeat detector can be one of: EKG detector, ECG detector, optical detector, ultrasonic detector, or microphone/digital stethoscope for picking up heart sound. In one embodiment, one EKG/ECG contact point is provided on the back of the wrist watch case and one or more EKG/ECG contact points are provided on the surface of the watch so that when a user's finger or skin touches the contact points, an electrical signal indicative of heartbeat activity is generated. An electrocardiogram (ECG) or EKG is a graphic tracing of the voltage generated by the cardiac or heart muscle during a heartbeat. It provides very accurate evaluation of the performance of the heart. The heart generates an electrochemical impulse that spreads out in the heart in such a fashion as to cause the cells to contract and relax in a timely order and thus give the heart a pumping characteristic. This sequence is initiated by a group of nerve cells called the sinoatrial (SA) node resulting in a polarization and depolarization of the cells of the heart. Because this action is electrical in nature and because the body is conductive with its fluid content, this electrochemical action can be measured at the surface of the body. An actual voltage potential of

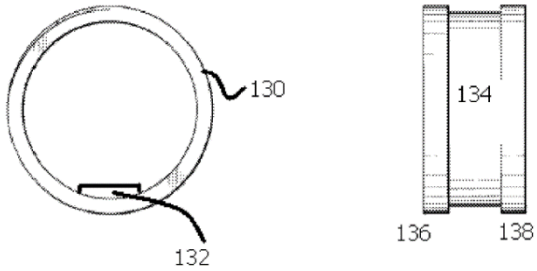
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	approximately 1 mV develops between various body points. This can be measured by placing electrode contacts on the body. The four extremities and the chest wall have become standard sites for applying the electrodes. Standardizing electrocardiograms makes it possible to compare them as taken from person to person and from time to time from the same person. The normal electrocardiogram shows typical upward and downward deflections that reflect the alternate contraction of the atria (the two upper chambers) and of the ventricles (the two lower chambers) of the heart. The voltages produced represent pressures exerted by the heart muscles in one pumping cycle. The first upward deflection, P, is due to atria contraction and is known as the atrial complex. The other deflections, Q, R, S, and T, are all due to the action of the ventricles and are known as the ventricular complexes. Any deviation from the norm in a particular electrocardiogram is indicative of a possible heart disorder. Tran at 59:38-60:8 In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implementation, a reflective sensor such as the Honeywell HLC1395 can be used. The device emits lights from a window in the infrared spectrum and receives reflected light in a second window. When the heart beats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, and the resulting optical waveform is captured by the CPU. Tran at 60:58-61:5 The output of the first receiver circuit is an analog signal representative of the Doppler frequency of the echo received by the transducer which is digitized and supplied to the CPU. Within the CPU, the digitized Doppler frequency is scaled to compute the blood velocity within the artery based on the Doppler frequency. The time-frequency distribution of the blood velocity is then computed. Finally, the CPU maps in time the peak of the time-frequency distribution to the corresponding pressure waveform to produce the estimated mean arterial pressure (MAP). The output of the ultrasonic receiver circuit is an analog echo signal proportional to absorption of the transmitted frequencies by blood or tissue. This analog signal is digitized and process so that each group of echoes, generated for a different transversal position, is integrated to determine a mean value.

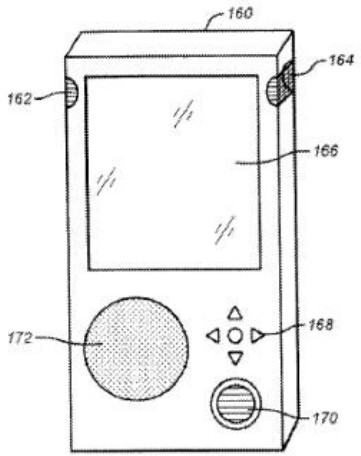
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	Tran at 62:26-39 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40 FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. Tran at 67:41-48 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	Tran discloses or renders obvious the output signal is indicative of the one or more physiological parameters. See element 1[b], above. A heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or

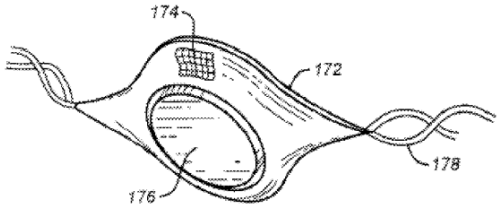
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	more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at [Abstract] FIG. 1 shows an exemplary patient monitoring system. The system can operate in a home, a nursing home, or a hospital. In this system, one or more mesh network appliances 8 are provided to enable wireless communication in the home monitoring system. Appliances 8 in the mesh network can include home security monitoring devices, door alarm, window alarm, home temperature control devices, fire alarm devices, among others. Appliances 8 in the mesh network can be one of multiple portable physiological transducer, such as a blood pressure monitor, heart rate monitor, weight scale, thermometer, spirometer, single or multiple lead electrocardiograph (ECG), a pulse oxymeter, a body fat monitor, a cholesterol monitor, a signal from a medicine cabinet, a signal from a drug container, a signal from a commonly used appliance such as a refrigerator/stove/oven/washer, or a signal from an exercise machine, such as a heart rate. As will be discussed in more detail below, one appliance is a patient monitoring device that can be worn by the patient and includes a single or bi-directional wireless communication link, generally identified by the bolt symbol in FIG. 1, for transmitting data from the appliances 8 to the local hub or receiving station or base station server 20 by way of a wireless radio frequency (RF) link using a proprietary or non-proprietary protocol. For example, within a house, a user may have mesh network appliances that detect window and door contacts, smoke detectors and motion sensors, video cameras, key chain control, temperature monitors, CO and other gas detectors, vibration sensors, and others. A user may have flood sensors and other detectors on a boat. An individual, such as an ill or elderly grandparent, may have access to a panic transmitter or other alarm transmitter. Other sensors and/or detectors may also be included. The user may register these appliances on a central security network by entering the identification code for each registered appliance/device and/or system. The mesh network can be Zigbee network or 802.15 network. More details of the mesh network is shown in FIG. 7 and discussed in more detail below. Tran at 8:29-65 The wearable appliance is small, easily worn by the patient during periods of exercise or day-to-day activities, and non-invasively measures blood pressure can be done in a matter of seconds without affecting the patient. An on-board or remote processor can analyze the time-dependent measurements to generate statistics on a patient's blood pressure (e.g., average pressures, standard deviation, beat-to-beat

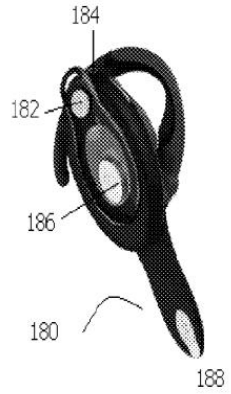
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	pressure variations) that are not available with conventional devices that only measure systolic and diastolic blood pressure at isolated times. Tran at 25:20-29  FIG. 1 Tran at Fig. 1 The base station 20 frequently collects and synchronizes data from the appliances 8. The base station 20 may use one of various transportation methods to connect to the repository on the server 200 using a PC as conduit or through a connection established using an embedded modem (connected to a phone line), a wireless router (DSL or cable wireless router), a cellular modem, or another network-connected appliance (such as, but not limited to, a web-phone, video-phone, embedded computer, PDA or handheld computer). Tran at 27:9-17 In another embodiment, inductive plethysmography can be used to measure a cross-sectional area of the body by determining the self-inductance of a flexible conductor closely encircling the area to be measured. Since the inductance of a substantially planar conductive loop is well known to vary as, inter

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	alia, the cross-sectional area of the loop, a inductance measurement may be converted into a plethysmographic area determination. Varying loop inductance may be measured by techniques known in the art, such as, e.g., by connecting the loop as the inductance in a variable frequency LC oscillator, the frequency of the oscillator then varying with the crosssectional area of the loop inductance varies. Oscillator frequency is converted into a digital value, which is then further processed to yield the physiological parameters of interest. Tran at 49:28-41 In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implementation, a reflective sensor such as the Honeywell HLC1395 can be used. The device emits lights from a window in the infrared spectrum and receives reflected light in a second window. When the heart beats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, and the resulting optical waveform is captured by the CPU. In another optical embodiment, blood pressure is estimated from the optical reading using a mathematical model such as a linear correlation with a known blood pressure reading. In this embodiment, the pulse oximeter readings are compared to the blood-pressure readings from a known working blood pressure measurement device during calibration. Using these measurements the linear equation is developed relating oximeter output waveform such as width to blood-pressure (systolic, mean and pulse pressure). In one embodiment, a transform (such as a Fourier analysis or a Wavelet transform) of the oximeter output can be used to generate a model to relate the oximeter output waveform to the blood pressure. Other non-linear math model or relationship can be determined to relate the oximeter waveform to the blood pressure. In one implementation, the pulse oximeter probe and a blood pressure cuff are placed on the corresponding contralateral limb to the oscillometric (Dinamap 8100; Critikon, Inc, Tampa, Fla., USA) cuff site. The pulse oximeter captures data on plethysmographic waveform, heart rate, and oxygen saturation. Simultaneous blood pressure measurements were obtained from the oscillometric device, and the pulse oximeter. Systolic, diastolic, and mean blood pressures are recorded from the oscillometric device. This information is used derive calibration parameters relating the pulse oximeter output to the

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	expected blood pressure. During real time operation, the calibration parameters are applied to the oximeter output to predict blood pressure in a continuous or in a periodic fashion. In yet another embodiment, the device includes an accelerometer or alternative motion-detecting device to determine when the patient' hand is at rest, thereby reducing motionrelated artifacts introduced to the measurement during calibration and/or operation. The accelerometer can also function as a falls detection device. Tran at 60:58-61:38 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40  FIG. 8 Tan at Fig.8 FIGS. 11 and 12 show two additional embodiments of the monitoring device. In FIG. 11, a wearable monitoring device is shown. The monitoring device has a body 160 comprising microphone ports 162, 164 and 170 arranged in a first order noise cancelling microphone arrangement. The microphones 162

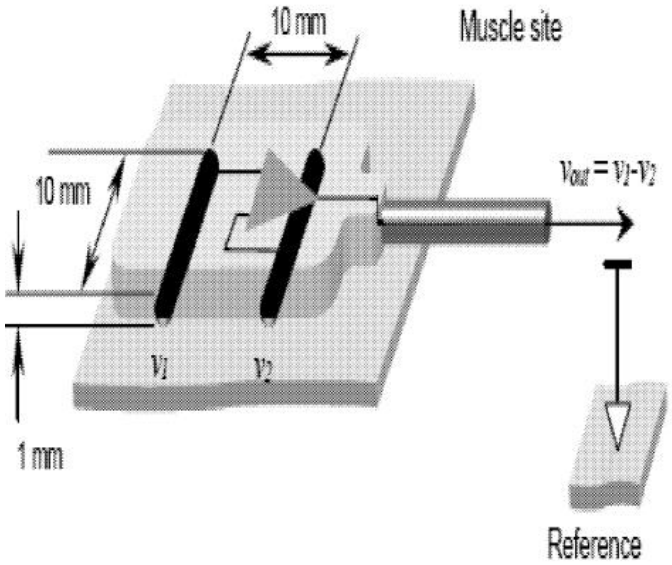
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	and 164 are configured to optimally receive distant noises, while the microphone 170 is optimized for capturing the user's speech. A touch sensitive display 166 and a plurality of keys 168 are provided to capture hand inputs. Further, a speaker 172 is provided to generate a verbal feedback to the user. Tran at 68:3-13  FIG. 11 Tran at fig. 11 Turning now to FIG. 12, a jewelry-sized monitoring device is illustrated. In this embodiment, a body 172 houses a microphone port 174 and a speaker port 176. The body 172 is coupled to the user via the necklace 178 so as to provide a personal, highly accessible personal computer. Due to space limitations, voice input/output is an important user interface of the jewelry-sized computer. Although a necklace is disclosed, one skilled in the art can use a number of other substitutes such as a belt, a brace, a ring, or a band to secure the jewelry-sized computer to the user. Tran at 68:14-23

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	 FIG. 12 Tran at fig. 12 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38

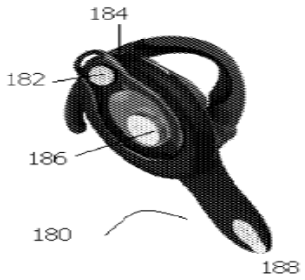
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	 FIG. 13 Tran at fig. 13 12. The system of claim 1, comprising a body impedance (BI) sensor to determine one of: total body water, compartmentalization of body fluids, cardiac monitoring, blood flow, skinfold thickness, dehydration, blood loss, wound monitoring, ulcer detection, deep vein thrombosis, hypovolemia, hemorrhage, blood loss, heart attack, stroke attack. Tran at Claim 12 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of	Tran discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity.

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light emitting diodes from an initial light intensity;	In the electromagnetic sensor embodiment, the wrist band 1374 is a flexible plastic material incorporated with a flexible magnet. The magnet provides a magnetic field, and one or more electrodes similar to electrode 1383 are positioned on the wrist band to measure voltage drops which are proportional to the blood velocity. The electromagnetic embodiment may be mounted on the upper arm of the patient, on the ankle or on the neck where peripheral blood vessels pass through and their blood velocity may be measured with minimal interruptions. The flexible magnet produces a pseudo-uniform (non-gradient) magnetic field. The magnetic field can be normal to the blood flow direction when wrist band 1374 is mounted on the user's wrist or may be a rotative pseudo-uniform magnetic field so that the magnetic field is in a transversal direction in respect to the blood flow direction. The electrode output signals are processed to obtain a differential measurement enhancing the signal to noise ratio. The flow information is derived based on the periodicity of the signals. The decoded signal is filtered over several periods and then analyzed for changes used to estimate artery and vein blood flow. Systemic stroke volume and cardiac output may be calculated from the peripheral SV index value. Tran at 37:13-34 An in-door positioning system links one or more mesh network appliances to provide location information. Inside the home or office, the radio frequency signals have negligible multipath delay spread (for timing purposes) over short distances. Hence, radio strength can be used as a basis for determining position. Alternatively, time of arrival can be used to determine position, or a combination of radio signal strength and time of arrival can be used. Position estimates can also be achieved in an embodiment by beamforming, a method that exchanges time-stamped raw data among the nodes. While the processing is relatively more costly, it yields processed data with a higher signal to noise ratio (SNR) for subsequent classification decisions, and enables estimates of angles of arrival for targets that are outside the convex hull of the participating sensors. Two such clusters of ZigBee nodes can then provide for triangulation of distant targets. Further, beamforming enables suppression of interfering sources, by placing nulls in the synthetic beam pattern in their directions. Another use of beamforming is in self-location of nodes when the positions of only a very small number of nodes or appliances are known such as those sensors nearest the wireless stations. In one implementation where each node knows the distances to its neighbors due to their positions, and some small fraction of the nodes (such as those nearest a PC with GPS) of the network know their true locations. As part of the network-building procedure, estimates of the locations of the nodes that lie within or near the convex hull of the nodes with known position can be quickly generated. To start, the shortest distance (multihop) paths are determined between each reference node. All nodes on this path are assigned a location that is the simple linear average of the two reference locations, as if the path were a straight line. A node which lies on the intersection of two such paths is

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	assigned the average of the two indicated locations. All nodes that have been assigned locations now serve as references. The shortest paths among these new reference nodes are computed, assigning locations to all intermediate nodes as before, and continuing these iterations until no further nodes get assigned locations. This will not assign initial position estimates to all sensors. The remainder can be assigned locations based on pairwise averages of distances to the nearest four original reference nodes. Some consistency checks on location can be made using trigonometry and one further reference node to determine whether or not the node likely lies within the convex hull of the original four reference sensors. Tran at 66:8-52 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40 In another embodiment, the wavelet decomposition and reconstruction method extract features from the heart sound recordings. An artificial neural network classification method classifies the heart sound signals into physiological and pathological murmurs. The heart sounds are segmented into four parts: the first heart sound, the systolic period, the second heart sound, and the diastolic period. The following features can be extracted and used in the classification algorithm: a) Peak intensity, peak timing, and the duration of the first heart sound b) the duration of the second heart sound c) peak intensity of the aortic component of S2 (A2) and the pulmonic component of S2 (P2), the splitting interval and the reverse flag of A2 and P2, and the timing of A2 d) the duration, the three largest frequency components of the systolic signal and the shape of the envelope of systolic murmur e) the duration the three largest frequency components of the diastolic signal and the shape of the envelope of the diastolic murmur. Tran at 75: 16-32

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	In one embodiment, the time intervals between the ECG R-waves are detected using an envelope detection process. The intervals between R and T waves are also determined. The Fourier transform is applied to the sound to detect S1 and S2. To expedite processing, the system applies Fourier transform to detect S1 in the interval 0.1-0.5 R-R. The system looks for S2 the intervals R-T and 0.6 R-R. S2 has an aortic component A2 and a pulmonary component P2. The interval between these two components and its changes with respiration has clinical significance. A2 sound occurs before P2, and the intensity of each component depends on the closing pressure and hence A2 is louder than P2. The third heard sound S3 results from the sudden halt in the movement of the ventricle in response to filling in early diastole after the AV valves and is normally observed in children and young adults. The fourth heart sound S4 is caused by the sudden halt of the ventricle in response to filling in presystole due to atrial contraction. Tran at 75: 33-49  FIG. 17A Tran at Fig.17A

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	As shown in FIG. 17A, to eliminate the potentially much greater noise signal from power line sources, a differential instrumentation amplifier is employed. Any signal that originates far away from the detection sites will appear as a common signal, whereas signals in the immediate vicinity of the detection surfaces will be different and consequently will be amplified. Thus, relatively distant power lines noise signals will be removed and relatively local EMG signals will be amplified. The source impedance at the junction of the skin and detection surface may range from several thousand ohms to several megohms for dry skin. In order to prevent attenuation and distortion of the detected signal due to the effects of input loading, the input impedance of the differential amplifier is as large as possible, without causing ancillary complications to the workings of the differential amplifier. The signal to noise ratio is increased by filtering between 20-500 Hz with a roll-off of 12 dB/octave. Tran at 91:12-28 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Tran discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off. See element 1[l], below. The wrist-band can be an expansion band or a wristwatch strap of plastic, leather or woven material. The wrist-band further contains an antenna for transmitting or receiving radio frequency signals. The wristband and the antenna inside the band are mechanically coupled to the top and bottom sides of the wrist-watch housing. Further, the antenna is electrically coupled to a radio frequency transmitter and receiver for wireless communications with another computer or another user. Although a wrist-band is disclosed, a number of substitutes may be used, including a belt, a ring holder, a brace, or a bracelet, among other suitable substitutes known to one skilled in the art. The housing contains the processor and associated peripherals to provide the human-machine interface. A display is located on the front section of the housing. A speaker, a microphone, and a plurality of push-button switches and are also located on the front section of housing. An infrared LED transmitter and an infrared LED receiver are positioned

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	on the right side of housing to enable the watch to communicate with another computer using infrared transmission. Tran at 10: 12-31  FIG. 13 Tran at Fig. 13 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an

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	optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67: 28-40 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Tran discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. See element 1[l], below. The wrist-band can be an expansion band or a wristwatch strap of plastic, leather or woven material. The wrist-band further contains an antenna for transmitting or receiving radio frequency signals. The wristband and the antenna inside the band are mechanically coupled to the top and bottom sides of the wrist-watch housing. Further, the antenna is electrically coupled to a radio frequency transmitter and receiver for wireless communications with another computer or another user. Although a wrist-band is disclosed, a number of substitutes may be used, including a belt, a ring holder, a brace, or a bracelet, among other suitable substitutes known to one skilled in the art. The housing contains the processor and associated peripherals to provide the human-machine interface. A display is located on the front section of the housing. A speaker, a microphone, and a plurality of push-button switches and are also located on the front section of housing. An infrared LED transmitter and an infrared LED receiver are positioned on the right side of housing to enable the watch to communicate with another computer using infrared transmission. Tran at 10: 12-31

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	In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the	Tran discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal.

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first signal and the second signal; and	See claim elements 1[j]-1[k], above. The wrist-band can be an expansion band or a wristwatch strap of plastic, leather or woven material. The wrist-band further contains an antenna for transmitting or receiving radio frequency signals. The wristband and the antenna inside the band are mechanically coupled to the top and bottom sides of the wrist-watch housing. Further, the antenna is electrically coupled to a radio frequency transmitter and receiver for wireless communications with another computer or another user. Although a wrist-band is disclosed, a number of substitutes may be used, including a belt, a ring holder, a brace, or a bracelet, among other suitable substitutes known to one skilled in the art. The housing contains the processor and associated peripherals to provide the human-machine interface. A display is located on the front section of the housing. A speaker, a microphone, and a plurality of push-button switches and are also located on the front section of housing. An infrared LED transmitter and an infrared LED receiver are positioned on the right side of housing to enable the watch to communicate with another computer using infrared transmission. Tran at 10: 12-31 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 In the electromagnetic sensor embodiment, the wrist band 1374 is a flexible plastic material incorporated with a flexible magnet. The magnet provides a magnetic field, and one or more electrodes similar to electrode 1383 are positioned on the wrist band to measure voltage drops which are proportional to the blood velocity. The electromagnetic embodiment may be mounted on the upper arm of the patient, on

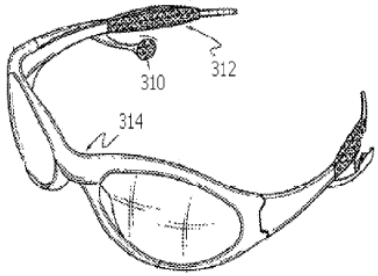
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	the ankle or on the neck where peripheral blood vessels pass through and their blood velocity may be measured with minimal interruptions. The flexible magnet produces a pseudo-uniform (non-gradient) magnetic field. The magnetic field can be normal to the blood flow direction when wrist band 1374 is mounted on the user's wrist or may be a rotative pseudo-uniform magnetic field so that the magnetic field is in a transversal direction in respect to the blood flow direction. The electrode output signals are processed to obtain a differential measurement enhancing the signal to noise ratio. The flow information is derived based on the periodicity of the signals. The decoded signal is filtered over several periods and then analyzed for changes used to estimate artery and vein blood flow. Systemic stroke volume and cardiac output may be calculated from the peripheral SV index value. Tran at 37:13-34 In another embodiment, the wireless node can be powered from thermal and/or kinetic energy. Temperature differentials between opposite segments of a conducting material result in heat flow and consequently charge flow, since mobile, high energy carriers diffuse from high to low concentration regions. Thermopiles consisting of n- and p-type materials electrically joined at the high-temperature junction are there fore constructed, allowing heat flow to carry the dominant charge carriers of each material to the low temperature end, establishing in the process a Voltage difference across the base electrodes. The generated Voltage and power is propor tional to the temperature differential and the Seebeck coeffi cient of the thermoelectric materials. Body heat from a user's wrist is captured by a thermoelectric element whose output is boosted and used to charge the a lithium ion rechargeable battery. The unit utilizes the Seeback Effect which describes the voltage created when a temperature difference exists across two different metals. The thermoelectric generator takes body heat and dissipates it to the ambient air, creating electricity in the process. Tran 40:18-37 The BI sensor can be a Series Model which assumes that there is one conductive path and that the body consists of a series of resistors. An electrical current, injected at a single frequency, is used to measure whole body impedance (i.e., wrist to ankle) for the purpose of estimating total body water and fat free mass. Alternatively, the BI instrument can be a Parallel BI Model In this model of impedance, the resistors and capacitors are oriented both in series and in parallel in the human body. Whole body BI can be used to estimate TBW and FFM in healthy subjects or to estimate intracellular water (ICW) and body cell mass (BCM). High-low BI can be used to estimate extracellular water (ECW) and total body water (TBW). Multi-frequency BI can be used to estimate ECW, ICW, and TBW: to monitor changes in the

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	ECW/BCM and ECW/TBW ratios in clinical populations. The instrument can also be a segmental BI Model and can be used in the evalu tion of regional fluid changes and in monitoring extra cellular water in patients with abnormal fluid distribution, such as those undergoing hemodialysis. Segmental BI can be used to measure fluid distribution or regional fluid accumulation in clinical populations. Upper-body and Lower-body BI can be used to estimate percentage BF in healthy subjects with nor malhydration status and fluid distribution. The BI sensor can be used to detect acute dehydration, pulmonary edema (caused by mitral stenosis or left ventricular failure or con gestive heart failure, among others), or hyperhydration cause by kidney dialysis, for example. In one embodiment, the system determines the impedance of skin and Subcutaneous adipose tissue using tetrapolar and bipolar impedance mea Surements. In the bipolar arrangement the inner electrodes act both as the electrodes that send the current (outer electrodes in the tetrapolar arrangement) and as receiving electrodes. If the outer two electrodes (electrodes sending current) are Super imposed onto the inner electrodes (receiving electrodes) then a bipolar BIA arrangement exists with the same electrodes acting as receiving and sending electrodes. The difference in impedance measurements between the tetrapolar and bipolar arrangement reflects the impedance of skin and Subcutaneous fat. The difference between the two impedance measure ments represents the combined impedance of skin and Sub cutaneous tissue at one or more sites. The system determines the resistivities of skin and Subcutaneous adipose tissue, and then calculates the skinfold thickness (mainly due to adipose tissue). Tran 43:53-44:28 The patient’s brain cell generates an electromagnetic field of positive or negative polarity, typically in the millivolt range. The sensor measures the electromagnetic field by detecting the difference in potential between one or more test electrodes and a reference electrode. The bio-potential sensor uses signal conditioners or processors to condition the poten tial signal. In one example, the test electrode and reference electrode are coupled to a signal conditioner/processor that includes a lowpass filter to remove undesired high frequency signal components. The electromagnetic field signal is typi cally a slowly varying DC voltage signal. The lowpass filter removes undesired alternating current components arising from static discharge, electromagnetic interference, and other sources. Tran 51:9-22 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an

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	optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40 As shown in FIG. 17A, to eliminate the potentially much greater noise signal from power line sources, a differential instrumentation amplifier is employed. Any signal that originates far away from the detection sites will appear as a common signal, whereas signals in the immediate vicinity of the detection surfaces will be different and consequently will be amplified. Thus, relatively distant power lines noise signals will be removed and relatively local EMG signals will be amplified. The source impedance at the junction of the skin and detection surface may range from several thousand ohms to several megohms for dry skin. In order to prevent attenuation and distortion of the detected signal due to the effects of input loading, the input impedance of the differential amplifier is as large as possible, without causing ancillary complications to the workings of the differential amplifier. The signal to noise ratio is increased by filtering between 20-500 Hz with a roll-off of 12 dB/octave. Tran at 91:12-28 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Tran discloses or renders obvious the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. Other advantages of the invention may include one or more of the following. The system for non-invasively and continually monitors a subject's arterial blood pressure, with reduced susceptibility to noise and subject movement, and relative insensitivity to placement of the apparatus on the subject. The system does not need frequent recalibration of the system while in use on the subject.

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	Tran at 4:37-43 The patient 30 may wear one or more wearable patient monitoring appliances such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance such as a wrist-watch includes sensors 40, for example devices for sensing ECG, EKG, blood pressure, sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient's wrist (such as a wristwatch sensor) and other convenient anatomical locations. Exemplary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascular system (ECG). Tran at 9:23-34 Bipolar or tetrapolar electrode systems can be used in the BI instruments. Of these, the tetrapolar system provides a uniform current density distribution in the body segment and measures impedance with less electrode interface artifact and impedance errors. In the tetrapolar system, a pair of surface electrodes (I1, I2) is used as current electrodes to introduce a low intensity constant current at high frequency into the body. A pair of electrodes (E1, E2) measures changes accompanying physiological events. Voltage measured across E1-E2 is directly proportional to the segment electrical impedance of the human subject. Circular flat electrodes as well as band type electrodes can be used. In one embodiment, the electrodes are in direct contact with the skin surface. In other embodiments, the voltage measurements may employ one or more contactless, voltage sensitive electrodes such as inductively or capacitively coupled electrodes. The current application and the voltage measurement electrodess in these embodiments can be the same, adjacent to one another, or at significantly different locations. The electrode(s) can apply current levels from 20 uA to 10 mA rms at a frequency range of 20-100 KHz. A constant current source and high input impedance circuit is used in conjunction with the tetrapolar electrode configuration to avoid the contact pressure effects at the electrode-skin interface. Tran at 40:30-52 In one implementation, BIA measurements can be made using an array of bipolar or tetrapolar electrodes that deliver a constant alternating current at 50 KHz frequency. Whole body measurements can be done using standard right-sided. The ability of any biological tissue to resist a constant electric current depends on the relative proportions of water and electrolytes it contains, and is called resistivity (in Ohms/cm3). The measuring of bioimpedance to assess congestive heart failure employs the different bio-electric

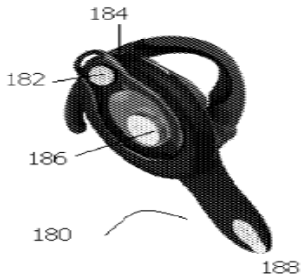
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	properties of blood and lung tissue to permit separate assessment of: (a) systemic venous congestion via a low frequency or direct current resistance measurement of the current path through the right ventricle, right atrium, superior vena cava, and subclavian vein, or by computing the real component of impedance at a high frequency, and (b) pulmonary congestion via a high frequency measurement of capacitive impedance of the lung. The resistance is impedance measured using direct current or alternating current (AC) which can flow through capacitors. Tran at 45:55-46:5 The heartbeat detector can be one of: EKG detector, ECG detector, optical detector, ultrasonic detector, or microphone/digital stethoscope for picking up heart sound. In one embodiment, one EKG/ECG contact point is provided on the back of the wrist watch case and one or more EKG/ECG contact points are provided on the surface of the watch so that when a user's finger or skin touches the contact points, an electrical signal indicative of heartbeat activity is generated. An electrocardiogram (ECG) or EKG is a graphic tracing of the voltage generated by the cardiac or heart muscle during a heartbeat. It provides very accurate evaluation of the performance of the heart. The heart generates an electrochemical impulse that spreads out in the heart in such a fashion as to cause the cells to contract and relax in a timely order and thus give the heart a pumping characteristic. This sequence is initiated by a group of nerve cells called the sinoatrial (SA) node resulting in a polarization and depolarization of the cells of the heart. Because this action is electrical in nature and because the body is conductive with its fluid content, this electrochemical action can be measured at the surface of the body. An actual voltage potential of approximately 1 mV develops between various body points. This can be measured by placing electrode contacts on the body. The four extremities and the chest wall have become standard sites for applying the electrodes. Standardizing electrocardiograms makes it possible to compare them as taken from person to person and from time to time from the same person. The normal electrocardiogram shows typical upward and downward deflections that reflect the alternate contraction of the atria (the two upper chambers) and of the ventricles (the two lower chambers) of the heart. The voltages produced represent pressures exerted by the heart muscles in one pumping cycle. The first upward deflection, P, is due to atria contraction and is known as the atrial complex. The other deflections, Q, R, S, and T, are all due to the action of the ventricles and are known as the ventricular complexes. Any deviation from the norm in a particular electrocardiogram is indicative of a possible heart disorder. Tran at 59:38-60:8

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	 FIG. 14B Tran at Fig.14B FIG. 14B shows a sunglass or eyeglass embodiment which contains electronics for communicating with the mesh network and for sensing acceleration and bioimpedance, EKG/ECG, EMG, heart sound, microphone, optical sensor, or ultrasonic sensor in contacts with a wearer's skin. In one embodiment, the ear module 310 contains optical sensors to detect temperature, blood flow and blood oxygen level as well as a speaker to provide wireless communication or hearing aid. The blood flow or velocity information can be used to estimate blood pressure. The side module 312 can contain an array of bioimpedance sensors such as bipolar or tetrapolar bioimpedance probes to sense fluids in the brain. Additional bioimpedance electrodes can be positioned around the rim of the glasses as well as the glass handle or in any spots on the eyewear that contacts the user. The side module 312 or 314 can also contain one or more EKG electrodes to detect heart beat parameters and to detect heart problems. The side module 312 or 314 can also contain piezoelectric transducers or microphones to detect heart activities near the brain. The side module 312 or 314 can also contain ultrasound transmitter and receiver to create an ultrasound model of brain fluids. Tran at 67:16-36 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.	See claim 1 above. Tran discloses or renders obvious the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal. In another aspect, heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless trans ceiver to communicate patient data over the wireless mesh network. Tran 3:6-13 Implementations of the above aspect may include one or more of the following. The wristwatch determines position based on triangulation. The wristwatch determines position based on RF signal strength and RF signal angle. A switch detects a confirmatory signal from the person. The confirmatory signal includes a head movement, a hand movement, or a mouth movement. The confirmatory signal includes the person's voice. A processor in the system executes computer readable code to transmit a help request to a remote computer. The code can encrypt or scramble data for privacy. The processor can execute voice over IP (VOIP) code to allow a user and a remote person to audibly communicate with each other. The voice communication system can include Zigbee VOIP or Bluetooth VOIP or 802.XX VOIP. The remote person can be a doctor, a nurse, a medical assistant, or a caregiver. The system includes code to store and analyze patient information. The patient information includes medicine taking habits, eating and drinking habits, sleeping habits, or excise habits. A patient interface is provided on a user computer for accessing information and the patient interface includes in one implementation a touch screen; voice-activated text reading; and one touch telephone dialing. The processor can execute code to store and analyze information relating to the person's ambulation. A global positioning system (GPS) receiver can be used to detect movement and where the person falls. The system can include code to map the person's location onto an area for viewing. The system can include one or more cameras positioned to capture three dimensional (3D) video of the patient; and a server coupled to the one or more cameras,

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	the server executing code to detect a dangerous condition for the patient based on the 3D video and allow a remote third party to view images of the patient when the dangerous condition is detected. Tran at 3:48-4:13 The patient 30 may wear one or more wearable patient monitoring appliances Such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance Such as a wrist-watch includes sensors 40. for example devices for sensing ECG, EKG, blood pressure, Sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient’s wrist (Such as a wristwatch sensor) and other convenient anatomical locations. Exem plary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascu lar system (ECG). Leg sensors can include piezoelectric accelerometers designed to give qualitative assessment of limb movement. Additionally, thoracic and abdominal bands used to measure expansion and contraction of the thorax and abdomen respectively. A Small sensor can be mounted on the Subjects finger in order to detect blood-oxygen levels and pulse rate. Additionally, a microphone can be attached to throat and used in sleep diagnostic recordings for detecting breathing and other noise. One or more position sensors can be used for detecting orientation of body (lying on left side, right side or back) during sleep diagnostic recordings. Each of sensors 40 can individually transmit data to the server 20 using wired or wireless transmission. Alternatively, all sen sors 40 can be fed through a common bus into a single trans ceiver for wired or wireless transmission. The transmission can be done using a magnetic medium Such as a floppy disk or a flash memory card, or can be done using infrared or radio networklink, among others. The sensor 40 can also includean indoor positioning system or alternatively a global position system (GPS) receiver that relays the position and ambulatory patterns of the patient to the server 20 for mobility tracking. Tran at 9:23-54 The server 20 also executes one or more software modules to analyze data from the patient. A module 50 monitors the patient’s vital signs such as ECG/EKG and generates warn ings should problems occur. In this module, vital signs can be collected and communicated to the server 20 using wired or wireless transmitters. In one embodiment, the server 20 feeds the data to a statistical analyzer Such as a neural network which has been trained to flag potentially dangerous condi tions. The neural network can be a back-propagation neural network, for example. In this embodiment, the statistical ana lyZer is trained with training data where certain signals are determined to be undesirable for the patient, given his age, weight, and physical limitations, among others. For example, the patient’s glucose level should be within

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	a well established range, and any value outside of this range is flagged by the statistical analyzer as a dangerous condition. As used herein, the dangerous condition can be specified as an event or a pattern that can cause physiological or psychological damage to the patient. Moreover, interactions between different vital signals can be accounted for so that the statistical analyzer can take into consideration instances where individually the vital signs are acceptable, but in certain combinations, the vital signs can indicate potentially dangerous conditions. Once trained, the data received by the server 20 can be appropri ately scaled and processed by the statistical analyzer. In addi tion to statistical analyzers, the server 20 can process vital signs using rule-based inference engines, fuZZylogic, as well as conventional if-then logic. Additionally, the server can process vital signs using Hidden Markov Models (HMMs), dynamic time warping, or template matching, among others. Tran at 11:1-30 In one embodiment, data driven analyzers may be used to track the patients habits. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric Statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models of the patient’s habits or ambulation patterns are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accu racy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate data set referred to as a test set for training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set. The selection of the analyzer or model parameters is performed iteratively until the performance of the analyzer in classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross validation, a single training data set is selected. Next, a num ber of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure is then determined on the basis of the combined performance of all models or analyzers. Under the cross-validation approach, the analyZeror model is typically retrained with data using the determined optimal model structure.

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	Tran 22:24-60 In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural net work is quite robust at recognizing user habits or patterns. Once the treatment features have been characterized, the neu ral network then compares the input user information with stored templates of treatment vocabulary known by the neural network recognizer, among others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination. Tran 23:39-50 An analog signal representative of the Doppler frequency of the echo is received by the transducer and converted to a digital representation by the ADC, and supplied to the CPU for signal processing. Within the CPU, the digitized Doppler frequency is scaled to compute the blood flow velocity within the artery based on the Doppler frequency. Based on the real time the blood flow velocity, the CPU applies the vital model to the corresponding blood flow velocity to produce the estimated blood pressure value. Tran at 35:57-65  FIG. 13 Tran at Fig. 13 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be

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	light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 The electronic circuitry housed in the watch case 1380 detects adverse conditions such as falls or seizures. In one implementation, the circuitry can recognize speech, namely utterances of spoken words by the user, and converting the utterances into digital signals. The circuitry for detecting and processing speech to be sent from the wristwatch to the base station 20 over the mesh network includes a central processing unit (CPU) connected to a ROM/RAM memory via a bus. The CPU is a preferably low power 16-bit or 32-bit microprocessor and the memory is preferably a high density, low-power RAM. The CPU is coupled via the bus to processor wake-up logic, one or more accelerometers to detect sudden movement in a patient, an ADC 102 which receives speech input from the microphone. The ADC converts the analog signal produced by the microphone into a sequence of digital values representing the amplitude of the signal produced by the microphone at a sequence of evenly spaced times. The CPU is also coupled to a digital to analog (D/A) converter, which drives the speaker to communicate with the user. Speech signals from the microphone are first amplified, pass through an antialiasing filter before being sampled. The front-end processing includes an amplifier, a bandpass filter to avoid antialiasing, and an analog-to-digital (A/D) converter or a CODEC. To minimize space, the ADC, the DAC and the interface for wireless transceiver and switches may be integrated into one integrated circuit to save space. In one embodiment, the wrist watch acts as a walkie-talkie so that voice is received over the mesh network by the base station 20 and then delivered to a call center over the POTS or PSTN network. In another embodiment, voice is provided to the call center using the Internet through suitable VOIP techniques. In one embodiment, speech recognition such as a speech recognizer is discussed in U.S. Pat. No. 6,070,140 by the inventor of the instant invention, the content of which is incorporated by reference. Tran at 37:51-38:18

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	In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implementation, a reflective sensor such as the Honeywell HLC1395 can be used. The device emits lights from a window in the infrared spectrum and receives reflected light in a second window. When the heart beats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, and the resulting optical waveform is captured by the CPU. Tran at 60:58-61:5 In addition to heart sound analysis, the timing between the onset and offset of particular features of the ECG (referred to as an interval) provides a measure of the state of the heart and can indicate the presence of certain cardiological conditions. An EKG analyzer is provided to interpret EKG/ECG data and generate warnings if needed. The analyzer examines intervals in the ECG waveform such as the QT interval and the PR interval. The QT interval is defined as the time from the start of the QRS complex to the end of the T wave and corresponds to the total duration of electrical activity (both depolarization and repolarization) in the ventricles. Similarly, the PR inter val is defined as the time from the start of the P wave to the the onset of atrial depolarization to the onset of ventricular depolarization. In one embodiment, hidden Markov and hid den semi-Markov models are used for automatically seg menting an electrocardiogram waveform into its constituent waveform features. An undecimated wavelet transform is used to generate an overcomplete representation of the signal that is more appropriate for Subsequent modelling. By exam ining the ECG signal in detail it is possible to derive a number of informative measurements from the characteristic ECG waveform. These can then be used to assess the medical well-being of the patient. The wavelet methods such as the undecimated wavelet transform, can be used instead of raw time series data to generate an encoding of the ECG which is tuned to the unique spectral characteristics of the ECG wave form features. The segmentation process can use of explicit state duration modelling with hidden semi-Markov models. Using a labelled data set of ECG waveforms, a hidden Markov model is trained in a supervised manner. The model was comprised of the following states: P wave, QRS complex, T wave, U wave, and Baseline. The parameters of the transi tion matrix aij were computed using the maximum likelihood estimates. The ECG data is encoded with wavelets from the Daubechies, Symlet, Coiflet or Biorthogonal wavelet fami lies, among others. In the frequency domain, a wavelet at a given scale is associated with a bandpass filter of a particular centre frequency.

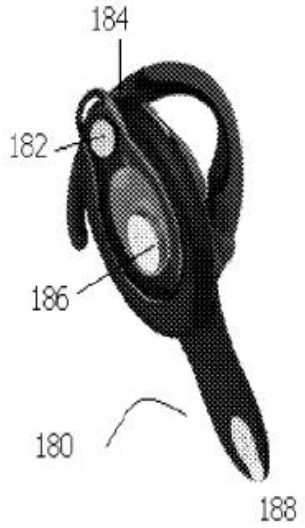
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	Thus the optimal wavelet basis will corre spond to the set of bandpass filters that are tuned to the unique spectral characteristics of the ECG. In another implementa tion, a hidden semi-Markov model (HSMM) is used. HSMM differs from a standard HMM in that each of the self-transi tion coefficients aii are set to zero, and an explicit probability density is specified for the duration of each state. In this way, the individual state duration densities govern the amount of time the model spends in a given state, and the transition matrix governs the probability of the next state once this time has elapsed. Thus the underlying stochastic process is now a “semi-Markov' process. To model the durations of the vari ous waveform features of the ECG, a Gamma density is used since this is a positive distribution which is able to capture the skewness of the ECG state durations. For each state i, maxi mum likelihood estimates of the shape and Scale parameters were computed directly from the set of labelled ECG signals. Tran 85:56-86:43 FIG. 16C shows an exemplary process to detect stroke attack. In this embodiment, 3D accelerometer sensing is used. First, the process looks for weakness (hemiparesis) in either the left half or the right half of the body, for example the left/right arms, legs, or face (3000). Next, the system analyzes walking pattern to see if the patient has a loss of balance or coordination (3002). The system then asks the user to move hands/feet in a predetermined pattern (3004) and reads accel erometer output in accordance with predetermined pattern movement (3006). For example, the system can ask the user to point his/her right or left hand to the nose. The accelerometer outputs are tested to check if the correct hand did reach the nose. In another example, the user can be prompted to extend his or her hands on both side and wiggle the hands or to kick the legs. Again, the outputs of the accelerometers are used to confirm that the user is able to follow direction. The acceler ometer outputs are provided to a pattern classifier, which can be an HMM, a neural network, a Bayesian network, fuzzy logic, or any suitable classifiers (3008). The system also checks whether patient is experiencing dizziness or Sudden, severe headache with no known cause (3010). Next, the sys tem displays a text image and asks the patient to readback the text image, one eye at a time (3012). Using a speech recog nizer module, the user speech is converted into text to com pare against the text image. The speech recognizer also detects if the user exhibits signs of confusion, trouble speak ing or understanding (3014). The system also asks the patient if they feel numbness in the body—arms, legs, face (3016). Next the system asks the patient to squeeze gauge/force sen sor to determine force applied during squeeze (3018). If any of the above tests indicate a possible stroke, the system dis plays a warning to the patient and also connects the patient to the appropriate emergency response authority, family mem ber, or physician. Tran 87:4-37

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	One major symptom of a stroke is unexplained weakness or numbness in the muscle. To detect muscle weakness or numb ness, in one embodiment, the system applies a pattern recog nizer such as a neural network or a Hidden Markov Model (HMM) to analyze accelerometer output. In another embodi ment, electromyography (EMG) is used to detect muscle weakness. In another embodiment, EMG and a pattern ana lyZer is used to detect muscle weakness. In yet another embodiment, a pattern analyzer analyzes both accelerometer and EMG data to determine muscle weakness. In a further embodiment, historical ambulatory information (time and place) is used to further detect changes in muscle strength. In yet other embodiments, accelerometer data is used to confirm that the patient is at rest so that EMG data can be accurately captured or to compensate for motion artifacts in the EMG data in accordance with a linear or non-linear compensation table. In yet another embodiment, the EMG data is used to detect muscle fatigue and to generate a warning to the patient to get to a resting place or a notification to a nurse or caretiver to render timely assistance. Tran 90:42-61 The EMG signal can be rectified, integrated a specified interval of and subsequently forming a time series of the integrated values. The system can calculate the root-mean-squared (rms) and the average rectified (avr) value of the EMG signal. The system can also determine muscle fatigue through the analysis of the frequency spectrum of the signal. The system can also assess neurological diseases which affect the fiber typing or the fiber cross-sectional area of the muscle. Various mathematical techniques and Artificial Intelligence (AI) analyzer can be applied. Mathematical models include wavelet transform, time-frequency approaches, Fourier transform, Wigner-Ville Distribution (WVD), statistical measures, and higher-order statistics. AI approaches towards signal recognition include Artificial Neural Networks (ANN), dynamic recurrent neural networks (DRNN), fuzzy logic system, Genetic Algorithm (GA), and Hidden Markov Model (HMM). Tran at 94:49-65 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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Claim 6	
6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	See claim 1 above. Tran discloses or renders obvious the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. In yet another aspect, a monitoring system for a person includes one or more wireless nodes forming a wireless mesh network; and a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a heartbeat detector coupled to the wireless transceiver. The system may also include an accelerometer to detect a dangerous condition such as a falling condition and to generate a warning when the dangerous condition is detected. Tran at 3:40-47 To view information sent from the blood-pressure monitor and fall detector on the wearable appliance, the patient or an authorized third party such as family members, emergency personnel, or medical professional accesses a patient user interface hosted on the web server 200 through the Internet 100 from a remote computer system. The patient interface displays vital information such as ambulation, blood pressure and related data measured from a single patient. The system may also include a call center, typically staffed with medical professionals such as doctors, nurses, or nurse practioners, whom access a care-provider interface hosted on the same website on the server 200. The care-provider interface displays vital data from multiple patients. Tran at 25:65-26:10 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is

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	digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:13 In one embodiment, an electrode array sensor can include impedance, bio-potential, or electromagnetic field tomography imaging of cranial tissue. The electrode array sensor can be a geometric array of discrete electrodes having an equallyspaced geometry of multiple nodes that are capable of functioning as sense and reference electrodes. In a typical tomography application the electrodes are equally-spaced in a circular configuration. Alternatively, the electrodes can have non-equal spacing and/or can be in rectangular or other configurations in one circuit or multiple circuits. Electrodes can be configured in concentric layers too. Points of extension form multiple nodes that are capable of functioning as an electrical reference. Data from the multiple reference points can be collected to generate a spectrographic composite for monitoring over time. Tran at 50:61-51:8 A stimulus device may optionally be placed on each subject, such as an audio generator in the form of an ear plug, which produces a series of “click” sounds. The subject's brain waves are detected and converted into audio tones. The device may have an array of LED (Light Emitting Diodes) which blink depending on the power and frequency composition of the brain wave signal. Power ratios in the frequencies of audio or somatosensory stimuli are similarly encoded. The EEG can be transmitted to a remote physician or medical aide who is properly trained to determine whether the patient's brain function is abnormal and may evaluate the functional state of various levels of the patient's nervous system. Tran at 52: 36-47 The heartbeat detector can be one of: EKG detector, ECG detector, optical detector, ultrasonic detector, or microphone/digital stethoscope for picking up heart sound. In one embodiment, one EKG/ECG contact point is provided on the back of the wrist watch case and one or more EKG/ECG contact points are provided on the surface of the watch so that when a user's finger or skin touches the contact points, an electrical signal indicative of heartbeat activity is generated. An electrocardiogram (ECG) or EKG is a graphic tracing of the voltage generated by the cardiac or heart muscle during a heartbeat. It provides very accurate evaluation of the performance of the heart. The heart generates an electrochemical impulse

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	that spreads out in the heart in such a fashion as to cause the cells to contract and relax in a timely order and thus give the heart a pumping characteristic. This sequence is initiated by a group of nerve cells called the sinoatrial (SA) node resulting in a polarization and depolarization of the cells of the heart. Because this action is electrical in nature and because the body is conductive with its fluid content, this electrochemical action can be measured at the surface of the body. An actual voltage potential of approximately 1 mV develops between various body points. This can be measured by placing electrode contacts on the body. The four extremities and the chest wall have become standard sites for applying the electrodes. Standardizing electrocardiograms makes it possible to compare them as taken from person to person and from time to time from the same person. The normal electrocardiogram shows typical upward and downward deflections that reflect the alternate contraction of the atria (the two upper chambers) and of the ventricles (the two lower chambers) of the heart. The voltages produced represent pressures exerted by the heart muscles in one pumping cycle. The first upward deflection, P, is due to atria contraction and is known as the atrial complex. The other deflections, Q, R, S, and T, are all due to the action of the ventricles and are known as the ventricular complexes. Any deviation from the norm in a particular electrocardiogram is indicative of a possible heart disorder. Tran at 59:38-60:8 In an optical heartbeat detector embodiment, an optical transducer is positioned on a finger, wrist, or ear lobe. The ear, wrist or finger pulse oximeter waveform is then analyzed to extract the beat-to-beat amplitude, area, and width (half height) measurements. The oximeter waveform is used to generate heartbeat rate in this embodiment. In one implementation, a reflective sensor such as the Honeywell HLC1395 can be used. The device emits lights from a window in the infrared spectrum and receives reflected light in a second window. When the heart beats, blood flow increases temporarily and more red blood cells flow through the windows, which increases the light reflected back to the detector. The light can be reflected, refracted, scattered, and absorbed by one or more detectors. Suitable noise reduction is done, and the resulting optical waveform is captured by the CPU. Tran 60:58-61:5

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	 FIG. 13 Tran at Fig. 13 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40 FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is

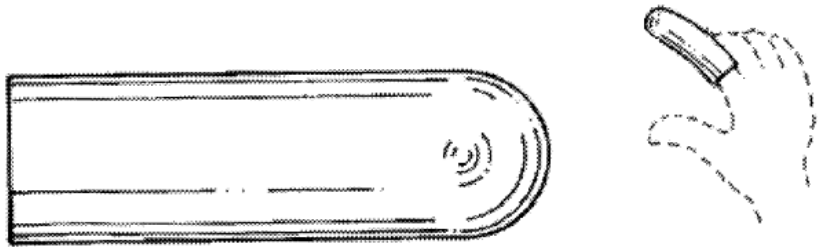
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	processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. Tran at 67:41-48 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a	See claim 6 above. Tran discloses or renders obvious the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. Implementations of the above aspect may include one or more of the following. The wristwatch determines position based on triangulation. The wristwatch determines position based on RF signal strength and RF signal angle. A switch detects a confirmatory signal from the person. The confirmatory

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speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	signal includes a head movement, a hand movement, or a mouth movement. The confirmatory signal includes the person's voice. A processor in the system executes computer readable code to transmit a help request to a remote computer. The code can encrypt or scramble data for privacy. The processor can execute voice over IP (VOIP) code to allow a user and a remote person to audibly communicate with each other. The voice communication system can include Zigbee VOIP or Bluetooth VOIP or 802.XX VOIP. The remote person can be a doctor, a nurse, a medical assistant, or a caregiver. The system includes code to store and analyze patient information. The patient information includes medicine taking habits, eating and drinking habits, sleeping habits, or excise habits. A patient interface is provided on a user computer for accessing information and the patient interface includes in one implementation a touch screen; voice-activated text reading; and one touch telephone dialing. The processor can execute code to store and analyze information relating to the person's ambulation. A global positioning system (GPS) receiver can be used to detect movement and where the person falls. The system can include code to map the person's location onto an area for viewing. The system can include one or more cameras positioned to capture three dimensional (3D) video of the patient; and a server coupled to the one or more cameras, the server executing code to detect a dangerous condition for the patient based on the 3D video and allow a remote third party to view images of the patient when the dangerous condition is detected. Tran at 3:48-4:13 One appliance is a patient monitoring device that can be worn by the patient and includes a single or bi-directional wireless communication link, generally identified by the bolt symbol in FIG. 1, for transmitting data from the appliances 8 to the local hub or receiving station or base station server 20 by way of a wireless radio frequency (RF) link using a proprietary or non-proprietary protocol. Tran at 8: 45-52 The base station/server 20 stores the patient's ambulation pattern and vital parameters and can be accessed by the patient's family members (sons/daughters), physicians, caretakers, nurses, hospitals, and elderly community. The base station/server 20 may communicate with the remote server 200 by DSL, T-1 connection over a private communication network or a public information network, such as the Internet 100, among others. Tran at 9: 15-22

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	In one embodiment, the sensors 40 for monitoring vital signs are enclosed in a wrist-watch sized case supported on a wrist band. The sensors can be attached to the back of the case. For example, in one embodiment, Cygnus' AutoSensor (Redwood City, Calif.) is used as a glucose sensor. A low electric current pulls glucose through the skin. Glucose is accumulated in two gel collection discs in the AutoSensor. The AutoSensor measures the glucose and a reading is displayed by the watch Tran at 9:55-63 The base station 20 frequently collects and synchronizes data from the appliances 8. The base station 20 may use one of various transportation methods to connect to the repository on the server 200 using a PC as conduit or through a connection established using an embedded modem (connected to a phone line), a wireless router (DSL or cable wireless router), a cellular modem, or another network-connected appliance (such as, but not limited to, a web-phone, video-phone, embedded computer, PDA or handheld computer). Tran at 17: 9-17 FIG. 5 shows an exemplary process to monitor patient. First, the process sets up mesh network appliances (1000). Next, the process determines patient position using in-door positioning system (1002). The process then determines patient movement using accelerometer output (1004). Sharp accelerations may be used to indicate fall. Further, the Z axis accelerometer changes can indicate the height of the appli ance from the floor and if the height is near Zero, the system infers that the patient had fallen. The system can also deter mine vital parameter including patient heart rate (1006). The system determines if patient needs assistance based on in door position, fall detection and vital parameter (1008). If a fall is suspected, the system confirms the fall by communi cating with the patient prior to calling a third party Such as the patient’s physician, nurse, family member, 911, 511, 411, or a paid call center to get assistance for the patient (1010). If confirmed or if the patient is non-responsive, the system contacts the third party and sends Voice over mesh network to appliance on the patient to allow one or more third parties to talk with the patient (1012). If needed, the system calls and/or conferences emergency personnel into the call (1014). In one embodiment, if the patient is outside of the mesh network range such as when the user is traveling away from his/her home, the system continuously records information into memory until the home mesh network is reached or until the monitoring appliance reaches an internet access point. While the wearable appliance is outside of the mesh network range, the device searches for a cell phone with an expansion

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	card plugged into a cell phone expansion slot such as the SDIO slot. If the wearable appliance detects a cell phone that is mesh network compatible, the wearable appliance communicates with the cell phone and provides information to the server 200 using the cellular connection. In one embodiment, a Zigbee SDIO card from C-guys, Inc., enables device-to-device communications for PDAs and smart phones. C-guys' ZigBee SDIO card includes the company's CG-100 SDIO application interface controller, which is designed to convert an application signal to an SD signal (or vice versa). The ZigBee card can provide signal ranges of up to 10 m in the 2.4 GHz band and data rates of up to 200 kbps. The card has peer-to-peer communications mode and supports direct application to PDAs or any SD supported hand-held cell phones. In this embodiment, the PDA or cell phone can provide a GPS position information instead of the indoor position information generated by the mesh network appliances 8. The cell phone GPS position information, accelerometer information and vital information such as heart rate information is transmitted using the cellular channel to the server 200 for processing as is normal. In another embodiment where the phone works through WiFi (802.11) or WiMAX (802.16) or ultra-wideband protocol instead of the cellular protocol, the wearable appliance can communicate over these protocols using a suitable mesh network interface to the phone. In instances where the wearable appliance is outside of its home base and a dangerous condition such as a fall is detected, the wearable appliance can initiate a distress call to the authorized third party using cellular, WiFi, WiMAX, or UWB protocols as is available. Tran at 33:50-34:40 After the computer model has been generated, the system is ready for real-time blood pressure monitoring. In an acoustic embodiment, the transducer directs ultrasound at the patient's artery and subsequently listens to the echos therefrom. The echoes are used to determine blood flow, which is fed to the computer model to generate the systolic and diastolic pressure values as well as heart rate value. The CPU's output signal is then converted to a form useful to the user such as a digital or analog display, computer data file, or audible indicator. The output signal can drive a speaker to enable an operator to hear a representation of the Doppler signals and thereby to determine when the transducer is located approximately over the radial artery. The output signal can also be wirelessly sent to a base station for subsequent analysis by a physician, nurse, caregiver, or treating professional. The output signal can also be analyzed for medical attention and medical treatment. Tran at 36:21-37

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Tran discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. See above at claim 1[pre] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Tran discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light. See above at claim 1[c], 1[j], 1[k] In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is

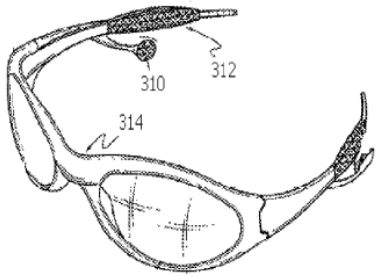
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	digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67: 28-40  FIG. 9 Tran at Fig. 9

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	FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. Tran at 67:41-48 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Tran discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. See above at claim 1[d] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Tran discloses or renders obvious a detector. See above at claim 1[e] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Tran discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and. See above at claim 1[e], 1[k], [5] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Tran discloses or renders obvious a processor configured to (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. See above at claim 1[e], 1[j], [5] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal	Tran discloses or renders obvious a processor configured to (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user.

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having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	See above at claim 1[b], 1[e], 1[l], [5] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.	Tran discloses or renders obvious a processor configured to (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user. The patient 30 may wear one or more wearable patient monitoring appliances such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance such as a wrist-watch includes sensors 40, for example devices for sensing ECG, EKG, blood pressure, sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient's wrist (such as a wristwatch sensor) and other convenient anatomical locations. Exemplary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascular system (ECG). Tran at 9: 23-34 Bipolar or tetrapolar electrode systems can be used in the BI instruments. Of these, the tetrapolar system provides a uniform current density distribution in the body segment and measures impedance with less electrode interface artifact and impedance errors. In the tetrapolar system, a pair of surface electrodes (I1, I2) is used as current electrodes to introduce a low intensity constant current at high frequency into the body. A pair of electrodes (E1, E2) measures changes accompanying physiological events. Voltage measured across E1-E2 is directly proportional to the segment electrical impedance of the human subject. Circular flat electrodes as well as band type electrodes can be used. In one embodiment, the electrodes are in direct contact with the skin surface. In other embodiments, the voltage measurements may employ one or more contactless, voltage sensitive electrodes such as inductively or capacitively coupled electrodes. The current application and the voltage measurement electrodess in these embodiments can be the same, adjacent to one another, or at significantly different locations. The electrode(s) can apply current levels from 20 uA to 10 mA rms at a frequency range of 20-100 KHz. A constant current source

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	and high input impedance circuit is used in conjunction with the tetrapolar electrode configuration to avoid the contact pressure effects at the electrode-skin interface. Tran at 40:30-52 In one implementation, BIA measurements can be made using an array of bipolar or tetrapolar electrodes that deliver a constant alternating current at 50 KHz frequency. Whole body measurements can be done using standard right-sided. The ability of any biological tissue to resist a constant electric current depends on the relative proportions of water and electrolytes it contains, and is called resistivity (in Ohms/cm3). The measuring of bioimpedance to assess congestive heart failure employs the different bio-electric properties of blood and lung tissue to permit separate assessment of: (a) systemic venous congestion via a low frequency or direct current resistance measurement of the current path through the right ventricle, right atrium, superior vena cava, and subclavian vein, or by computing the real component of impedance at a high frequency, and (b) pulmonary congestion via a high frequency measurement of capacitive impedance of the lung. The resistance is impedance measured using direct current or alternating current (AC) which can flow through capacitors. Tran at 45:55-46:5 The heartbeat detector can be one of: EKG detector, ECG detector, optical detector, ultrasonic detector, or microphone/digital stethoscope for picking up heart sound. In one embodiment, one EKG/ECG contact point is provided on the back of the wrist watch case and one or more EKG/ECG contact points are provided on the surface of the watch so that when a user's finger or skin touches the contact points, an electrical signal indicative of heartbeat activity is generated. An electrocardiogram (ECG) or EKG is a graphic tracing of the voltage generated by the cardiac or heart muscle during a heartbeat. It provides very accurate evaluation of the performance of the heart. The heart generates an electrochemical impulse that spreads out in the heart in such a fashion as to cause the cells to contract and relax in a timely order and thus give the heart a pumping characteristic. This sequence is initiated by a group of nerve cells called the sinoatrial (SA) node resulting in a polarization and depolarization of the cells of the heart. Because this action is electrical in nature and because the body is conductive with its fluid content, this electrochemical action can be measured at the surface of the body. An actual voltage potential of approximately 1 mV develops between various body points. This can be measured by placing electrode contacts on the body. The four extremities and the chest wall have become standard sites for applying the electrodes. Standardizing electrocardiograms makes it possible to compare them as taken from person to person and from time to time from the same person. The normal electrocardiogram shows typical

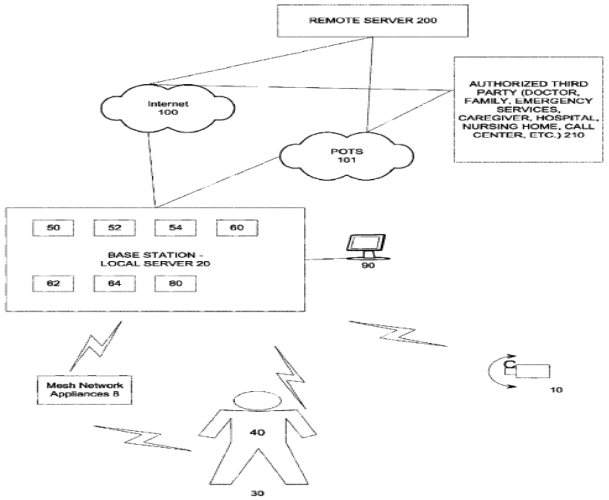
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	upward and downward deflections that reflect the alternate contraction of the atria (the two upper chambers) and of the ventricles (the two lower chambers) of the heart. The voltages produced represent pressures exerted by the heart muscles in one pumping cycle. The first upward deflection, P, is due to atria contraction and is known as the atrial complex. The other deflections, Q, R, S, and T, are all due to the action of the ventricles and are known as the ventricular complexes. Any deviation from the norm in a particular electrocardiogram is indicative of a possible heart disorder. Tran at 59:38-60:8  FIG. 14B Tran at Fig.14B FIG. 14B shows a sunglass or eyeglass embodiment which contains electronics for communicating with the mesh network and for sensing acceleration and bioimpedance, EKG/ECG, EMG, heart sound, microphone, optical sensor, or ultrasonic sensor in contacts with a wearer's skin. In one embodiment, the ear module 310 contains optical sensors to detect temperature, blood flow and blood oxygen level as well as a speaker to provide wireless communication or hearing aid. The blood flow or velocity information can be used to estimate blood pressure. The side module 312 can contain an array of bioimpedance sensors such as bipolar or tetrapolar bioimpedance probes to sense fluids in the brain. Additional bioimpedance electrodes can be positioned around the rim of the glasses as well as the glass handle or in any spots on the eyewear that contacts the user. The side module 312 or 314 can also contain one or more EKG electrodes to detect heart beat parameters and to detect heart problems. The side module 312 or 314 can also contain piezoelectric transducers or microphones to detect heart

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	activities near the brain. The side module 312 or 314 can also contain ultrasound transmitter and receiver to create an ultrasound model of brain fluids. Tran at 67:16-36 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. Tran discloses or renders obvious at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry

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	information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electron ics, accelerometer, and physiological sensors such as EKG/ ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communica tion and pick up heart sound when the user is not using the microphone for Voice communication. The earphone option ally has an ear canal temperature sensor for sensing tempera ture in a human. Tran 68:24-38 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. Tran discloses or renders obvious the physiological parameter of the user is associated with a blood constituent or a blood flow of the user. A heart monitoring system for a patient includes one or more wireless nodes forming a wireless mesh network; a wearable appliance having a wireless transceiver adapted to communicate with the one or more wireless nodes; and a statistical analyzer to determine heart attack or stroke attack, the statistical analyzer coupled to the wireless transceiver to communicate patient data over the wireless mesh network. Tran at [Abstract] FIG. 1 shows an exemplary patient monitoring system. The system can operate in a home, a nursing home, or a hospital. In this system, one or more mesh network appliances 8 are provided to enable wireless communication in the home monitoring system. Appliances 8 in the mesh network can include home security monitoring devices, door alarm, window alarm, home temperature control devices, fire alarm devices, among others. Appliances 8 in the mesh network can be one of multiple portable

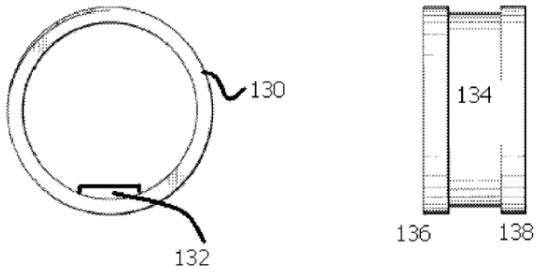
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	physiological transducer, such as a blood pressure monitor, heart rate monitor, weight scale, thermometer, spirometer, single or multiple lead electrocardiograph (ECG), a pulse oxymeter, a body fat monitor, a cholesterol monitor, a signal from a medicine cabinet, a signal from a drug container, a signal from a commonly used appliance such as a refrigerator/stove/oven/washer, or a signal from an exercise machine, such as a heart rate. As will be discussed in more detail below, one appliance is a patient monitoring device that can be worn by the patient and includes a single or bi-directional wireless communication link, generally identified by the bolt symbol in FIG. 1, for transmitting data from the appliances 8 to the local hub or receiving station or base station server 20 by way of a wireless radio frequency (RF) link using a proprietary or non-proprietary protocol. For example, within a house, a user may have mesh network appliances that detect window and door contacts, smoke detectors and motion sensors, video cameras, key chain control, temperature monitors, CO and other gas detectors, vibration sensors, and others. A user may have flood sensors and other detectors on a boat. An individual, such as an ill or elderly grandparent, may have access to a panic transmitter or other alarm transmitter. Other sensors and/or detectors may also be included. The user may register these appliances on a central security network by entering the identification code for each registered appliance/device and/or system. The mesh network can be Zigbee network or 802.15 network. More details of the mesh network is shown in FIG. 7 and discussed in more detail below. Tran at 8: 29-65 The patient 30 may wear one or more wearable patient monitoring appliances Such as wrist-watches or clip on devices or electronic jewelry to monitor the patient. One wearable appliance Such as a wrist-watch includes sensors 40. for example devices for sensing ECG, EKG, blood pressure, Sugar level, among others. In one embodiment, the sensors 40 are mounted on the patient’s wrist (Such as a wristwatch sensor) and other convenient anatomical locations. Exem plary sensors 40 include standard medical diagnostics for detecting the body's electrical signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascu lar system (ECG). Leg sensors can include piezoelectric accelerometers designed to give qualitative assessment of limb movement. Additionally, thoracic and abdominal bands used to measure expansion and contraction of the thorax and abdomen respectively. A Small sensor can be mounted on the Subjects finger in order to detect blood-oxygen levels and pulse rate. Additionally, a microphone can be attached to throat and used in sleep diagnostic recordings for detecting breathing and other noise. One or more position sensors can be used for detecting orientation of body (lying on left side, right side or back) during sleep diagnostic recordings. Each of sensors 40 can individually transmit data to the server 20 using wired or wireless transmission. Alternatively, all sen sors 40 can be fed through a common bus into a single trans ceiver for wired or wireless transmission. The transmission

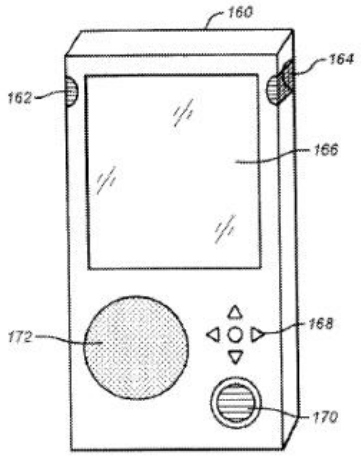
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	can be done using a magnetic medium Such as a floppy disk or a flash memory card, or can be done using infrared or radio networklink, among others. The sensor 40 can also includean indoor positioning system or alternatively a global position system (GPS) receiver that relays the position and ambulatory patterns of the patient to the server 20 for mobility tracking. In one embodiment, the sensors 40 for monitoring vital signs are enclosed in a wrist-watch sized case Supported on a wrist band. The sensors can be attached to the back of the case. For example, in one embodiment, Cygnus AutoSensor (Redwood City, Calif.) is used as a glucose sensor. A low electric current pulls glucose through the skin. Glucose is accumulated in two gel collection discs in the AutoSensor. The AutoSensor measures the glucose and a reading is dis played by the watch. Tran at 9:23-63 The wearable appliance is small, easily worn by the patient during periods of exercise or day-to-day activities, and non-invasively measures blood pressure can be done in a matter of seconds without affecting the patient. An on-board or remote processor can analyze the time-dependent measurements to generate statistics on a patient's blood pressure (e.g., average pressures, standard deviation, beat-to-beat pressure variations) that are not available with conventional devices that only measure systolic and diastolic blood pressure at isolated times. Tran at 25:20-29

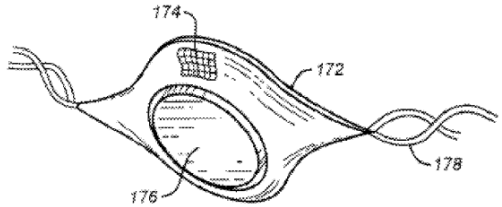
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	 FIG. 1 Tran at Fig. 1 The base station 20 frequently collects and synchronizes data from the appliances 8. The base station 20 may use one of various transportation methods to connect to the repository on the server 200 using a PC as conduit or through a connection established using an embedded modem (connected to a phone line), a wireless router (DSL or cable wireless router), a cellular modem, or another network-connected appliance (such as, but not limited to, a web-phone, video-phone, embedded computer, PDA or handheld computer). Tran at 27:9-17 In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a

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	pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12 In one embodiment, stimulations to elicit EEG signals are used in two different modes, i.e., auditory clicks and electric pulses to the skin. The stimuli, although concurrent, are at different prime number frequencies to permit separation of different evoked potentials (EPs) and avoid interference. Such concurrent stimulations for EP permit a more rapid, and less costly, examination and provide the patient's responses more quickly. Power spectra of spontaneous EEG, wave shapes of Averaged Evoked Potentials, and extracted mea Sures, such as frequency specific power ratios, can be trans mitted to a remote receiver. The latencies of successive EP peaks of the patient may be compared to those of a normal group by use of a normative template. To test for ischemic stroke or intracerebral or subarachnoid hemorrhage, the sys tem provides a blood oxygen Saturation monitor, using an infra-red or laser source, to alert the user if the patient’s blood in the brain or some brain region is deoxygenated. Tran at 52:19-35 In one embodiment, the sensors are mounted on the patient’s wrist (Such as a wristwatch sensor) and other con Venient anatomical locations. Exemplary sensors include standard medical diagnostics for detecting the body's electri cal signals emanating from muscles (EMG and EOG) and brain (EEG) and cardiovascular system (ECG). Leg sensors can include piezoelectric accelerometers designed to give qualitative assessment of limb movement. Additionally, thoracic and abdominal bands used to measure expansion and contraction of the thorax and abdomen respectively. A Small sensor can be mounted on the Subjects finger in order to detect blood-oxygen levels and pulse rate. Additionally, a microphone can be attached to throat and used in sleep diagnostic recordings for detecting breathing and other noise. One or more position sensors can be used for detecting orientation of body (lying on left side, right side or back) during sleep diagnostic recordings. Each of sensors can individually trans mit data to the server 20 using wired or wireless transmission. Alternatively, all sensors can be fed through a common bus into a single transceiver for wired or wireless transmission. The transmission can be done using a magnetic medium Such as a floppy disk or a flash memory card, or can be done using infrared or radio network link, among others. Tran 58:60-59:15

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	In another optical embodiment, blood pressure is estimated from the optical reading using a mathematical model Such as a linear correlation with a known blood pressure reading. In this embodiment, the pulse oximeter readings are compared to the blood-pressure readings from a known working blood pressure measurement device during calibration. Using these measurements the linear equation is developed relating oximeter output waveform such as width to blood-pressure (systolic, mean and pulse pressure). In one embodiment, a transform (such as a Fourier analysis or a Wavelet transform) of the Oximeter output can be used to generate a model to relate the oximeter output waveform to the blood pressure. Other non-linear math model or relationship can be deter mined to relate the oximeter waveform to the blood pressure. In one implementation, the pulse oximeter probe and a blood pressure cuffare placed on the corresponding contralat eral limb to the oscillometric (Dinamap 8100; Critikon, Inc. Tampa, Fla., USA) cuffsite. The pulse oximeter captures data on plethysmographic waveform, heart rate, and oxygen Satu ration. Simultaneous blood pressure measurements were obtained from the oscillometric device, and the pulse oxime ter. Systolic, diastolic, and meanblood pressures are recorded from the oscillometric device. This information is used derive calibration parameters relating the pulse Oximeter output to the expected blood pressure. During real time operation, the calibration parameters are applied to the oXimeter output to predict blood pressure in a continuous or in a periodic fash ion. In yet another embodiment, the device includes an accel erometer or alternative motion-detecting device to determine when the patient hand is at rest, thereby reducing motion related artifacts introduced to the measurement during cali bration and/or operation. The accelerometer can also function as a falls detection device. Tran 61:6-38 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical implementation, a second opening (not shown) is provided to emit an optical signal from an LED, for example, and an optical detector can be located at the opening 132 to receive the optical signal passing through the finger wearing the ring 130. In another implementation, the ring has an electrically movable portion 134 and rigid portions 136-138 connected thereto. The electrically movable portion 134 can squeeze the finger as directed by the CPU during an applanation sweep to determine the arterial blood pressure. Tran at 67:28-40

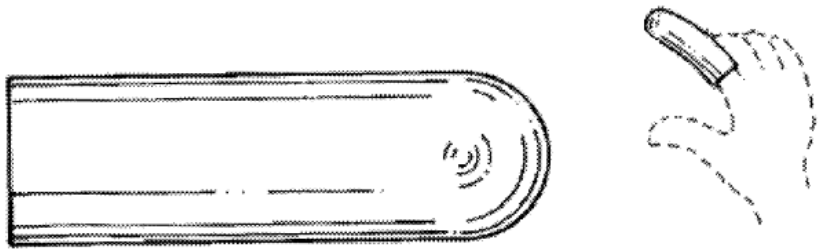
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	 FIG. 8 Tan at Fig.8 FIGS. 11 and 12 show two additional embodiments of the monitoring device. In FIG. 11, a wearable monitoring device is shown. The monitoring device has a body 160 comprising microphone ports 162, 164 and 170 arranged in a first order noise cancelling microphone arrangement. The microphones 162 and 164 are configured to optimally receive distant noises, while the microphone 170 is optimized for capturing the user's speech. A touch sensitive display 166 and a plurality of keys 168 are provided to capture hand inputs. Further, a speaker 172 is provided to generate a verbal feedback to the user. Tran at 68:3-13

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	 FIG. 11 Tran at fig. 11 Turning now to FIG. 12, a jewelry-sized monitoring device is illustrated. In this embodiment, a body 172 houses a microphone port 174 and a speaker port 176. The body 172 is coupled to the user via the necklace 178 so as to provide a personal, highly accessible personal computer. Due to space limitations, voice input/output is an important user interface of the jewelry-sized computer. Although a necklace is disclosed, one skilled in the art can use a number of other substitutes such as a belt, a brace, a ring, or a band to secure the jewelry-sized computer to the user. Tran at 68:14-23

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	 FIG. 12 Tran at fig. 12 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electronics, accelerometer, and physiological sensors such as EKG/ECG sensors or temperature sensors or ultrasonic sensors. In addition, a speaker (not shown) is provided to enable voice communication over the mesh network, and a microphone 188 is provided to pick up voice during verbal communication and pick up heart sound when the user is not using the microphone for voice communication. The ear phone optionally has an ear canal temperature sensor for sensing temperature in a human. Tran at 68:24-38 FIG. 14B shows a sunglass or eyeglass embodiment which contains electronics for communicating with the mesh net work and for sensing acceleration and bioimpedance, EKG/ ECG, EMG, heart sound, microphone, optical sensor, or ultrasonic sensor in contacts with a wearer's skin. In one embodiment, the ear module 310 contains optical sensors to detect temperature, blood flow and blood oxygen level as well as a speaker to provide wireless communication or hearing aid. The blood flow or velocity information can be used to estimate blood pressure. Tran at 69:16-25

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	12. The system of claim 1, comprising a body impedance (BI) sensor to determine one of: total body water, compartmentalization of body fluids, cardiac monitoring, blood flow, skinfold thickness, dehydration, blood loss, wound monitoring, ulcer detection, deep vein thrombosis, hypovolemia, hemorrhage, blood loss, heart attack, stroke attack. Tran at Claim 12 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	See claim 8 above. Tran discloses or renders obvious the processor is further configured to modulate the light source with a modulation frequency. In one optical embodiment, the transducer can be an optical transducer. The optical transducer can be a light source and a photo-detector embedded in the wrist band portions 1374. The light source can be light-emitting diodes that generate red (λ˜630 nm) and infrared (λ˜900 nm) radiation, for example. The light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of the red and infrared radiation depending on how much oxygen binds to the cells' hemoglobin. The photo-detector detects transmission at the predetermined wavelengths, for example red and infrared wavelengths, and provides the detected transmission to a pulse-oximetry circuit embedded within the wrist-watch. The output of the pulse-oximetry circuit is digitized into a time-dependent optical waveform, which is then sent back to the pulse-oximetry circuit and analyzed to determine the user's vital signs. Tran at 36:62-37:12

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	In yet another embodiment, measurement of lung function such as peak expiratory flow readings is done though a sensor such as Wright's peak flow meter. In another embodiment, a respiratory estimator is provided that avoids the inconvenience of having the patient breathing through the flow sensor. In the respiratory estimator embodiment, heart period data from EKG/ECG is used to extract respiratory detection features. The heart period data is transformed into time-frequency distribution by applying a time-frequency transformation such as short-term Fourier transformation (STFT). Other possible methods are, for example, complex demodulation and wavelet transformation. Next, one or more respiratory detection features may be determined by setting up amplitude modulation of time-frequency plane, among others. The respiratory recognizer first generates a math model that correlates the respiratory detection features with the actual flow readings. The math model can be adaptive based on pre-determined data and on the combination of different features to provide a single estimate of the respiration. The estimator can be based on different mathematical functions, such as a curve fitting approach with linear or polynomical equations, and other types of neural network implementations, non-linear models, fuzzy systems, time series models, and other types of multivariate models capable of transferring and combining the information from several inputs into one estimate. Once the math model has been generated, the respirator estimator provides a real-time flow estimate by receiving EKG/ECG information and applying the information to the math model to compute the respiratory rate. Next, the computation of ventilation uses information on the tidal volume. An estimate of the tidal volume may be derived by utilizing different forms of information on the basis of the heart period signal. For example, the functional organization of the respiratory system has an impact in both respiratory period and tidal volume. Therefore, given the known relationships between the respiratory period and tidal volume during and transitions to different states, the information inherent in the heart period derived respiratory frequency may be used in providing values of tidal volume. In specific, the tidal volume contains inherent dynamics which may be, after modeling, applied to capture more closely the behavioral dynamics of the tidal volume. Moreover, it appears that the heart period signal, itself, is closely associated with tidal volume and may be therefore used to increase the reliability of deriving information on tidal volume. The accuracy of the tidal volume estimation may be further enhanced by using information on the subjects vital capacity (i.e., the maximal quantity of air that can be contained in the lungs during one breath). The information on vital capacity, as based on physiological measurement or on estimates derived from body measures such as height and weight, may be helpful in estimating tidal volume, since it is likely to reduce the effects of individual differences on the estimated tidal volume. Using information on the vital capacity, the mathematical model may first give values on the percentage of lung capacity in use, which may be then transformed to liters per breath. The optimizing of tidal volume estimation can based on, for example, least squares or other type of fit between the features and actual tidal volume.

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	The minute ventilation may be derived by multiplying respiratory rate (breaths/min) with tidal volume (liters/breath). Tran at 48:35-49:27  FIG. 9 Tran at Fig. 9 FIG. 9 shows an alternate finger cover embodiment where a finger-mounted module housing the photo-detector and light source. The finger mounted module can be used to measure information that is processed to determine the user's blood pressure by measuring blood flow in the user's finger and sending the information through a wireless connection to the base station. In one implementation, the housing is made from a flexible polymer material. Tran at 67:41-48 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

U.S. Pat. No. 12,268,475 in view of U.S. Pat. No. 8,922,788 to Paul Stanley Addison ("Addison-788")

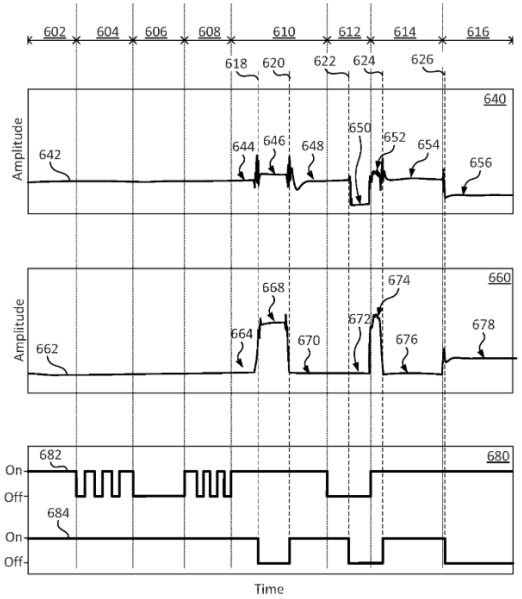
As described in detail below, Addison-788 (individually or collectively) anticipates and/or renders obvious claim 1, 5-8, 11-13 ("Asserted Claims") of U.S. Patent No. 12,268,475 (the "'475 Patent") under 35 U.S.C. §102 and/or §103, either alone, in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits G1-G14, the contents of which are hereby incorporated by reference into this chart. One of ordinary skill in the art, as of the priority date of the '475 Patent, would have known to combine the prior art elements disclosed by the foregoing references using known methods, and to use these elements according to their established functions in order to achieve a known and predictable result. This invalidity claim chart is based on Defendants' present understanding of the Asserted Claims and Plaintiff's apparent construction of the Asserted Claims in its Preliminary Infringement Contentions ("Infringement Contentions").

The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Addison-788. The cited portions of Addison-788 are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Addison-788. Where a particular figure is cited, the citation should be understood to encompass the caption and description of the figure as well as any text relating to or describing the figure. Conversely, where particular text referring to a figure is cited, the citation should be understood to include the figure as well. Although the documentation collectively evidences prior knowledge, use, or sale, Defendants reserve the right to rely upon individual documents as printed publications. Where the chart below states that Addison-788 "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Addison-788 does not expressly disclose certain limitations in the asserted claim, such limitations are inherent. Defendants reserve the right to present direct evidence of the structure, function, operation, and/or features of the technology described in Addison-788 (including product samples, source code, and/or witness testimony) and/or its prior art status, and to present alternative or additional documents concerning the same as evidence that the technology described in Addison-788 anticipates and/or renders obvious the Asserted Claims of the '475 Patent.

This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that Defendants agree with Plaintiff regarding the scope of the Asserted Claims, Plaintiff's apparent claim constructions, or the accuracy of any particular claim construction. Defendants reserve all rights to challenge any of the claim terms herein under 35 U.S.C. § 112, including by arguing that they are indefinite, are not supported by the written description, and/or are not enabled. Defendants further reserve all rights to amend this invalidity claim chart without leave of court pursuant to the Court's Docket Control Order, or upon a showing of good cause.

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Claim 1	
1[pre]. An apparatus adapted to be worn by a user comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Addison-788 discloses or renders obvious An apparatus adapted to be worn by a user comprising. The present disclosure is directed towards determining a probe-off condition in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. For example, the physiological monitoring system may include a pulse oximeter. The system may include, for example, a light source and a photosensitive detector. In some embodiments, a sensor may be attached to a target area of a patient. For example, the sensor may be attached using an adhesive, a strap, a band, elastic, any other suitable attachment, or any combination thereof. In some embodiments, the sensor may be located proximate to a desired structural element. For example, a sensor may be held near to the radial artery using a wrist strap. In another example, a sensor may be held near to the blood vessels of the forehead using an adhesive, tape, a headband strap, any other suitable attachment, or any combination thereof. In a further example, a sensor may be held near the blood vessels on a fingertip using an adhesive, tape or mechanical clip. Addison-788 at 2:10-29 In some embodiments, the system may determine a probe-off condition. As used herein, the probe-off condition may include any condition where the sensor is fully or partially detached or moved from the desired target area of the subject. A probe-off condition may include a condition where an adhesive coupling the sensor to the subject has fully or partially failed. A probe-off condition may include a condition where a sensor held with a strap or band has loosened, shifted, slid, moved, detached, repositioned in any other unsuitable arrangement, or any combination thereof. For example, a sensor held by an adhesive to the forehead of a subject may fully or partially separate due to an adhesive failure, resulting in a probe-off condition. In another example, a sensor held proximal to the radial artery at the wrist of a subject by a strap or band may shift out of position, resulting in a probe-off position. It will be understood that the probe-off conditions described here are merely exemplary and that any suitable undesirable positioning of the sensor may result in a probe-off condition. It will also be understood that the particular arrangement of a probe-off condition may dependent upon the configuration and type of probe. Addison-788 at 2:34-50

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	In some embodiments, for example, with a fingertip sensor where light may be generated by the system on one side of a finger and detected on the opposite side of a finger, removing the finger from the sensor (i.e., a probe-off condition) may result in a large portion of the generated light being received by the sensor, rather than a portion of the light being attenuated by interacting with the tissue of the subject. This very high signal level may be detected as a probe-off condition by the system. Addison-788 at 4:1-9 An oximeter may include a light sensor that is placed at a site on a patient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot or hand. The oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically understood to be optimal for pulse oximetry serve as suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional suitable sensor locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patient's thigh to monitor femoral artery pulsatile flow, the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. Suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. In all suitable locations, for example, the oximeter may measure the intensity of light that is received at the light sensor as a function of time. The oximeter may also include sensors at multiple locations. A signal representing light intensity versus time or a mathematical manipulation of this signal (e.g., a scaled version thereof, a log taken thereof, a scaled version of a log taken thereof, etc.) may be referred to as the photoplethysmograph (PPG) signal. In addition, the term “PPG signal,” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue) or any suitable mathematical manipulation thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs. Addison-788 at 5:50-6:15 FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. Physiological monitoring system 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include

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	one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detectors 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Physiological monitoring system 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two or more different locations on a subject's body. Addison-788 at 13:5-29  FIG. 6 Addison-788 at Fig. 6

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	In some embodiments, input signal 416 may include PPG signals corresponding to one or more light frequencies. Such as an IR PPG signal and a Red PPG signal, and ambient light. In some embodiments, input signal 416 may include signals measured at one or more sites on a subject's body, for example, a subjects finger, toe, ear, arm, or any other body site. In some embodiments, input signal 416 may include multiple types of signals (e.g., one or more of an ECG signal, an EEG signal, an acoustic signal, an optical signal, a signal representing a blood pressure, and a signal representing a heart rate). Input signal 416 may be any suitable biosignal or any other suitable signal. Addison-788, 15:21-33. The signals of FIG. 6 may, for example, be obtained from a forehead pulse oximeter sensor. Other suitable sensors may be used including, for example, a fingertip, earlobe, wrist, arm, foot, other suitable sensor, or any combination thereof. In some embodiments, different sensors may produce different signals, however it will be understood that the techniques described herein may be applied to multiple sensor types with appropriate modifications. For example, a sensor such as a fingertip sensor which may rely primarily on transmitted light rather than the reflected light of a forehead sensor may result in very high detected light signals being received when the sensor is improperly positioned in a dark room—rather than low signal levels. Thresholds, target values, time windows, other signal processing parameters, and any combination thereof may be adjusted based on the sensor and measurement type. Addison-788 at 22:8-23 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[a]. one or more biosensors adapted to be placed on the user,	Addison-788 discloses or renders obvious one or more biosensors adapted to be placed on the user. In some embodiments, a sensor may be configured to limit the amount of ambient light received by a detector. For example, a detector may be held close to and facing the skin. A detector may include a light blocking material between the detector and any ambient light sources, to prevent or reduce ambient light

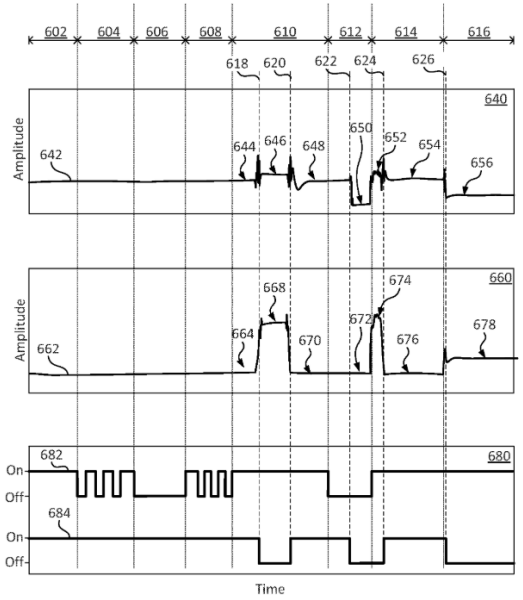
’475 Patent	Addison-788
	from reaching the detector. In a further example, a system may include other suitable shields, optics, filters, arrangements, or any combination thereof, to reduce ambient light signals received by the receiver. In some embodiments, the particular arrangement of light blocking structures or material may depend on the type of probe. For example, a forehead probe may include a relatively flat light blocking structure, while a fingertip probe may include a light blocking structure that encircles the finger. It will be understood, however, that may clinical settings include relatively bright light sources and the ambient light signals received by the detector may not be fully blocked when the sensor is positioned as desired. Similarly, fully shielding ambient light may be more difficult for a forehead sensor than, for example, a fingertip sensor. Addison-788 at 3:48-67 In some embodiments, for example, with a fingertip sensor where light may be generated by the system on one side of a finger and detected on the opposite side of a finger, removing the finger from the sensor (i.e., a probe-off condition) may result in a large portion of the generated light being received by the sensor, rather than a portion of the light being attenuated by interacting with the tissue of the subject. This very high signal level may be detected as a probe-off condition by the system. Addison-788 at 4:1-9 An oximeter may include a light sensor that is placed at a site on a patient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot or hand. The oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically understood to be optimal for pulse oximetry serve as suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional suitable sensor locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patient's thigh to monitor femoral artery pulsatile flow, the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. Suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. In all suitable locations, for example, the oximeter may measure the intensity of light that is received at the light sensor as a function of time. The oximeter may also include sensors at multiple locations**.** A signal representing light intensity versus time or a mathematical manipulation of this signal (e.g., a scaled version thereof, a log taken thereof, a scaled version of a log taken thereof, etc.) may be referred to as the photoplethysmograph (PPG) signal. In addition, the term “PPG signal,” as used herein, may also

’475 Patent	Addison-788
	refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue) or any suitable mathematical manipulation thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs. Addison-788 at 5:50-6:15 FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g. Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g. Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Addison-788 at 6:64-7:19 Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g. Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g. Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light.

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	Addison-788 at 7:3-19 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed, scattered, or reflected, less light of that wavelength is typically received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Addison-788 at 7:31-49 Monitor 104 may be communicatively coupled to sensor 102. Control circuitry 110 may be coupled to light drive cir cuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, con trol circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals of control circuitry 110 to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals of control circuitry 110 to coordinate its operation with front end processing circuitry 150. Addison-788 7:50-8:5. Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform

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	various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Addison-788 9:4-14. Referring back to FIG. 1, front end processing circuitry 150, which may receive a detection signal, such as detector current waveform 214, may include analog conditioner 152, demultiplexer 154, digital conditioner 156, analog-to-digital converter (ADC) 158, decimator/interpolator 160, and ambient subtractor 162. In some embodiments, front end processing circuitry 150 may include a second analog-to-digital converter (not shown) configured to sample the unprocessed detector signal. This signal may be used to detect changes in the ambient light level without applying the signal condition and other steps that may improve the quality of determined physiological param eters but may reduce the amount of information regarding a probe-off condition. Addison-788 9:46-59. The components of front end processing circuitry 150 are merely illustrative and any suitable components and combinations of components may be used to perform the front end processing operations. The front end processing circuitry 150 may be configured to take advantage of the full dynamic range of analog-to digital converter 158. This may be achieved by applying a gain to the detected signal using analog conditioner 152 to map the expected range of the detection signal to the full or close to full dynamic range of analog-to-digital converter 158. In some embodiments, the input to the analog to digital converter may be the sum of the detected light multiplied by an analog gain value. Addison-788 11:16-29. It will be understood that the components of physiological monitoring system 100 that are shown and described as sepa rate components are shown and described as Such for illus trative purposes only. In some embodiments the functionality of Some of the components may be combined in a single component. For example, the functionality of front end pro cessing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in Some embodiments the functionality of some of the com ponents of monitor 104 shown and described herein may be divided over multiple components. For example, Some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other

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	embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In some embodiments, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Addison-788 12:54-13:4. FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. Physiological monitoring system 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detectors 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Physiological monitoring system 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two or more different locations on a subject's body. Addison-788 at 13:5-29

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	 FIG. 6 Addison-788 at Fig. 6 FIG. 4 shows illustrative signal processing system 400 in accordance with some embodiments of the present disclo Sure. Signal processing system 400 includes input signal gen erator 410, processor 412 and output 414. In the illustrated embodiment, input signal generator 410 may include pre processor 420 coupled to sensor 418. As illustrated, input signal generator 410 generates an input signal 416. In some embodiments, input signal 416 may include one or more intensity signals based on a detector output. In some embodi ments, pre-processor 420 may be an oximeterandinput signal 416 may be a PPG signal. In an embodiment, pre-processor 420 may be any Suitable signal processing device and input signal 416 may include PPG signals and one or more other physiological signals, such as an electrocardiogram (ECG) signal. It will be understood that input signal generator 410 may include any suitable signal source, signal generating data, signal generating equipment, or any combination thereof to produce input signal 416. Input signal 416 may be a single signal, or may be multiple signals transmitted over a single pathway or multiple pathways. Pre-processor 420 may apply one or more signal process ing operations to the signal generated by sensor 418. For example, pre-processor 420 may apply a pre-determined set of processing operations to the

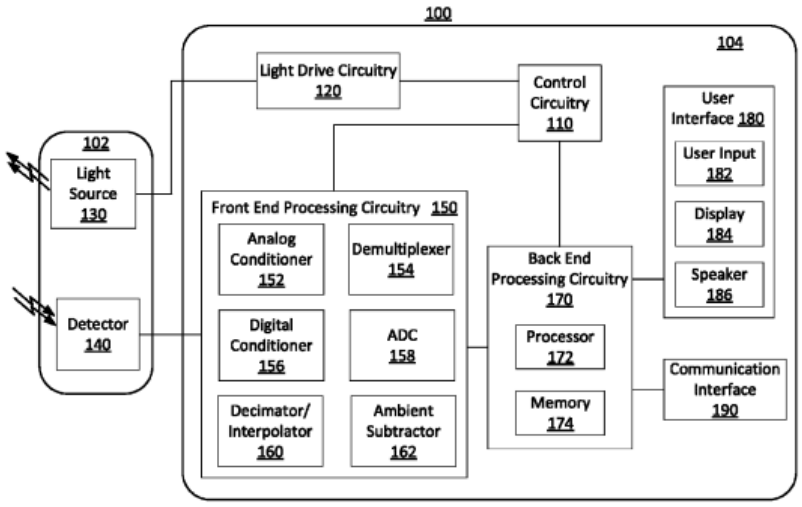
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	signal provided by sensor 418 to produce input signal 416 that can be appropriately inter preted by processor 412, Such as performing A/D conversion. In some embodiments, A/D conversion may be performed by processor 412. Pre-processor 420 may also performany of the following operations on the signal provided by sensor 418: reshaping the signal for transmission, multiplexing the signal, modulating the signal onto carrier signals, compressing the signal, encoding the signal, and filtering the signal. In some embodiments, pre-processor 420 may include a current-to Voltage converter (e.g., to convert a photocurrent into a Volt age), an amplifier, a filter, and A/D converter, a de-multi plexer, any other Suitable pre-processing components, or any combination thereof. In some embodiments, pre-processor 420 may include one or more comp Addison-788 14:50-15:221. In some embodiments, input signal 416 may include PPG signals corresponding to one or more light frequencies. Such as an IR PPG signal and a Red PPG signal, and ambient light. In some embodiments, input signal 416 may include signals measured at one or more sites on a subject's body, for example, a subjects finger, toe, ear, arm, or any other body site. In some embodiments, input signal 416 may include multiple types of signals (e.g., one or more of an ECG signal, an EEG signal, an acoustic signal, an optical signal, a signal representing a blood pressure, and a signal representing a heart rate). Input signal 416 may be any suitable biosignal or any other suitable signal. Addison-788, 15:21-33. The signals of FIG. 6 may, for example, be obtained from a forehead pulse oximeter sensor. Other suitable sensors may be used including, for example, a fingertip, earlobe, wrist, arm, foot, other suitable sensor, or any combination thereof. In some embodiments, different sensors may produce different signals, however it will be understood that the techniques described herein may be applied to multiple sensor types with appropriate modifications. For example, a sensor such as a fingertip sensor which may rely primarily on transmitted light rather than the reflected light of a forehead sensor may result in very high detected light signals being received when the sensor is improperly positioned in a dark room—rather than low signal levels. Thresholds, target values, time windows, other signal processing parameters, and any combination thereof may be adjusted based on the sensor and measurement type. Addison-788 at 22:8-23

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement;	Addison-788 discloses or renders obvious wherein one or more physiological parameters are measured, wherein measuring of the one or more physiological parameters comprises a differential measurement, and wherein the one or more physiological parameters comprises a pulse rate monitoring and a blood flow measurement. See elements 1[h], 1[j]-1[l], below. The present disclosure is directed towards determining a probe-off condition in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. For example, the physiological monitoring system may include a pulse oximeter. The system may include, for example, a light source and a photosensitive detector. In some embodiments, a sensor may be attached to a target area of a patient. For example, the sensor may be attached using an adhesive, a strap, a band, elastic, any other suitable attachment, or any combination thereof. In some embodiments, the sensor may be located proximate to a desired structural element. For example, a sensor may be held near to the radial artery using a wrist strap. In another example, a sensor may be held near to the blood vessels of the forehead using an adhesive, tape, a headband strap, any other suitable attachment, or any combination thereof. In a further example, a sensor may be held near the blood vessels on a fingertip using an adhesive, tape or mechanical clip. Addison-788 at 2:10-29 As will be described in detail below, a detected light signal may include information related to the amount of light a detector receives when one or more associated light sources are in an “on” state. In some embodiments where a detector receives light from light sources coupled to the system and from light sources not coupled to the system, the detected light signal may include light from both sources. Detected light signals may be time division demultiplexed in a drive pulse modulation or other suitable technique. As described above, a detected light signal may include both a detected emitted photonic signal

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	component and an ambient signal component. In some embodiments, an ambient signal may be Subtracted or otherwise separated from a detected light signal. In some embodiments, a detected light signal baseline may be identified based on the detected light signal and the detected ambient signal. Addison-788 3:31-47 In some embodiments, for example, with a forehead sensor, a probe-off condition may not result in a relatively high detected signal level. A forehead sensor may include a light source placed relatively close to a detector on the forehead of a patient using tape, an adhesive, a band encircling the skull, any other Suitable arrangement, or any combination thereof. The light source and detector may be arranged such that a portion of the light emitted from the light source interacts with, and is partially attenuated by, the tissue of the subject and is detected by the detector. The light source may be pulsed, such that a detected ambient signal is detected by the detector between the pulses, and a detected light signal is detected during the pulses including both a detected ambient light signal and a detected emitted photonic signal. In deter mining a physiological parameter, the detected ambient light signal may be, for example, Subtracted from the detected light signal. The detected ambient signal may exhibit certain char acteristic behavior during a probe-off condition, but may remain relatively constant with respect to other changes. For example, during a probe-off condition, the detected ambient light signal may be relatively insensitive to changes in physi ological conditions. Addison-788 4:10-31 In some embodiments, a detected light signal (e.g., an IR signal) and a detected ambient signal may have similar or equal amplitudes. This may be referred to as mimicking equal behavior. In some embodiments, the system may iden tify mimicking-equal behavioras being indicative of a probe off condition. This may occur, for example, when only ambient light is reaching the detector. In this case, the detected ambient and detected light signals are of the same level because they both correspond to the ambient light level. That is to say, the same amount of light is reaching the detector during the “on” and “off” states of the emitters. Mimicking-equal behavior may be identified, for example, when the subtracted difference of one signal from the other is constant within a particular tolerance. In some embodiments, a detected light signal (e.g., an IR signal) and a detected ambient signal may show similar or parallel variations, referred to as mimicking-parallel behav ior. This may be identified, for example, when a first signal is Subtracted from a second signal and the result is Substantially constant. The difference may be evaluated by its derivative, by changes within a time window, by any other Suitable technique, or any combination

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	thereof. In some embodi ments, the system may identify mimicking-parallel behavior as being indicative of a probe-off condition. Addison-788 4:40-63 The foregoing probe-off techniques may be implemented in an oximeter. An oximeter is a medical device that may determine the oxygen saturation of an analyzed tissue. One common type of oximeter is a pulse oximeter, which may non-invasively measure the oxygen saturation of a patient's blood (as opposed to measuring oxygen saturation directly by analyzing a blood sample taken from the patient). Pulse oximeters may be included in patient monitoring systems that measure and display various blood flow characteristics including, but not limited to, the oxygen saturation of hemoglobin in arterial blood. Such patient monitoring systems may also measure and display additional physiological parameters, such as a patient's pulse rate and blood pressure. Addison-788 at 5:37-49 An oximeter may include a light sensor that is placed at a site on apatient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot or hand. The oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically understood to be optimal for pulse oximetry serve as suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional Suit able sensor locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patient’s thigh to monitor femoral artery pulsatile flow, the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. Suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. In all suitable locations, for example, the oximeter may measure the intensity of light that is received at the light sensor as a function of time. The oximeter may also include sensors at multiple locations. A signal representing light intensity ver sus time or a mathematical manipulation of this signal (e.g., a scaled version thereof, a log taken thereof, a scaled version of a log taken thereof, etc.) may be referred to as the photopl ethysmograph (PPG) signal. In addition, the term “PPG signal” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue) or any Suitable mathematical manipulation thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemo globin) being measured as well as a pulse rate and when each individual pulse occurs.

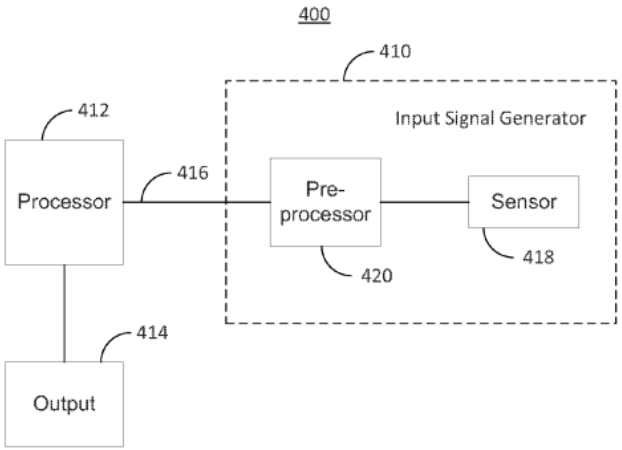
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	Addison-788 5:50-6:15. In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed, scattered, or reflected, less light of that wavelength is typically received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Addison-788 at 7:31-49 FIG. 2A shows an illustrative plot of a light drive signal including red drive pulse 202 and IR drive pulse 204 in accordance with some embodiments of the present disclosure. Red drive pulse 202 and IR drive pulse 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, drive pulses may refer to switching power or other components on and off, high and low output states, high and low values within a continuous modulation, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red drive pulse 202 and IR drive pulse 204 to drive red and IR light emitters, respectively, within light source 130. Red drive pulse 202 may have a higher amplitude than IR drive pulse 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. In some embodiments, the output levels may be the equal, may be adjusted for nonlinearity of emitters, may be modulated in any other suitable technique, or any combination thereof. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary any that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof.

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	Addison-788 at 8:17-47 The light drive signal of FIG. 2A may also include “off periods 220 between the Red and IR light drive pulse. “Off periods 220 are periods during which no drive current may be applied to light source 130. “Off” periods 220 may be pro vided, for example, to prevent overlap of the emitted light, since light source 130 may require time to turn completely on and completely off. Similarly, the signal from detector 140 may require time to decay completely to a final State after light source 130 is switched off. The period from time 216 to time 218 may be referred to as a drive cycle, which includes four segments: a red drive pulse 202, followed by an “off period 220 in FIG. 2A, followed by an IR drive pulse 204, and followed by an “off” period 220. After time 218, the drive cycle may be repeated (e.g., as long as a light drive signal is provided to light source 130). It will be understood that the starting point of the drive cycle is merely illustrative and that the drive cycle can start at any location within FIG. 2A, provided the cycle spans two drive pulses and two “off periods. Thus, each red drive pulse 202 and each IR drive periods 220 in FIG. 2A. “Off” periods may also be referred to as dark periods, in that the emitters are dark or returning to dark during that period. Addison-788 8:48-9:3  FIG. 1

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	Addison-788 at Fig. 1 Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Addison-788 at 9:4-13 FIG. 2B shows an illustrative plot of detector current wave form 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current sig nals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The ampli tude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with drive pulses driving one or more emitters of a light source. Such as light source 130 of FIG.1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not decrease to zero. Rather, ambient signal 222 may be present in the detector waveform, as well as other background ampli tude contributions. In some embodiments, the shapes of the pulses in detector current waveforms may include distortions, clipping, delayed Switching, relatively slow rising and falling edges, and other non-idealities due in part to Switching of the light drive, switching of the LEDs, switching in the detector, stabilization of the detector, stabilization of the detected sig nal, parasitic inductance and/or capacitances, any other Suit able signal contribution, or any combination thereof. In some embodiments, ambient signal 222 may be used to determine a probe-off condition. In some embodiments, ambient signal 222 may be removed from a processed signal to facilitate determination of physiological parameters. Addison-788 9:14-45 The conditioned analog signal may be processed by ana log-to-digital converter 158, which may convert the condi tioned analog signal into a digital signal. Analog-to-digital converter 158 may operate under

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	the control of control cir cuitry 110. Analog-to-digital converter 158 may use timing control signals from control circuitry 110 to determine when to sample the analog signal. Analog-to-digital converter 158 may be any Suitable type of analog-to-digital converter of Sufficient resolution to enable a physiological monitor to accurately determine physiological parameters. Addison-788 10:1-11. Ambient Subtractor 162 may operate on the digital signal. In some embodiments, ambient subtractor 162 may remove ambient values from the Red and IR components. In some embodiments, the system may subtract the ambient values from the Red and IR components to generate adjusted Red and IR signals. For example, ambient Subtractor 162 may determine a subtraction amount from the ambient signal por tion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the ambient signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red drive pulse 202 may be adjusted by determining the amount of ambient signal during the “off period 220 preceding red drive pulse 202. The ambient signal amount determined in this manner may be subtracted from the detector peak corre sponding to red drive pulse 202. Alternatively, the “off period 220 after red drive pulse 202 may be used to correct red drive pulse 202 rather than the “off period 220 preceding it. Additionally, an average of the “off periods 220 before and after “on” periods of red drive pulse 202 may be used. In some embodiments, ambient Subtractor 162 may output an ambient signal for further processing. Ambient Subtractor 162 may average the ambient signal from multiple “off periods 220, may apply filters to the ambient signal Such as averaging filters, integration filters, delay filters, buffers, counters, any other Suitable filters or processing, or any combination thereof. It will be understood that in some embodiments, ambient subtractor 162 may be omitted. It will also be understood that in Some embodiments, the system may not subtract the ambi ent contribution of the signal. It will also be understood that the functions of demultiplexer 154 and ambient subtractor 162 may be complementary, overlapping, combined into a signal function, combined or separated in any Suitable arrangement, or any combination thereof. For example, the received light signal may include an ambient signal, an IR light signal, and a red light signal. The system may use any suitable arrangement of demultiplexer 154 and ambient sub tractor 162 to determine or generate any combination of a red signal, an IR signal, a red ambient signal, an IR ambient signal, an average ambient signal, a red with ambient signal, an IR with ambient signal, any other Suitable signal, or any combination thereof. Addison-788 10:41-11:16

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	Back end processing circuitry 170 may include processor 172 and memory 174. Processor 172 may be adapted to execute software, which may include an operating system and one or more applications, as part of performing the functions described herein. Processor 172 may receive and further pro cess physiological signals received from front end processing circuitry 150. For example, processor 172 may determine one or more physiological parameters based on the received physiological signals. Addison-788 11:43-51. User interface 180 may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device. The inputs received by user input 182 can include information about the subject, such as age, weight, height, diagnosis, medications, treatments, and so forth. In an embodiment, the subject may be a medical patient and display 184 may exhibit a list of values which may generally apply to the patient, such as, for example, age ranges or medication families, which the user may select using user inputs 182. Additionally, display 184 may display, for example, an estimate of a subject's blood oxygen saturation generated by monitor 104 (referred to as an “SpO2” measurement), pulse rate information, respiration rate information, blood pressure, sensor condition, any other parameters, and any combination thereof. Display 184 may include any type of display such as a cathode ray tube display, a flat panel display such a liquid crystal display or plasma display, or any other suitable display device. Speaker 186 within user interface 180 may provide an audible sound that may be used in various embodiments, such as for example, sounding an audible alarm in the event that a patient's physiological parameters are not within a predefined normal range. Addison-788 at 12:7-30 In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and detection received from one or more sensor units such as sensor unit 312. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxygenated, and/or total), any other suitable physiological parameters, or any combination thereof. In some embodiments, calculations may be performed on the sensor units or an intermediate device and the result

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	of the calculations may be passed to monitor 314. Further, monitor 314 may include display 320 configured to display the physiological parameters or other information about the system. In the embodiment shown, monitor 314 may also include a speaker 322 to provide an audible sound that may be used in various other embodiments, such as for example, sounding an audible alarm in the event that a subject's physiological parameters are not within a predefined normal range or when a sensor is not properly positioned. In some embodiments, physiological monitoring system 310 may include a stand-alone monitor in communication with the monitor 314 via a cable or a wireless network link. In some embodiments, monitor 314 may be implemented as display 184 of FIG. 1. Addison-788 at 13:30-58  FIG. 4 Addison-788 at Fig. 4 FIG. 4 shows illustrative signal processing system 400 in accordance with some embodiments of the present disclosure. Signal processing system 400 includes input signal generator 410, processor 412 and output 414. In the illustrated embodiment, input signal generator 410 may include pre-processor 420

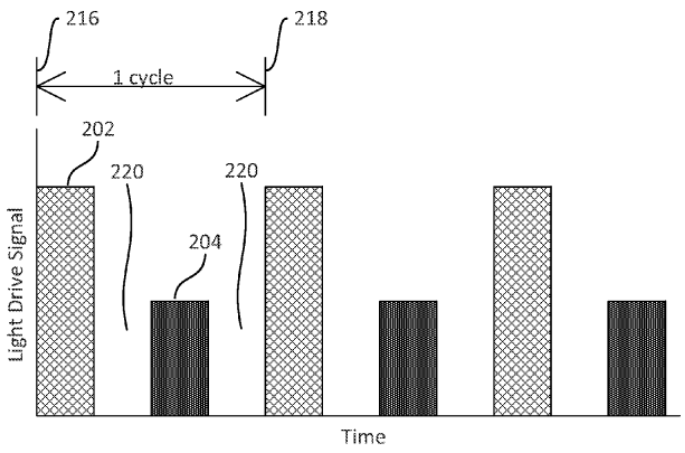
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	coupled to sensor 418. As illustrated, input signal generator 410 generates an input signal 416. In some embodiments, input signal 416 may include one or more intensity signals based on a detector output. In some embodiments, pre-processor 420 may be an oximeter and input signal 416 may be a PPG signal. In an embodiment, pre-processor 420 may be any suitable signal processing device and input signal 416 may include PPG signals and one or more other physiological signals, such as an electrocardiogram (ECG) signal. It will be understood that input signal generator 410 may include any suitable signal source, signal generating data, signal generating equipment, or any combination thereof to produce input signal 416. Input signal 416 may be a single signal, or may be multiple signals transmitted over a single pathway or multiple pathways. Addison-788 at 14:50-15:2 In some embodiments, input signal 416 may be coupled to processor 412. Processor 412 may be any suitable software, firmware, hardware, or combination thereof for processing input signal 416. For example, processor 412 may include one or more hardware processors (e.g., integrated circuits), one or more software modules, non-transitory computer-readable media such as memory, firmware, or any combination thereof. Processor 412 may, for example, be a computer or may be one or more chips (i.e., integrated circuits). Processor 412 may, for example, include an assembly of analog electronic components. Processor 412 may calculate physiological information. For example, processor 412 may compute one or more of a pulse rate, respiration rate, blood pressure, or any other suitable physiological parameter. Processor 412 may perform any suitable signal processing of input signal 416 to filter input signal 416, such as any suitable band-pass filtering, adaptive filtering, closed-loop filtering, any other suitable filtering, and/or any combination thereof. Processor 412 may also receive input signals from additional sources (not shown). For example, processor 412 may receive an input signal containing information about treatments provided to the subject. Additional input signals may be used by processor 412 in any of the calculations or operations it performs in accordance with processing system 400. Addison-788 at 15:34-57 Processor 412 may be coupled to one or more memory devices (not shown) or incorporate one or more memory devices such as any suitable volatile memory device (e.g., RAM, registers, etc.), non-volatile memory device (e.g., ROM, EPROM, magnetic storage device, optical storage device, flash memory, etc.), or both. The memory may be used by processor 412 to, for example, store fiducial information or initialization information corresponding to physiological monitoring. In some embodiments, processor 412 may store physiological measurements or previously received data from input signal 416 in a

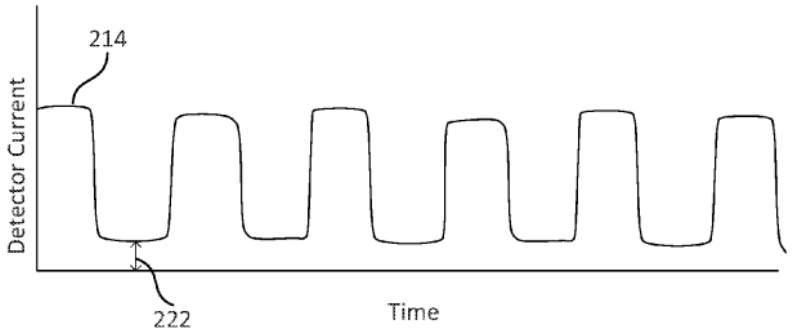
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	memory device for later retrieval. In some embodiments, processor 412 may store calculated values, such as a pulse rate, a blood pressure, a blood oxygen saturation, a fiducial point location or characteristic, an initialization parameter, or any other calculated values, in a memory device for later retrieval. Addison-788 at 15:61-16:9 In step 510, the system may analyze the first and second signals to identify similar behavior. For example, the analysis may include a comparison of the first signal (e.g., the detected ambient light) to the second signal (e.g., the detected light signal). Comparisons may include subtraction, division, multiplication, integration, any other suitable function, or any combination thereof. Addison-788 18:45-51 In some embodiments, the system may use complex and/or different comparisons of the two or more signals or charac teristics of the signals. For example, the system may compare the difference of the slopes of two signals to a threshold or target value to determine parallel behavior. The system may compare derivatives, averages, integrals, slopes, trends, any other suitable operation, or any combination thereof. For example, the system may compare the first derivatives of two signals by Subtracting one from the other. Addison-788 19:26-34 Plot 640 may include detected light signal 642. Detected light signal 642 may include information related to an emitted photonic signal emitted by the system and detected ambient light. In some embodiments, detected light signal 642 need not include detected ambient light. Detected light signal 642 may have been processed by ambient subtractor 162 of FIG. 1, demultiplexer 154 of FIG. 1, pre-processor 420 of FIG.4, any other suitable processing equipment, or any combination thereof. Addison-788 21:25-33 Plot 660 may include detected ambient signal 662. Detected ambient signal 662 may include information related to the amplitude of light received during an “off” or dark period of a drive pulse modulation. For example, detected ambient signal may include information related to light received during “off” period

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	220 of FIG. 2A, as processed by ambient subtractor 162 of FIG. 1, demultiplexer 154 of FIG. 1, any other suitable processing equipment, or any combination thereof. Addison-788 21:55-63 In time interval 710, the sensor may be removed at time point 718 and reattached at time point 720, as indicated by sensor positioning signal 784. The sensor may be operating in an illuminated environment, as indicated by environmental light level signal 782. In region 744, the level of detected light signal 742 may be relatively higher than the level of detected ambient signal 762 because, for example, the sensor is properly positioned and some or all of the ambient light is blocked from reaching the detector by the sensor body. In region 746 following time point 718 where the sensor is removed from the Subject and directly exposed to environmental light, detected light signal 742 and detected ambient signal 762 may go to a relatively higher, common level. This common movement may be referred to as mimicking-equal behavior, and may be recognized as being indicative of a probe-off condition. The behavior may be identified, for example, by subtracting detected light signal 742 from ambient detected light signal 762 and generating a substantially Zero amplitude signal within a time window. Addison-788 26:62-27:13 In some embodiments, offset 810 may be determined by subtracting detected ambient signal 862 from detected light signal 842. This subtraction would, for the illustrated signals, result in a small, relatively constant signal. This signal, or variations in the signal, may be compared to a threshold or target value to identify a probe-off condition. A threshold may be defined at a predetermined value, by user input, by histori cal information, by information related to the equipment, by any other suitable criteria, or any combination thereof. For example, the threshold may allow parallel behavior to be recognized within a tolerance level. Such that signals that display a certain degree of parallel behavior are identified as indicating a probe-off condition. Variations in the offset or any other signal may be analyzed using, for example, slope, fractal dimension, any other suitable technique, or any com bination thereof. In some embodiments, the system may use more complex mathematical comparisons of the two or more signals, as described above. Addison-788 29:11-28 In some embodiments, the detected ambient signal may, for example, include ambient signal 222 of FIG.2B. In some embodiments, the system may subtract ambient signal 222 or a signal derived from

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	ambient signal 222 from the received signal to generate an adjusted signal. The adjusted signal may be used to determine physiological parameters. In some embodiments, the system may determine an ambient signal for probe-off analysis before generating the adjusted signal. Separation of the ambient signal from the received signal may include, for example, demultiplexer 154 of FIG. 1, any other Suitable equipment, or any combination thereof. Signal pro cessing of the ambient component and emitted light compo nent may include any Suitable components of physiological monitoring system 100 of FIG. 1, physiological monitoring system 310 of FIG.3, signal processing system 400 of FIG.4, any other Suitable components, or any combination thereof. Addison-788 30:25-40 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths;	Addison-788 discloses or renders obvious including a light source comprising a plurality of light emitting diodes that are configured to generate an output optical light having one or more optical wavelengths. In some embodiments, the system may analyze a first signal and a second signal to identify similar behavior. For example, a level or trend of the detected ambient signal may be compared to a level or trend of a detected light signal (e.g., an IR signal). In some embodiments, the detected light signal may include light from a red light emitting diode, an infrared light emitting diode, ambient light, any other suitable light source, or any combination thereof. Addison-788 at 4:32-39 In some embodiments, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Red and infrared (IR) wave lengths may be used because it has been observed that highly oxygenated blood will absorb relatively less red light and more IR light than blood with a lower oxygen

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	saturation. By comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen Saturation of hemoglobin in arterial blood. The system may process data to determine physiological parameters using techniques well known in the art. For example, the system may determine blood oxygen saturation using two wavelengths of light and a ratio-of-ratios calcula tion. The system also may identify pulses and determine pulse amplitude, respiration, blood pressure, other Suitable param eters, or any combination thereof, using any suitable calcula tion techniques. In some embodiments, the system may use information from external sources (e.g., tabulated data, secondary sensor devices) to determine physiological param eters. Addison-788 6:16-36 Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g. Red and IR) into a subjects tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light Source, e.g. Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodi ments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. It will be understood that, as used herein, the term “light' may refer to energy produced by radiative sources and may include one or more of ultrasound, radio, microwave, milli meter wave, infrared, visible, ultraviolet, gamma ray or X-ray electromagnetic radiation. As used herein, light may also include any wavelength within the radio, microwave, infra red, visible, ultraviolet, or X-ray spectra, and that any suitable wavelength of electromagnetic radiation may be appropriate for use with the present techniques. Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130. Addison-788 7:3-30

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	 FIG. 2A Addison-788 at Fig.2A Light drive circuitry 120, as discussed above, may be con figured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of switching light source 130 on and off. When light source 130 is configured to emit two or more wavelengths of light, the light drive signal may be configured to control the operation of each wavelength of light. The light drive signal may comprise a single signal or may comprise multiple sig nals (e.g., one signal for each wavelength of light). An illus trative light drive signal is shown in FIG. 2A. FIG. 2A shows an illustrative plot of a light drive signal including red drive pulse 202 and IR drive pulse 204 in accordance with some embodiments of the present disclosure. Red drive pulse 202 and IR drive pulse 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, drive pulses may refer to switching power or other components on and off, high and low output states, high and low values within a continuous modulation, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red drive pulse 202 and IR drive pulse 204 to drive red and IR light emitters, respectively, within light source 130. Red drive pulse 202 may have a higher amplitude than IR drive pulse 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. In some embodiments, the output levels may be the equal, may be adjusted for nonlinearity of emitters, may be modulated in any other suitable technique, or any combination thereof. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue. When the red and IR

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	light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary any that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. Addison-788 at 8:6-47  FIG. 2B Addison-788 at Fig. 2B FIG. 2B shows an illustrative plot of detector current waveform 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with drive pulses driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not decrease to zero. Rather, ambient signal 222 may be present in the detector waveform, as well as other background amplitude contributions. In some embodiments, the shapes of the pulses in detector current waveforms

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	may include distortions, clipping, delayed switching, relatively slow rising and falling edges, and other non-idealities due in part to switching of the light drive, switching of the LEDs, switching in the detector, stabilization of the detector, stabilization of the detected signal, parasitic inductance and/or capacitances, any other suitable signal contribution, or any combination thereof. In some embodiments, ambient signal 222 may be used to determine a probe-off condition. In some embodiments, ambient signal 222 may be removed from a processed signal to facilitate determination of physiological parameters. Addison-788 at 9:15-45 FIG. 3 is a perspective view of an embodiment of a physi ological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodi ments, one or more components of physiological monitoring system 310 may include one or more components of physi ological monitoring system 100 of FIG. 1. Physiological monitoring system 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subjects tissue. One or more detectors 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subjects tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light Sources and detectors, which may be spaced apart. Physiological monitoring system 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a pho toacoustic sensor). Multiple sensor units may be capable of being positioned at two or more different locations on a subjects body. Addison-788 13:5-29 In step 502, the system may use the physiological sensor to emit an emitted photonic signal. The system may emit the emitted photonic signal including one wavelength of light, multiple wavelengths of light, a broad spectrum light (e.g., white light), or any combination thereof. For example, the emitted photonic signal may include light from a red LED and light from an IR LED. The emitted photonic signal may be emitted, for example, by light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the emitted photonic signal may include a light drive modulation. For example, when the emitted photonic signal includes a red light source and an IR light source, the light drive modulation may include a red drive pulse followed by an “off” period followed by an IR drive pulse followed by an off period. It

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	will be understood that this drive cycle modulation is merely exemplary and that any suitable drive cycle modulation or combination of modulations may be used. In some embodiments, the emitted photonic signal may include a cardiac cycle modulation, where the brightness, duty cycle, or other parameters of one or more emitters are varied at a rate substantially related to the cardiac cycle. Addison-788 at 17:19-42 In some embodiments, the system may adjust or compensate a received light signal depending in part on a light drive setting. Drive settings may include the LED drive signal, the detector gain, other suitable system parameters, or any combination thereof. For example, increasing the gain on a detected signal may result in an increased level of the detected ambient signal. The system may compensate for this increase in the ambient light signal that is not correlated with a change in the sensor positioning, in part so that the gain change is distinguished from a change in sensor positioning. In a further example, the system may change the LED emitter brightness, resulting in a change in the detected light signal. The system may compensate for these changes in the detected signal amplitude to distinguish them from a change in the sensor positioning. It will be understood that the system may make any adjustments in gain, amplification, frequency, wavelength, amplitude, any other suitable adjustments, or any combination thereof. It will be understood that the adjustments may be made to the emitted photonic signal, the received signal, any signal following a number of processing steps, any other suitable signals, or any combination thereof. Addison-788 at 17:64-18:17 In step 902, the system may use the physiological sensor to emit a photonic signal. The system may emit a photonic signal including one wavelength of light, multiple wavelengths of light, a broad spectrum light (e.g., white light), or any combination thereof. For example, the photonic signal may include light from a red LED and light from an IR LED. The emitted photonic signal may be emitted, for example, by light source 130 of FIG. 1. In some embodiments, the emitted photonic signal may include a light drive modulation. For example, where the photonic signal includes a red light source and an IR light source, the light drive modulation may include a red drive pulse followed by an “off” period followed by an IR drive pulse followed by an off period. It will be understood that this drive cycle modulation is merely exemplary and that any suitable drive cycle modulation or combination of modulations may be used. In some embodiments, the photonic signal may include a cardiac cycle modulation, where the brightness, duty cycle, or other parameters of one or more emitters are varied at a rate substantially related to the cardiac cycle.

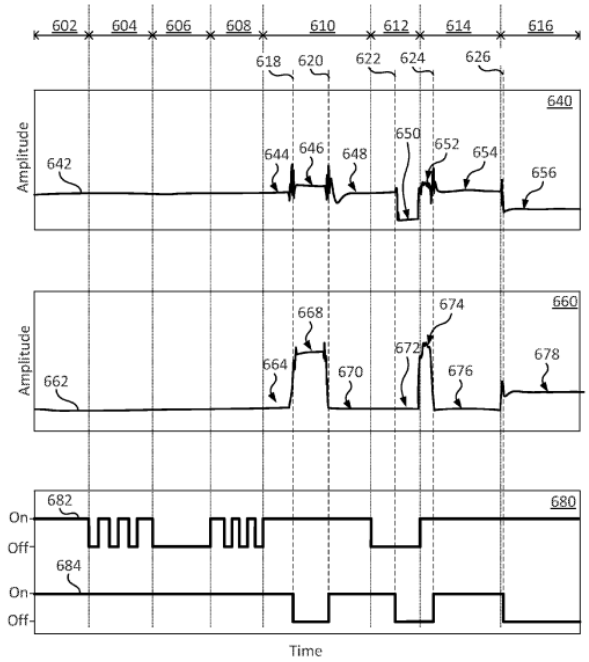
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	Addison-788 at 29:52-30:4 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin;	Addison-788 discloses or renders obvious one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue comprising skin. In some embodiments, a sensor may be configured to limit the amount of ambient light received by a detector. For example, a detector may be held close to and facing the skin. A detector may include a light blocking material between the detector and any ambient light sources, to prevent or reduce ambient light from reaching the detector. In a further example, a system may include other suitable shields, optics, filters, arrangements, or any combination thereof, to reduce ambient light signals received by the receiver. In some embodiments, the particular arrangement of light blocking structures or material may depend on the type of probe. For example, a forehead probe may include a relatively flat light blocking structure, while a fingertip probe may include a light blocking structure that encircles the finger. It will be understood, however, that may clinical settings include relatively bright light sources and the ambient light signals received by the detector may not be fully blocked when the sensor is positioned as desired. Similarly, fully shielding ambient light may be more difficult for a forehead sensor than, for example, a fingertip sensor. Addison-788 at 3:48-67 In some embodiments, for example, with a fingertip sensor where light may be generated by the system on one side of a finger and detected on the opposite side of a finger, removing the finger from the sensor (i.e., a probe-off condition) may result in a large portion of the generated light being received by the sensor, rather than a portion of the light being attenu ated by interacting with the tissue of the subject. This very high signal level may be detected as a probe-off condition by the system.

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	In some embodiments, for example, with a forehead sen Sor, a probe-off condition may not result in a relatively high detected signal level. A forehead sensor may include a light source placed relatively close to a detector on the forehead of a patient using tape, an adhesive, a band encircling the skull, any other Suitable arrangement, or any combination thereof. The light source and detector may be arranged such that a portion of the light emitted from the light source interacts with, and is partially attenuated by, the tissue of the subject and is detected by the detector. Addison-788 4:1-19 The foregoing probe-off techniques may be implemented in an oximeter. An oximeter is a medical device that may determine the oxygen Saturation of an analyzed tissue. One common type of oximeter is a pulse oximeter, which may non-invasively measure the oxygen Saturation of a patients blood (as opposed to measuring oxygen Saturation directly by analyzing a blood sample taken from the patient). Pulse Oximeters may be included in patient monitoring systems that measure and display various blood flow characteristics including, but not limited to, the oxygen Saturation of hemo globin in arterial blood. Such patient monitoring systems may also measure and display additional physiological param eters, such as a patient’s pulse rate and blood pressure. An oximeter may include a light sensor that is placed at a site on apatient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot or hand. The oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. Addison-788 5:37-55 In addition, the term “PPG signal” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue) or any Suitable mathematical manipulation thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemo globin) being measured as well as a pulse rate and when each individual pulse occurs. In some embodiments, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Addison-788 6:7-19

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	FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodiments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Addison-788 at 6:64-7:2 Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g. Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g. Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Addison-788 at 7:3-19 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed, scattered, or reflected, less light of that wavelength is typically received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Addison-788 at 7:31-49

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	FIG. 2A shows an illustrative plot of a light drive signal including red drive pulse 202 and IR drive pulse 204 in accordance with some embodiments of the present disclosure. Red drive pulse 202 and IR drive pulse 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, drive pulses may refer to switching power or other components on and off, high and low output states, high and low values within a continuous modulation, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red drive pulse 202 and IR drive pulse 204 to drive red and IR light emitters, respectively, within light source 130. Red drive pulse 202 may have a higher amplitude than IR drive pulse 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. In some embodiments, the output levels may be the equal, may be adjusted for nonlinearity of emitters, may be modulated in any other suitable technique, or any combination thereof. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary any that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. Addison-788 at 8:17-47 User interface 180 may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device. The inputs received by user input 182 can include information about the subject, such as age, weight, height, diagnosis, medications, treatments, and so forth. In an embodiment, the subject may be a medical patient and display 184 may exhibit a list of values which may generally apply to the patient, such as, for example, age ranges or medication families, which the user may select using user inputs 182. Additionally, display 184 may display, for example, an estimate of a subject's blood oxygen saturation generated by monitor 104 (referred to as an “SpO2” measurement), pulse rate information, respiration rate information, blood pressure, sensor condition, any other parameters, and any combination thereof. Display 184 may include any type of display such as a cathode ray tube display, a flat panel display such a liquid crystal display or plasma display, or any other suitable display device. Speaker 186 within user interface 180 may provide an audible sound that may be used in various embodiments, such as for example, sounding an

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	audible alarm in the event that a patient's physiological parameters are not within a predefined normal range. Addison-788 at 12:7-30 FIG. 3 is a perspective view of an embodiment of a physi ological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodi ments, one or more components of physiological monitoring system 310 may include one or more components of physi ological monitoring system 100 of FIG. 1. Physiological monitoring system 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subjects tissue. One or more detectors 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subjects tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light Sources and detectors, which may be spaced apart. Physiological monitoring system 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a pho toacoustic sensor). Multiple sensor units may be capable of being positioned at two or more different locations on a subjects body. Addison-788 13:5-29 In step 504, the system may receive a light signal. The received light signal may include the detected light signal and the detected ambient signal, as described above. For example, the detected light signal and the ambient signal may be deter mined by demultiplexing a received light signal based on time division multiplexing of the emitters. In some embodiments, the received light signal may in part correspond to the emitted photonic signals of step 502, light from ambient light sources, any other suitable source, or any combination thereof. The received light signal may be received by, for example, detec tor 140 of FIG. 1 or detector 318 of FIG. 3. In some embodi ments, a portion of the emitted photonic light signal may be partially attenuated by the tissue of the subject before being detected as a received light signal. In some embodiments, the received light signal may have been primarily reflected by the subject. For example, reflected light may be detected by a forehead-attached system where the emitter and detector are on the same side of the Subject. In some embodiments, the received light may be have

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	been transmitted through the subject. For example, transmitted light may be detected in a fingertip-attached or earlobe-attached sensor. Addison-788 17:43-63  FIG. 6 Addison-788 at Fig. 6 The signals of FIG. 6 may, for example, be obtained from a forehead pulse oximeter sensor. Other suitable sensors may be used including, for example, a fingertip, earlobe, wrist, arm, foot, other suitable sensor, or any combination thereof. In some embodiments, different sensors may produce different signals, however it will be understood that the techniques described herein may be applied to multiple sensor types with appropriate modifications. For example, a sensor such as a fingertip sensor which may rely primarily on transmitted light rather than the reflected light of a forehead sensor may result in very high detected light signals being received when the sensor is improperly positioned in a dark room—

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	rather than low signal levels. Thresholds, target values, time windows, other signal processing parameters, and any combination thereof may be adjusted based on the sensor and measurement type. Addison-788 at 22:8-23 In time interval 602, the system may be under constant natural light conditions from a window with a properly attached forehead sensor. Accordingly, environmental light level signal 682 is “On” and sensor positing signal 684 is “On.” The signal levels of time interval 602 may, for example, be indicative of signals received for 30 seconds. Addison-788 at 22:56-61 In step 904, the system may receive a light signal. The received light signal may include light from drive pulses or other emitted light in the emitted photonic signal that has interacted with the subject. The received light signal may be detected by, for example, detector 140 of FIG. 1. In some embodiments, a portion of the emitted light may be partially attenuated by the tissue of the subject before being received as a received light signal. In some embodiments, the received light may have been primarily reflected by the subject. For example, reflected light may be detected by a forehead-at tached system where the emitter and detector are on the same side of the subject. In some embodiments, the received light may have been transmitted through the Subject. For example, transmitted light may be detected in a fingertip-attached or earlobe-attached sensor. Addison-788 30:5-19 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. a detection system configured to receive at least a portion of the lens output light reflected from the	Addison-788 discloses or renders obvious a detection system configured to receive at least a portion of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio.

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tissue and to generate an output signal having a signal-to-noise ratio,	The present disclosure is directed towards determining a probe-off condition in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physi ological sensors. For example, the physiological monitoring system may include a pulse Oximeter. The system may include, for example, a light source and a photosensitive detector. In some embodiments, a sensor may be attached to a target area of a patient. Addison-788 2:10-19 Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g. Red and IR) into a subjects tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light Source, e.g. Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodi ments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Addison-788 7:3-19 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In Some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subjects tissue. Detector 140 may convert the intensity of the received light into an electri cal signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed, scat tered, or reflected, less light of that wavelength is typically received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection sig nal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the Subjects tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Addison-788 7:31-49

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	Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal.” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. FIG. 2B shows an illustrative plot of detector current wave form 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current sig nals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with drive pulses driving one or more emitters of a light source. Such as light source 130 of FIG.1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not decrease to zero. Rather, ambient signal 222 may be present in the detector waveform, as well as other background ampli tude contributions. In some embodiments, the shapes of the pulses in detector current waveforms may include distortions, clipping, delayed Switching, relatively slow rising and falling edges, and other non-idealities due in part to Switching of the light drive, switching of the LEDs, switching in the detector, stabilization of the detector, stabilization of the detected sig nal, parasitic inductance and/or capacitances, any other Suit able signal contribution, or any combination thereof. In some embodiments, ambient signal 222 may be used to determine a probe-off condition. In some embodiments, ambient signal 222 may be removed from a processed signal to facilitate determination of physiological parameters. Referring back to FIG. 1, front end processing circuitry 150, which may receive a detection signal, such as detector current waveform 214, may include analog conditioner 152, demultiplexer 154, digital conditioner 156, analog-to-digital converter (ADC) 158, decimator/interpolator 160, and ambient subtractor 162. In some embodiments, front end processing circuitry 150 may include a second analog-to-digital converter (not shown) configured to sample the unprocessed detector signal. This signal may be used to detect changes in the ambient light level without applying the signal condition and other steps that may improve the quality of determined physiological param eters but may reduce the amount of information regarding a probe-off condition. Analog conditioner 152 may perform any suitable analog conditioning of the detector signal. The conditioning per formed may include any type offiltering (e.g., low pass, high pass, band pass, notch, or

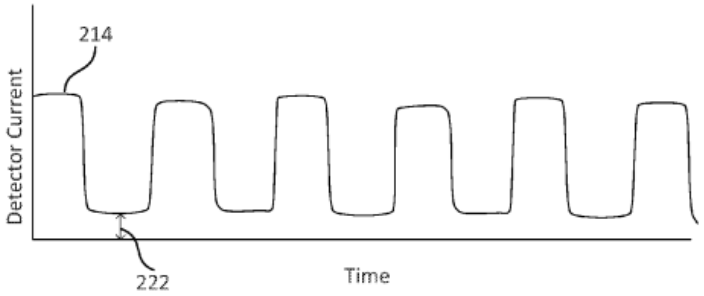
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	any other Suitable filtering), ampli fying, performing an operation on the received signal (e.g., taking a derivative, averaging), performing any other Suitable signal conditioning (e.g., converting a current signal to a Voltage signal), or any combination thereof. The conditioned analog signal may be processed by ana log-to-digital converter 158, which may convert the condi tioned analog signal into a digital signal. Analog-to-digital converter 158 may operate under the control of control cir cuitry 110. Analog-to-digital converter 158 may use timing control signals from control circuitry 110 to determine when to sample the analog signal. Analog-to-digital converter 158 may be any Suitable type of analog-to-digital converter of Sufficient resolution to enable a physiological monitor to accurately determine physiological parameters. Demultiplexer 154 may operate on the analog or digital form of the detector signal to separate out different compo nents of the signal. For example, detector current waveform 214 of FIG. 2B includes a Red component, an IR component, and at least one ambient component. Demultiplexer 154 may operate on detector current waveform 214 of FIG. 2B to generate a Red signal, an IR signal, a first ambient signal (e.g., corresponding to the ambient component that occurs immediately after the Red component), and a second ambient sig nal (e.g., corresponding to the ambient component that occurs immediately after the IR component). Demultiplexer 154 may operate under the control of control circuitry 110. For example, demultiplexer 154 may use timing control signals from control circuitry 110 to identify and separate out the different components of the detector signal. Digital conditioner 156 may perform any suitable digital conditioning of the detector signal. Digital conditioner 156 may include any type of digital filtering of the signal (e.g., low pass, high pass, band pass, notch, or any other Suitable filter ing), amplifying, performing an operation on the signal, per forming any other suitable digital conditioning, or any com bination thereof. Decimator/interpolator 160 may decrease the number of samples in the digital detector signal. For example, decima tor/interpolator 160 may decrease the number of samples by removing samples from the detector signal or replacing samples with a smaller number of samples. The decimation or interpolation operation may include or be followed by filter ing to Smooth the output signal. Ambient Subtractor 162 may operate on the digital signal. In some embodiments, ambient subtractor 162 may remove ambient values from the Red and IR components. In some embodiments, the system may subtract the ambient values from the Red and IR components to generate adjusted Red and IR signals. For example, ambient Subtractor 162 may determine a subtraction amount from the ambient signal por tion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the ambient signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red drive pulse 202 may be adjusted by determining the amount of ambient signal during the "off period 220 preceding red drive pulse 202. The ambient signal amount determined in this manner may be subtracted from the detector peak corre sponding to red drive pulse 202. Alternatively,

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	the “off period 220 after red drive pulse 202 may be used to correct red drive pulse 202 rather than the “off period 220 preceding it. Additionally, an average of the “off periods 220 before and after “on” periods of red drive pulse 202 may be used. In some embodiments, ambient Subtractor 162 may output an ambient signal for further processing. Ambient Subtractor 162 may average the ambient signal from multiple “off periods 220, may apply filters to the ambient signal Such as averaging filters, integration filters, delay filters, buffers, counters, any other Suitable filters or processing, or any combination thereof. Addison-788 9:4-10:67 FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodi ments, one or more components of physiological monitoring system 310 may include one or more components of physi ological monitoring system 100 of FIG. 1. Physiological monitoring system 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subjects tissue. One or more detectors 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subjects tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light Sources and detectors, which may be spaced apart. Physiological monitoring system 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a pho toacoustic sensor). Multiple sensor units may be capable of being positioned at two or more different locations on a subjects body. Addison-788 13:5-29 FIG. 4 shows illustrative signal processing system 400 in accordance with some embodiments of the present disclo Sure. Signal processing system 400 includes input signal gen erator 410, processor 412 and output 414. In the illustrated embodiment, input signal generator 410 may include pre processor 420 coupled to sensor 418. As illustrated, input signal generator 410 generates an input signal 416. In some embodiments, input signal 416 may include one or more intensity signals based on a detector output. In some embodi ments, pre-processor 420 may be an oximeterandinput signal 416 may be a PPG signal. In an embodiment, pre-processor 420 may be any Suitable signal processing device and input signal 416

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	may include PPG signals and one or more other physiological signals, such as an electrocardiogram (ECG) signal. It will be understood that input signal generator 410 may include any suitable signal source, signal generating data, signal generating equipment, or any combination thereof to produce input signal 416. Input signal 416 may be a single signal, or may be multiple signals transmitted over a single pathway or multiple pathways.` Addison-788 14:50-15:2 The system may determine characteristics of the first sig nal, the second signal, any other Suitable signal, or any com bination thereof. Characteristics may include the signal level, amplitude, rate of change, slope, moving average, other trend, any other Suitable characteristic, or any combination thereof. For example, a trend may include a first derivative of the amplitude signal. A characteristic may include a combination of parameters. For example, a trend may include the magni tude and polarity of the first derivative. In another example, the characteristic may include the signal amplitude and the polarity of the first derivative. Characteristics may be relative, absolute, or any combination thereof. For example, the signal level may be the absolute amplitude. In another example, the signal level may be relative to a baseline or to another signal. Determining the signal level may include any Suitable pro cessing equipment described above. The system may apply to the light signal filtering, Smoothing, averaging, any other Suitable technique, or any combination thereof. For example, the light signal may be filtered to remove noise. In another example, the signal may be smoothed or averaged to remove transient signals. Addison-788 19:5-25 In some embodiments, signal noise, ringing, and/or transients may occur at or near the point in time when a sensor is attached or removed from a subject. This can be seen, for example in detected light signal 642 at time point 618. The noise may be related to, for example, changes in signal processing, changes in front end amplification, increased amounts of reflected light when the sensor is partially out of proper position, any other suitable sources of noise, or any combination thereof. In some embodiments, this noise may be identified and ignored by the system in determining a probe-off condition. Addison-788 at 21:64-22:7 In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 610 may be indicative of the sensor being removed and reattached while operating in an illuminated room. In time interval 610, the sensor (e.g., a forehead sensor) may be removed from the

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	patient at time point 618. The level of detected light signal 642 may increase from a relatively lower level in region 644 to a relatively higher level in region 646 substantially coincident with the removal of the sensor at time point 618. The level of detected ambient signal 662 may increase from a relatively lower level in region 664 to a relatively higher level in region 668 substantially coincident with the removal of the sensor at time point 618. The increase in both detected light signal 642 and detected ambient signal 662 may be indicative of an increased amount of light reaching the detector. In some embodiments, shielding or light blocking structures may have prevented ambient light from reaching the detector while it was properly positioned, but not while it is removed from the subject. In some embodiments, the changes in signal levels may be in part attributed to increased ambient light reaching the detector, light from the emitters that is not attenuated as much as it would have been in a properly positioned sensor arrangement reaching the detector, sensor noise, other suitable signal sources, or any combination thereof. Addison-788 at 24:8-31 In time interval 714, the sensor may operate in an illuminated environment, as indicated by environmental light level signal 782. The sensor may be removed from the patient during region 752 of time interval 714, reattached at time point 724, and remain attached during region 754. In region 752, where the sensor is operating removed from the subject in an illuminated room, changes in detected light signal 742 and detected ambient signal 762 may parallel each other. In some embodiments, the system may identify this behavior as being indicative of a probe-off condition, as described above. In some embodiments, region 752 may display a relatively higher amount of signal noise than, for example, region 750. In some embodiments, signal noise may be related to an improperly positioned sensor being moved in relation to ambient light sources, to cable connector noise, to other sources of noise, or any combination thereof. In some embodiments, the system may identify the increased noise as being indicative of a probe-off condition. In region 754 after time point 724, where the sensor is reattached as indicated by sensor positioning signal 784, detected light signal 742 and detected ambient signal 762 may return to varying independently. Addison-788 at 27:52-28:6 The signals in plot 800 may include information from a sensor operating in an illuminated room, as indicated by environmental light level signal 882. The sensor, for example a forehead sensor, may be attached in time interval 802 and removed at a particular time, as indicated by time point 886 of sensor positioning signal 884. Upon removal of the sensor, it may be seen in time interval 804 that detected

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	ambient signal 862 and detected light signal 842 vary together with a small, parallel offset. In the time immediately following removal of the sensor, there may be an increased amount of noise present in both signals. The system may recognize this increased amount of noise as being indicative of a probe-off condition. Additionally, the mimicking-equal behavior of time interval 804 which may correspond to an equal or approximately equal amount of light reaching the detector during both detected light signal and detected ambient signal periods, may be recognized by the system as being indicative of a probe-off condition Addison-788 28:44-61 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system is configured to be synchronized to the light source,	Addison-788 discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. As will be described in detail below, a detected ambient signal may include information related to the amount of light a detector receives when one or more associated light sources are in an "off" state. Detected ambient signals may be time division multiplexed in a drive pulse modulation technique. In some embodiments where a detector receives light from light sources coupled to the system and from light sources not coupled to the system, the detected ambient signal may include the light from the light sources not coupled to the system. Ambient light sources may include sunlight, incandescent room lights, fluorescent room lights, fireplaces, candles, naked flames, LED room lights, instrument panel lighting, heat sources, any other suitable light sources not intended for determining a physiological parameter, or any combination thereof. It will be understood that heat sources may generate non-visible IR light that may be detected by the system. It will be understood that any visible or non-visible source of electromagnetic radiation may be included in the detected ambient signal including, for example, radio waves, microwave, IR, visible, UV, X-ray, gamma ray. In some arrangements, the detected ambient signal may include decaying LED light from the system light sources. For example, it may take a particular amount of time for the light output from a light source to decrease to zero following the light

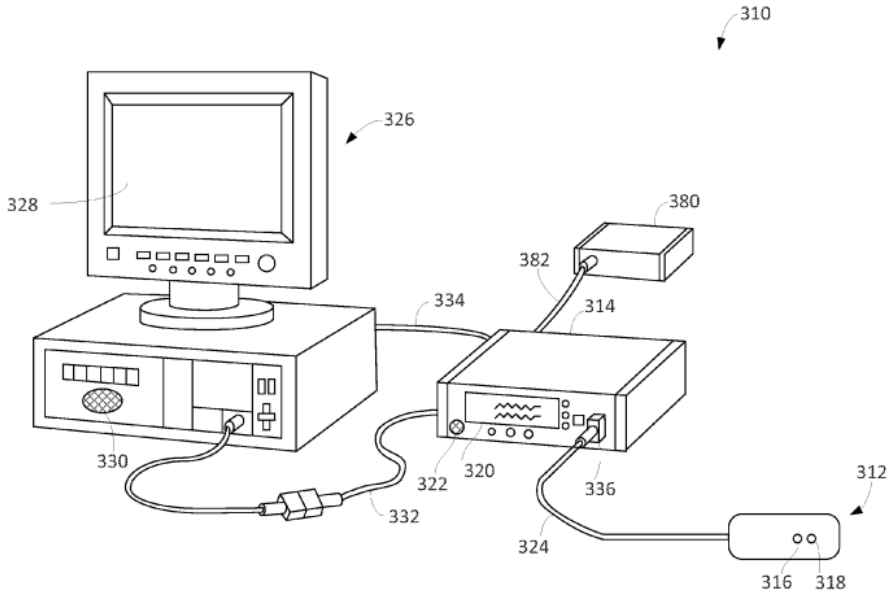
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	drive signal being switched off. A portion of this emitted light may be included in the detected ambient signal. In some arrangements, the detected ambient signal may not contain physiological information. Addison-788 at 3:4-31  FIG. 2B Addison-788 at Fig. 2B Control circuitry 110 may be coupled to light drive cir cuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, con trol circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals of control circuitry 110 to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals of control circuitry 110 to coordinate operation with front end processing circuitry 150. Addison-788 7:55-8:5. FIG. 2B shows an illustrative plot of detector current waveform 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is

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	being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with drive pulses driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not decrease to zero. Rather, ambient signal 222 may be present in the detector waveform, as well as other background amplitude contributions. In some embodiments, the shapes of the pulses in detector current waveforms may include distortions, clipping, delayed switching, relatively slow rising and falling edges, and other non-idealities due in part to switching of the light drive, switching of the LEDs, switching in the detector, stabilization of the detector, stabilization of the detected signal, parasitic inductance and/or capacitances, any other suitable signal contribution, or any combination thereof. In some embodiments, ambient signal 222 may be used to determine a probe-off condition. In some embodiments, ambient signal 222 may be removed from a processed signal to facilitate determination of physiological parameters. Addison-788 at 9:15-45 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors;	Addison-788 discloses or renders obvious wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one analog to digital converter is coupled to at least one of the plurality of detectors. The present disclosure is directed towards determining a probe-off condition in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient, typically using one or more physiological sensors. For example, the physiological monitoring system may include a pulse oximeter. The system may include, for example, a light source and a photosensitive detector. In some embodiments, a sensor may be attached to a target area of a patient. For example, the sensor may be attached using an adhesive, a strap, a band, elastic, any other suitable attachment, or any

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	combination thereof. In some embodiments, the sensor may be located proximate to a desired structural element. For example, a sensor may be held near to the radial artery using a wrist strap. In another example, a sensor may be held near to the blood vessels of the forehead using an adhesive, tape, a headband strap, any other suitable attachment, or any combination thereof. In a further example, a sensor may be held near the blood vessels on a fingertip using an adhesive, tape or mechanical clip. Addison-788 at 2:10-29 Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g. Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g. Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Addison-788 at 7:3-19 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed, scattered, or reflected, less light of that wavelength is typically received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Addison-788 at 7:31-49

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	Control circuitry 110 may be coupled to light drive cir cuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, con trol circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals of control circuitry 110 to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals of control circuitry 110 to coordinate operation with front end processing circuitry 150. Addison-788 7:55-8:5. Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Addison-788 at 9:4-13 FIG. 2B shows an illustrative plot of detector current waveform 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with drive pulses driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not decrease to zero. Rather, ambient signal 222 may be present in the detector waveform, as well as other background amplitude contributions. In some embodiments, the shapes of the pulses in detector current waveforms

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	may include distortions, clipping, delayed switching, relatively slow rising and falling edges, and other non-idealities due in part to switching of the light drive, switching of the LEDs, switching in the detector, stabilization of the detector, stabilization of the detected signal, parasitic inductance and/or capacitances, any other suitable signal contribution, or any combination thereof. In some embodiments, ambient signal 222 may be used to determine a probe-off condition. In some embodiments, ambient signal 222 may be removed from a processed signal to facilitate determination of physiological parameters. Addison-788 at 9:15-45 Referring back to FIG. 1, front end processing circuitry 150, which may receive a detection signal, such as detector current waveform 214, may include analog conditioner 152, demultiplexer 154, digital conditioner 156, analog-to-digital converter (ADC) 158, decimator/interpolator 160, and ambient subtractor 162. Addison-788 at 9:46-51 In some embodiments, front end processing circuitry 150 may include a second analog-to-digital converter (not shown) configured to sample the unprocessed detector signal. This signal may be used to detect changes in the ambient light level without applying the signal condition and other steps that may improve the quality of determined physiological parameters but may reduce the amount of information regarding a probe-off condition. Addison-788 at 9:52-59

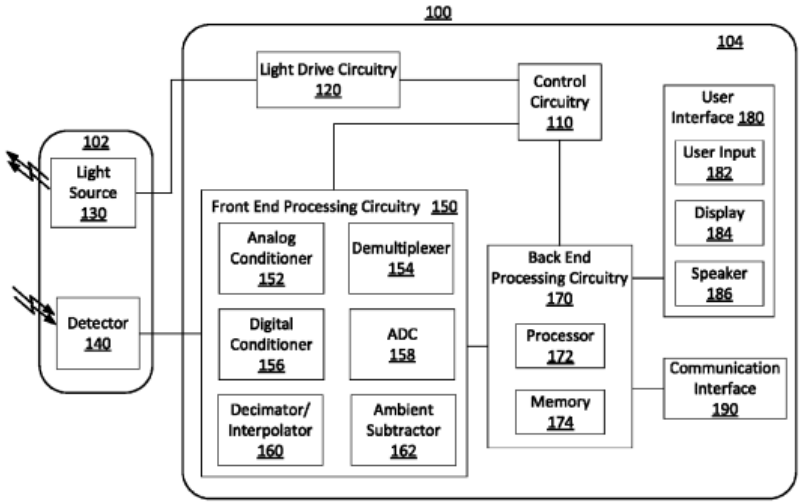
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	 FIG. 3 Addison-788 at Fig. 3 FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. Physiological monitoring system 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detectors 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Physiological monitoring system 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor).

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	Multiple sensor units may be capable of being positioned at two or more different locations on a subject's body. Addison-788 at 13:5-29 In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 612 may be indicative of the sensor being removed while operating in a dark room. In time interval 612, the sensor (e.g., a forehead sensor) may be removed from the patient at time point 622. The level of detected light signal 642 may decrease to a relatively lower level in region 650 substantially coincident with the removal of the sensor at time point 622. The level of detected ambient signal 662 may remain relatively constant in region 672 substantially coincident with the removal of the sensor at time point 622. The decrease in detected light signal 642 coincident with the constant level of detected ambient signal 662 may be indicative of less light from the emitters reaching the detector. In a reflective arrangement such as a forehead sensor, this would be expected when the sensor is removed because it relies on a reflective structure for light to be communicated from the emitters to the detectors. The relatively constant level of detected ambient signal 662 in time interval 612 may be indicative of a relatively constant amount of light reaching the detector when the environmental light level signal 682 is at “Off.” Addison-788 at 24:62-25:15 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of the one or more physiological parameters;	Addison-788 discloses or renders obvious wherein the output signal is indicative of the one or more physiological parameters. See element 1[b], above. The present disclosure is directed towards determining a probe-off condition in a medical device. A physiological monitoring system may monitor one or more physiological parameters of a patient,

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	typically using one or more physiological sensors. For example, the physiological monitoring system may include a pulse oximeter. The system may include, for example, a light source and a photosensitive detector. In some embodiments, a sensor may be attached to a target area of a patient. For example, the sensor may be attached using an adhesive, a strap, a band, elastic, any other suitable attachment, or any combination thereof. In some embodiments, the sensor may be located proximate to a desired structural element. For example, a sensor may be held near to the radial artery using a wrist strap. In another example, a sensor may be held near to the blood vessels of the forehead using an adhesive, tape, a headband strap, any other suitable attachment, or any combination thereof. In a further example, a sensor may be held near the blood vessels on a fingertip using an adhesive, tape or mechanical clip. Addison-788 at 2:10-29 As will be described in detail below, a detected ambient signal may include information related to the amount of light a detector receives when one or more associated light sources are in an “off” state. Detected ambient signals may be time division multiplexed in a drive pulse modulation technique. In some embodiments where a detector receives light from light sources coupled to the system and from light Sources not coupled to the system, the detected ambient signal may include the light from the light sources not coupled to the system. Ambient light sources may include Sunlight, incan descent room lights, fluorescent room lights, fireplaces, candles, naked flames, LED room lights, instrument panel lighting, heat Sources, any other Suitable light sources not intended for determining a physiological parameter, or any combination thereof. It will be understood that heat sources may generate non-visible IR light that may be detected by the system. It will be understood that any visible or non-visible Source of electromagnetic radiation may be included in the detected ambient signal including, for example, radio waves, microwave, IR, visible, UV. X-ray, gamma ray. In some arrangements, the detected ambient signal may include decaying LED light from the system light Sources. For example, it may take a particular amount of time for the light output from a light Source to decrease to Zero following the light drive signal being switched off. A portion of this emitted light may be included in the detected ambient signal. In some arrangements, the detected ambient signal may not contain physiological information. Addison-788 3:4-31 In some embodiments, for example, with a forehead sen Sor, a probe-off condition may not result in a relatively high detected signal level. A forehead sensor may include a light source placed relatively close to a detector on the forehead of a patient using tape, an adhesive, a band encircling the skull, any other Suitable arrangement, or any combination thereof. The light source and detector may be arranged such

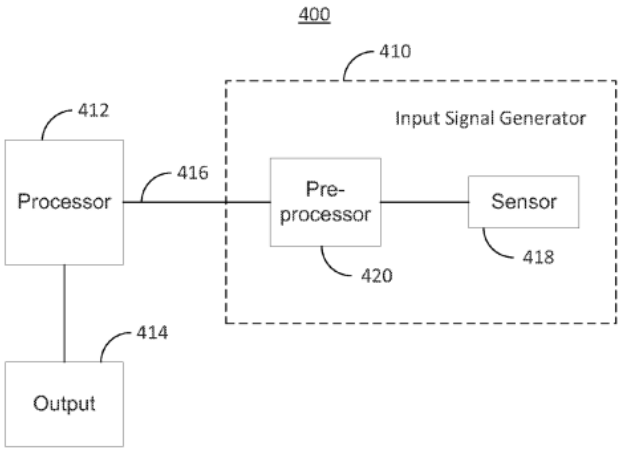
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	that a portion of the light emitted from the light source interacts with, and is partially attenuated by, the tissue of the subject and is detected by the detector. The light source may be pulsed, such that a detected ambient signal is detected by the detector between the pulses, and a detected light signal is detected during the pulses including both a detected ambient light signal and a detected emitted photonic signal. In deter mining a physiological parameter, the detected ambient light signal may be, for example, Subtracted from the detected light signal. The detected ambient signal may exhibit certain char acteristic behavior during a probe-off condition, but may remain relatively constant with respect to other changes. For example, during a probe-off condition, the detected ambient light signal may be relatively insensitive to changes in physiological conditions. Addison-788 4:10-31 In addition, the term “PPG signal” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue) or any Suitable mathematical manipulation thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemo globin) being measured as well as a pulse rate and when each individual pulse occurs. Addison-788 6:7-15 The system may process data to determine physiological parameters using techniques well known in the art. For example, the system may determine blood oxygen Saturation using two wavelengths of light and a ratio-of-ratios calcula tion. The system also may identify pulses and determine pulse amplitude, respiration, blood pressure, other Suitable param eters, or any combination thereof, using any suitable calcula tion techniques. In some embodiments, the system may use information from external sources (e.g., tabulated data, sec ondary sensor devices) to determine physiological parameters. In some embodiments, a light drive modulation may be used. For example, a first light source may be turned on for a first drive pulse, followed by an off period, followed by a second light Source for a second drive pulse, followed by an off period. The first and second drive pulses may be used to determine physiological parameters. The off periods may be used to determine detected ambient signal levels, reduce overlap of the light drive pulses, allow time for light sources to stabilize, allow time for detected light signals to stabilize or settle, reduce heating effects, reduce power consumption, for any other suitable reason, or any combination thereof. It will be understood that the probe-off techniques described herein are not limited to pulse Oximeters and may be applied to any Suitable medical and non-medical devices. For example, the system may

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	include probes for regional saturation (SpO2), respiration rate, respiration effort, continu ous non-invasive blood pressure, saturation pattern detection, fluid responsiveness, cardiac output, any other Suitable clini cal parameter, or any combination thereof. Probes may be used with a pulse oximeter, a general purpose medical moni tor, any other Suitable medical device, or any combination thereof. In some embodiments, the probe-off identification techniques described herein may be applied to analysis of light levels where an ambient or dark signal is detected. Addison-788 6:26-61 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed, scattered, or reflected, less light of that wavelength is typically received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Addison-788 at 7:31-49 FIG. 2A shows an illustrative plot of a light drive signal including red drive pulse 202 and IR drive pulse 204 in accordance with some embodiments of the present disclosure. Red drive pulse 202 and IR drive pulse 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, drive pulses may refer to switching power or other components on and off, high and low output states, high and low values within a continuous modulation, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red drive pulse 202 and IR drive pulse 204 to drive red and IR light emitters, respectively, within light source 130. Red drive pulse 202 may have a higher amplitude than IR drive pulse 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. In some embodiments, the output levels may be the equal, may be adjusted for nonlinearity of emitters, may be modulated in any other suitable technique, or any combination thereof. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue. When the red and IR

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	light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary any that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. Addison-788 at 8:17-47  FIG. 1 Addison-788 at Fig. 1 Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal,” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform

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	various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Addison-788 at 9:4-13 The conditioned analog signal may be processed by ana log-to-digital converter 158, which may convert the condi tioned analog signal into a digital signal. Analog-to-digital converter 158 may operate under the control of control cir cuitry 110. Analog-to-digital converter 158 may use timing control signals from control circuitry 110 to determine when to sample the analog signal. Analog-to-digital converter 158 may be any Suitable type of analog-to-digital converter of Sufficient resolution to enable a physiological monitor to accurately determine physiological parameters. Addison-788 10:1-10 Back end processing circuitry 170 may include processor 172 and memory 174. Processor 172 may be adapted to execute software, which may include an operating system and one or more applications, as part of performing the functions described herein. Processor 172 may receive and further pro cess physiological signals received from front end processing circuitry 150. For example, processor 172 may determine one or more physiological parameters based on the received physiological signals. Addison-788 11:43-51 In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and detection received from one or more sensor units such as sensor unit 312. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen Saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxy genated, and/or total), any other Suitable physiological parameters, or any combination thereof. In some embodi ments, calculations may be performed on the sensor units or an intermediate device and the result of the calculations may be passed to monitor 314. Further, monitor 314 may include display 320 configured to display the physiological param eters or other information about the system. In the embodi ment shown, monitor 314 may also include a speaker 322 to provide an audible sound that may be used in various other embodiments, such as for example, Sounding an audible alarm in the event that a Subject's

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	physiological parameters are not within a predefined normal range or when a sensor is not properly positioned. In some embodiments, physiological monitoring system 310 may include a stand-alone monitor in communication with the monitor 314 via a cable or a wireless network link. In some embodiments, monitor 314 may be implemented as display 184 of FIG. 1. Addison-788 13:30-58 In the illustrated embodiment, physiological monitoring system 310 includes a multi-parameter physiological monitor 326. The display 328 of multi-parameter physiological moni tor 326 may include a cathode ray tube display, a flat panel display (as shown) such as a liquid crystal display (LCD) or a plasma display, or may include any other type of monitor now known or later developed. Multi-parameter physiological monitor 326 may be configured to calculate physiological parameters and to provide information from monitor 314 and from other medical monitoring devices or systems (not shown) using display 328. For example, multi-parameter physiological monitor 326 may be configured to display an estimate of a Subject’s blood oxygen saturation and hemoglo bin concentration generated by monitor 314. Multi-parameter physiological monitor 326 may include a speaker 330. Monitor 314 may be communicatively coupled to multi parameter physiological monitor 326 via a cable 332 or 334 that is coupled to a sensor input port or a digital communica tions port, respectively and/or may communicate wirelessly (not shown). In addition, monitor 314 and/or multi-parameter physiological monitor 326 may be coupled to a network to enable the sharing of information with servers or other work stations (not shown). Monitor 314 may be powered by a battery (not shown) or by a conventional power source Such as a wall outlet. In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. Addison-788 14:22-49

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	 FIG. 4 Addison-788 at Fig. 4 FIG. 4 shows illustrative signal processing system 400 in accordance with some embodiments of the present disclosure. Signal processing system 400 includes input signal generator 410, processor 412 and output 414. In the illustrated embodiment, input signal generator 410 may include pre-processor 420 coupled to sensor 418. As illustrated, input signal generator 410 generates an input signal 416. In some embodiments, input signal 416 may include one or more intensity signals based on a detector output. In some embodiments, pre-processor 420 may be an oximeter and input signal 416 may be a PPG signal. In an embodiment, pre-processor 420 may be any suitable signal processing device and input signal 416 may include PPG signals and one or more other physiological signals, such as an electrocardiogram (ECG) signal. It will be understood that input signal generator 410 may include any suitable signal source, signal generating data, signal generating equipment, or any combination thereof to produce input signal 416. Input signal 416 may be a single signal, or may be multiple signals transmitted over a single pathway or multiple pathways.

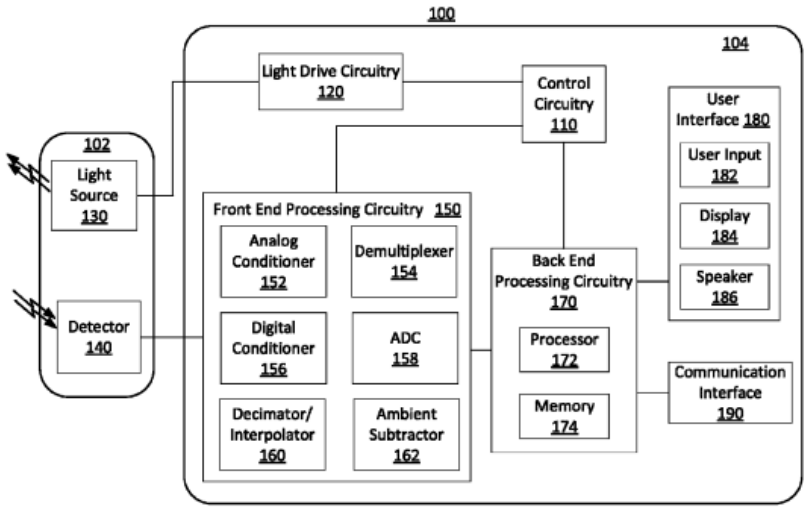
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	Addison-788 at 14:50-15:2 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity;	Addison-788 discloses or renders obvious the apparatus being configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of light emitting diodes from an initial light intensity. Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g. Red and IR) into a subject's tissue. For example**,** light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g. Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Addison-788 at 7:3-19 Light drive circuitry 120, as discussed above, may be con figured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of switching light source 130 on and off. When light source 130 is configured to emit two or more wavelengths of light, the light drive signal may be configured to control the operation of each wavelength of light. The light drive signal may comprise a single signal or may comprise multiple sig nals (e.g., one signal for each wavelength of light). An illus trative light drive signal is shown in FIG. 2A. Addison-788 8:6-16

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	In step 502, the system may use the physiological sensor to emit an emitted photonic signal. The system may emit the emitted photonic signal including one wavelength of light, multiple wavelengths of light, a broad spectrum light (e.g., white light), or any combination thereof. For example, the emitted photonic signal may include light from ared LED and light from an IR LED. The emitted photonic signal may be emitted, for example, by light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the emitted photonic signal may include a light drive modulation. For example, when the emitted photonic signal includes a red light source and an IR light source, the light drive modulation may include a red drive pulse followed by an “off period followed by an IR drive pulse followed by an off period. It will be understood that this drive cycle modulation is merely exemplary and that any Suitable drive cycle modulation or combination of modulations may be used. In some embodi ments, the emitted photonic signal may include a cardiac cycle modulation, where the brightness, duty cycle, or other parameters of one or more emitters are varied at a rate Sub stantially related to the cardiac cycle. Addison-788 17:22-42 In some embodiments, the system may adjust or compensate a received light signal depending in part on a light drive setting. Drive settings may include the LED drive signal, the detector gain, other suitable system parameters, or any combination thereof. For example, increasing the gain on a detected signal may result in an increased level of the detected ambient signal. The system may compensate for this increase in the ambient light signal that is not correlated with a change in the sensor positioning, in part so that the gain change is distinguished from a change in sensor positioning. In a further example, the system may change the LED emitter brightness, resulting in a change in the detected light signal. The system may compensate for these changes in the detected signal amplitude to distinguish them from a change in the sensor positioning. It will be understood that the system may make any adjustments in gain, amplification, frequency, wavelength, amplitude, any other suitable adjustments, or any combination thereof. It will be understood that the adjustments may be made to the emitted photonic signal, the received signal, any signal following a number of processing steps, any other suitable signals, or any combination thereof. Addison-788 at 17:64-18:17 In some embodiments, signal noise, ringing, and/or transients may occur at or near the point in time when a sensor is attached or removed from a subject. This can be seen, for example in detected light signal 642 at time point 618. The noise may be related to, for example, changes in signal processing,

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	changes in front end amplification, increased amounts of reflected light when the sensor is partially out of proper position, any other suitable sources of noise, or any combination thereof. In some embodiments, this noise may be identified and ignored by the system in determining a probe-off condition. Addison-788 at 21:64-22:7 In time interval 714, the sensor may operate in an illuminated environment, as indicated by environmental light level signal 782. The sensor may be removed from the patient during region 752 of time interval 714, reattached at time point 724, and remain attached during region 754. In region 752, where the sensor is operating removed from the subject in an illuminated room, changes in detected light signal 742 and detected ambient signal 762 may parallel each other. In some embodiments, the system may identify this behavior as being indicative of a probe-off condition, as described above. In some embodiments, region 752 may display a relatively higher amount of signal noise than, for example, region 750. In some embodiments, signal noise may be related to an improperly positioned sensor being moved in relation to ambient light sources, to cable connector noise, to other sources of noise, or any combination thereof. In some embodiments, the system may identify the increased noise as being indicative of a probe-off condition. In region 754 after time point 724, where the sensor is reattached as indicated by sensor positioning signal 784, detected light signal 742 and detected ambient signal 762 may return to varying independently. Addison-788 at 27:52-28:6 In step 902, the system may use the physiological sensor to emit a photonic signal. The system may emit a photonic signal including one wavelength of light, multiple wave lengths of light, a broad spectrum light (e.g., white light), or any combination thereof. For example, the photonic signal may include light from a red LED and light from an IRLED. The emitted photonic signal may be emitted, for example, by light source 130 of FIG.1. In some embodiments, the emitted photonic signal may include a light drive modulation. For example, where the photonic signal includes a red light Source and an IR light Source, the light drive modulation may include a red drive pulse followed by an “off” period followed by an IR drive pulse followed by an off period. It will be understood that this drive cycle modulation is merely exem plary and that any suitable drive cycle modulation or combi nation of modulations may be used. In some embodiments, the photonic signal may include a cardiac cycle modulation, where the brightness, duty cycle, or other parameters of one or more emitters are varied at a rate substantially related to the cardiac cycle.

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	Addison-788 29:52-30:4 In some embodiments, the system may adjust or compen sate a signal depending in part on the LED drive signal, the detector gain, other Suitable system parameters, or any com bination thereof. For example, increasing the gain on a detected signal may result in an increased ambient signal. The system may compensate for this increased ambient that is not correlated with a change in the sensor positioning. In a further example, the system may change the LED emitter brightness, resulting in a change in the detected signals. The system may compensate for these changes in the detected signal ampli tude to distinguish them from a change in the sensor position ing. It will be understood that the system may make any adjustments in gain, amplification, frequency, wavelength, amplitude, any other Suitable adjustments, or any combina tion thereof. It will be understood that the adjustments may be made to the emitted photonic signal, the received signal, a signal following a number of processing steps, any other Suitable signals, or any combination thereof. Addison-788 30:41-58 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Addison-788 discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off. See element 1[l], below. Methods and systems are provided for determining whether a physiological sensor is properly positioned on a Subject. In some embodiments, a detected light signal may be received using the physiological sensor. The detected light signal may be processed to obtain a first signal corresponding to ambient light and a second signal corresponding to an emitted photonic signal and ambient light. The first and sec ond signal may be analyzed to determine similar behavior, and it may be determined that the physiological sensor is not properly positioned based on the analysis. In some embodiments, similar behaviors may include mimicking-equal behavior, mimicking-parallel behavior, nonlinear Scaling, any other Suitable

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	behavior, or any combi nation thereof. For example, mimicking-equal or mimicking parallel behavior may be identified when both the first and second signals move together or with a constant offset. In some embodiments, this behavior may be identified as a probe-off condition, and may be indicative of the same amount of light reaching the detector irrespective of light emitted by the system. In some embodiments, the system may identify a constant amplitude or signal flatness. A constant amplitude may be used alone or in combination with other signals to determine a probe-off condition. Addison-788 1:9-34. As will be described in detail below, a detected ambient signal may include information related to the amount of light a detector receives when one or more associated light sources are in an “off” state. Detected ambient signals may be time division multiplexed in a drive pulse modulation technique. In some embodiments where a detector receives light from light sources coupled to the system and from light Sources not coupled to the system, the detected ambient signal may include the light from the light sources not coupled to the system. Ambient light sources may include Sunlight, incan descent room lights, fluorescent room lights, fireplaces, candles, naked flames, LED room lights, instrument panel lighting, heat Sources, any other Suitable light sources not intended for determining a physiological parameter, or any combination thereof. It will be understood that heat sources may generate non-visible IR light that may be detected by the system. It will be understood that any visible or non-visible Source of electromagnetic radiation may be included in the detected ambient signal including, for example, radio waves, microwave, IR, visible, UV. X-ray, gamma ray. In some arrangements, the detected ambient signal may include decaying LED light from the system light Sources. For example, it may take a particular amount of time for the light output from a light Source to decrease to Zero following the light drive signal being switched off. A portion of this emitted light may be included in the detected ambient signal. In some arrangements, the detected ambient signal may not contain physiological information. Addison-788 3:4-31 In some embodiments, the system may analyze a first signal and a second signal to identify similar behavior. For example, a level or trend of the detected ambient signal may be compared to a level or trend of a detected light signal (e.g., an IR signal). In some embodiments, the detected light signal may include light from a red light emitting diode, an infrared light emitting diode, ambient light, any other suitable light source, or any combination thereof. Addison-788 at 4:32-39

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	 FIG. 1 Addison-788 at Fig. 1 Control circuitry 110 may be coupled to light drive circuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, control circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals of control circuitry 110 to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals of control circuitry 110 to coordinate its operation with front end processing circuitry 150. Addison-788 at 7:55-8:5

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	FIG. 2B shows an illustrative plot of detector current wave form 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current sig nals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The ampli tude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with drive pulses driving one or more emitters of a light source. Such as light source 130 of FIG.1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not decrease to zero. Rather, ambient signal 222 may be present in the detector waveform, as well as other background ampli tude contributions. In some embodiments, the shapes of the pulses in detector current waveforms may include distortions, clipping, delayed Switching, relatively slow rising and falling edges, and other non-idealities due in part to Switching of the light drive, switching of the LEDs, switching in the detector, stabilization of the detector, stabilization of the detected sig nal, parasitic inductance and/or capacitances, any other Suit able signal contribution, or any combination thereof. In some embodiments, ambient signal 222 may be used to determine a probe-off condition. In some embodiments, ambient signal 222 may be removed from a processed signal to facilitate determination of physiological parameters. Addison-788 at 9:15-45 Ambient Subtractor 162 may operate on the digital signal. In some embodiments, ambient subtractor 162 may remove ambient values from the Red and IR components. In some embodiments, the system may subtract the ambient values from the Red and IR components to generate adjusted Red and IR signals. For example, ambient Subtractor 162 may determine a subtraction amount from the ambient signal por tion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the ambient signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red drive pulse 202 may be adjusted by determining the amount of ambient signal during the “off period 220 preceding red drive pulse 202. The ambient signal amount determined in this manner may be subtracted from the detector peak corre sponding to red drive pulse 202. Alternatively, the “off period 220 after red drive pulse 202 may be used to correct red drive pulse 202 rather than the “off period 220 preceding it. Additionally, an average of the “off periods 220 before and after “on” periods of red drive pulse 202 may be used. In some embodiments, ambient Subtractor 162 may output an ambient signal for further processing. Ambient Subtractor 162 may average the ambient signal from

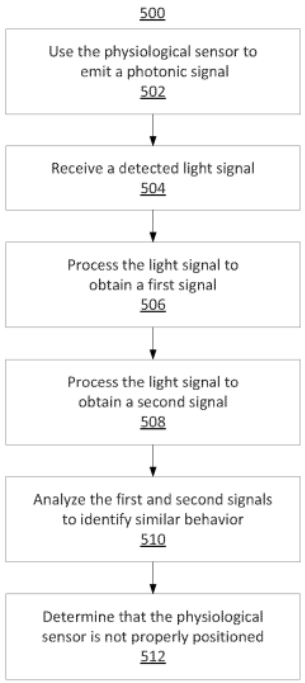
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	multiple "off periods 220, may apply filters to the ambient signal Such as averaging filters, integration filters, delay filters, buffers, counters, any other Suitable filters or processing, or any combination thereof. It will be understood that in some embodiments, ambient subtractor 162 may be omitted. It will also be understood that in Some embodiments, the system may not subtract the ambi ent contribution of the signal. It will also be understood that the functions of demultiplexer 154 and ambient subtractor 162 may be complementary, overlapping, combined into a signal function, combined or separated in any Suitable arrangement, or any combination thereof. For example, the received light signal may include an ambient signal, an IR light signal, and a red light signal. The system may use any suitable arrangement of demultiplexer 154 and ambient sub tractor 162 to determine or generate any combination of a red signal, an IR signal, a red ambient signal, an IR ambient signal, an average ambient signal, a red with ambient signal, an IR with ambient signal, any other Suitable signal, or any combination thereof. Addison-788 at 10:41-11:16 In step 506, the system may process the received light signal to obtain a first signal. The first signal may correspond to detected ambient light signal. In some embodiments, the detected ambient light signal may, for example, correspond to detected ambient signal 222 of FIG. 2B. The first signal may be extracted from the received signal using, for example, demultiplexer 154 of FIG. 1. The processing of the light signal to obtain the first signal may be implemented using any suitable components of physiological monitoring system 100 of FIG. 1, physiological monitoring system 310 of FIG. 3, processing system 400 of FIG. 4, any other suitable components, or any combination thereof. In step 508, the system may process the received light signal to obtain a second signal. In some embodiments, the second signal may correspond to the detected light signal, that is, the combination of the detected emitted photonic signal and the detected ambient light. In some embodiments, the second signal need not include the ambient light component. The second signal may correspond to one or more wave lengths of emitted light, for example, an IR signal, a red signal, any other suitable signal, or any combination thereof. The processing of the light signal to obtain the first signal may be implemented using any Suitable components of physi ological monitoring system 100 of FIG. 1, physiological monitoring system 310 of FIG. 3, processing system 400 of FIG. 4, any other Suitable components, or any combination thereof. In step 510, the system may analyze the first and second signals to identify similar behavior. For example, the analysis may include a comparison of the first signal (e.g., the detected ambient light) to the second signal (e.g., the detected light signal). Comparisons may include Subtraction, division, mul tiplication, integration, any other Suitable function, or any combination thereof. Comparisons may also include time

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	domain comparisons. Similar behavior may include, for example, signals at equal amplitudes, signals showing paral lel changes, signals with the same or similar trends, signals with equal or similar slopes, signals changing in a non-linear but parallel trend, any other suitable similar behavior, or any combination thereof. For example, a detected ambient signal level may be compared to the moving average of the signal corresponding to the emitted photonic signal. In some embodiments, comparing multiple signals may help identify a sensor-off or other undesirable system condition from an external, unrelated change. For example, a large increase in ambient light caused by Switching on an examination room light source may cause the ambient light signal to cross a threshold, but, for example, may not cause the same change in the detected emitted light signal. Thus, comparing the detected ambient signal to another signal may help classify an ambient signal change. In another example, an external detector, for example, on the monitor, may be used to determine an ambient light level that could be used to normalize changes in the detected ambient signal of the sensor. The system may determine characteristics of the first sig nal, the second signal, any other Suitable signal, or any com bination thereof. Characteristics may include the signal level, amplitude, rate of change, slope, moving average, other trend, any other Suitable characteristic, or any combination thereof. For example, a trend may include a first derivative of the amplitude signal. A characteristic may include a combination of parameters. For example, a trend may include the magni tude and polarity of the first derivative. In another example, the characteristic may include the signal amplitude and the polarity of the first derivative. Characteristics may be relative, absolute, or any combination thereof. For example, the signal level may be the absolute amplitude. In another example, the signal level may be relative to a baseline or to another signal. Determining the signal level may include any Suitable pro cessing equipment described above. The system may apply to the light signal filtering, Smoothing, averaging, any other Suitable technique, or any combination thereof. For example, the light signal may be filtered to remove noise. In another example, the signal may be smoothed or averaged to remove transient signals. Addison-788 at 18:18-29 Plot 660 may include detected ambient signal 662. Detected ambient signal 662 may include information related to the amplitude of light received during an “off” or dark period of a drive pulse modulation. For example, detected ambient signal may include information related to light received during “off” period 220 of FIG. 2A, as processed by ambient subtractor 162 of FIG. 1, demultiplexer 154 of FIG. 1, any other Suitable processing equipment, or any combina tion thereof. Addison-788 at 21:55-63

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	In some embodiments, the detected ambient signal may, for example, include ambient signal 222 of FIG.2B. In some embodiments, the system may subtract ambient signal 222 or a signal derived from ambient signal 222 from the received signal to generate an adjusted signal. The adjusted signal may be used to determine physiological parameters. In some embodiments, the system may determine an ambient signal for probe-off analysis before generating the adjusted signal. Separation of the ambient signal from the received signal may include, for example, demultiplexer 154 of FIG. 1, any other Suitable equipment, or any combination thereof. Signal pro cessing of the ambient component and emitted light compo nent may include any Suitable components of physiological monitoring system 100 of FIG. 1, physiological monitoring system 310 of FIG.3, signal processing system 400 of FIG.4, any other Suitable components, or any combination thereof. In some embodiments, the system may adjust or compen Addison-788 at 30:25-40 1. A method for determining whether a physiological sensor is properly positioned on a subject, the method comprising: receiving a light signal using the physiological sensor; processing, using processing equipment, the light signal to obtain a first signal corresponding to ambient light; processing, using the processing equipment, the light signal to obtain a second signal corresponding to an emitted photonic signal and ambient light; analyzing, using the processing equipment, the first signal and the second signal to identify similar signal amplitude behavior; and determining, using the processing equipment, that the physiological sensor is not properly positioned based on the analysis. Addison-788 at Claim 1 15. A system for determining whether a physiological sensor is properly positioned on a subject, the system comprising: processing equipment configured to: receive a light signal from the physiological sensor; process the light signal to obtain a first signal corresponding to ambient light; process the light signal to obtain a second signal corresponding to an emitted photonic signal and ambient light;

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	analyze the first signal and the second signal to identify similar signal amplitude behavior; and determine that the physiological sensor is not properly positioned based on the analysis. Addison-788 at Claim 15 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Addison-788 discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. See element 1[l], below. Methods and systems are provided for determining whether a physiological sensor is properly positioned on a Subject. In some embodiments, a detected light signal may be received using the physiological sensor. The detected light signal may be processed to obtain a first signal corresponding to ambient light and a second signal corresponding to an emitted photonic signal and ambient light. The first and sec ond signal may be analyzed to determine similar behavior, and it may be determined that the physiological sensor is not properly positioned based on the analysis. In some embodiments, similar behaviors may include mimicking-equal behavior, mimicking-parallel behavior, nonlinear Scaling, any other Suitable behavior, or any combi nation thereof. For example, mimicking-equal or mimicking parallel behavior may be identified when both the first and second signals move together or with a constant offset. In some embodiments, this behavior may be identified as a probe-off condition, and may be indicative of the same amount of light reaching the detector irrespective of light emitted by the system. In some embodiments, the system may identify a constant amplitude or signal flatness. A constant amplitude may be used alone or in combination with other signals to determine a probe-off condition. Addison-788 1:9-34. The probe-off condition may be detected by the system. In Some embodiments, the system may use a detected ambient signal and a detected light signal to determine a probe-off condition. As used herein,

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	the emitted photonic signal is a light signal emitted by the system. As used herein, a received light signal is a light signal received by a detector of the system. As used herein, a detected light signal is a light signal corresponding to light detected during the “on” period of a multiplexed drive. As used herein, a detected emitted light signal is a light signal corresponding to light from the emitted photonic signal. As used herein, a detected ambient light signal is a light signal corresponding to light detected during the “off period of a multiplexed drive signal. In some embodiments, the received light signal is split into one or more detected light signals and one or more ambient light signals by demultiplexing. It will be understood that in some embodiments, the detected light signal may be the same or similar to the detected emitted light signal (e.g., when there is no ambient lig Addison-788 2:51-3:3 As will be described in detail below, a detected light signal may include information related to the amount of light a detector receives when one or more associated light sources are in an “on” state. In some embodiments where a detector receives light from light sources coupled to the system and from light sources not coupled to the system, the detected light signal may include light from both sources. Detected light signals may be time division demultiplexed in a drive pulse modulation or other suitable technique. As described above, a detected light signal may include both a detected emitted photonic signal component and an ambient signal component. In some embodiments, an ambient signal may be Subtracted or otherwise separated from a detected light signal. In some embodiments, a detected light signal baseline may be identified based on the detected light signal and the detected ambient signal. Addison-788 3:32-47 In some embodiments, for example, with a forehead sen Sor, a probe-off condition may not result in a relatively high detected signal level. A forehead sensor may include a light source placed relatively close to a detector on the forehead of a patient using tape, an adhesive, a band encircling the skull, any other Suitable arrangement, or any combination thereof. The light source and detector may be arranged such that a portion of the light emitted from the light source interacts with, and is partially attenuated by, the tissue of the subject and is detected by the detector. The light source may be pulsed, such that a detected ambient signal is detected by the detector between the pulses, and a detected light signal is detected during the pulses including both a detected ambient light signal and a detected emitted photonic signal. In deter mining a physiological parameter, the detected ambient light signal may be, for example, Subtracted from the detected light signal. The detected ambient signal may exhibit certain char acteristic behavior during a probe-off condition, but may remain relatively constant with respect to other changes.

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	For example, during a probe-off condition, the detected ambient light signal may be relatively insensitive to changes in physiological conditions. Addison-788 4:10-31 In some embodiments, the system may analyze a first signal and a second signal to identify similar behavior. For example, a level or trend of the detected ambient signal may be compared to a level or trend of a detected light signal (e.g., an IR signal). In some embodiments, the detected light signal may include light from a red light emitting diode, an infrared light emitting diode, ambient light, any other suitable light source, or any combination thereof. Addison-788 at 4:32-39  FIG. 5

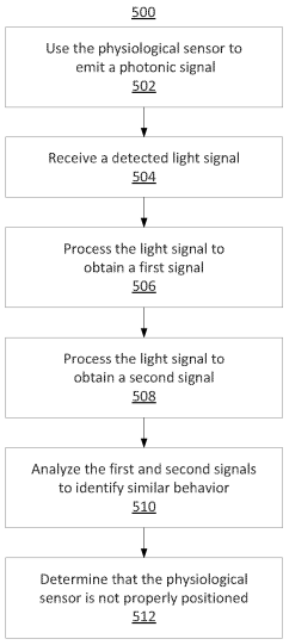
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	Addison-788 at Fig. 5 In step 504, the system may receive a light signal. The received light signal may include the detected light signal and the detected ambient signal, as described above. For example, the detected light signal and the ambient signal may be deter mined by demultiplexing a received light signal based on time division multiplexing of the emitters. In some embodiments, the received light signal may in part correspond to the emitted photonic signals of step 502, light from ambient light sources, any other suitable source, or any combination thereof. The received light signal may be received by, for example, detec tor 140 of FIG. 1 or detector 318 of FIG. 3. In some embodi ments, a portion of the emitted photonic light signal may be partially attenuated by the tissue of the subject before being detected as a received light signal. In some embodiments, the received light signal may have been primarily reflected by the subject. For example, reflected light may be detected by a forehead-attached system where the emitter and detector are on the same side of the Subject. In some embodiments, the received light may be have been transmitted through the Subject. For example, transmitted light may be detected in a fingertip-attached or earlobe-attached sensor. Addison-788 17:43-64 In step 508, the system may process the received light signal to obtain a second signal. In some embodiments, the second signal may correspond to the detected light signal, that is, the combination of the detected emitted photonic signal and the detected ambient light. In some embodiments, the second signal need not include the ambient light component. The second signal may correspond to one or more wavelengths of emitted light, for example, an IR signal, a red signal, any other suitable signal, or any combination thereof. The processing of the light signal to obtain the first signal may be implemented using any suitable components of physiological monitoring system 100 of FIG. 1, physiological monitoring system 310 of FIG. 3, processing system 400 of FIG. 4, any other suitable components, or any combination thereof. Addison-788 at 18:30-44 1. A method for determining whether a physiological sensor is properly positioned on a subject, the method comprising: receiving a light signal using the physiological sensor; processing, using processing equipment, the light signal to obtain a first signal corresponding to ambient light;

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	processing, using the processing equipment, the light signal to obtain a second signal corresponding to an emitted photonic signal and ambient light; analyzing, using the processing equipment, the first signal and the second signal to identify similar signal amplitude behavior; and determining, using the processing equipment, that the physiological sensor is not properly positioned based on the analysis. Addison-788 at Claim 1 15. A system for determining whether a physiological sensor is properly positioned on a subject, the system comprising: processing equipment configured to: receive a light signal from the physiological sensor; process the light signal to obtain a first signal corresponding to ambient light; process the light signal to obtain a second signal corresponding to an emitted photonic signal and ambient light; analyze the first signal and the second signal to identify similar signal amplitude behavior; and determine that the physiological sensor is not properly positioned based on the analysis. Addison-788 at Claim 15 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Addison-788 discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See claim elements 1[j]-1[k], above.

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	As will be described in detail below, a detected light signal may include information related to the amount of light a detector receives when one or more associated light sources are in an “on” state. In some embodiments where a detector receives light from light sources coupled to the system and from light sources not coupled to the system, the detected light signal may include light from both sources. Detected light signals may be time division demultiplexed in a drive pulse modulation or other suitable technique. As described above, a detected light signal may include both a detected emitted photonic signal component and an ambient signal component. In some embodiments, an ambient signal may be Subtracted or otherwise separated from a detected light signal. In some embodiments, a detected light signal baseline may be identified based on the detected light signal and the detected ambient signal. Addison-788 3:32-47 In some embodiments, for example, with a forehead sen Sor, a probe-off condition may not result in a relatively high detected signal level. A forehead sensor may include a light source placed relatively close to a detector on the forehead of a patient using tape, an adhesive, a band encircling the skull, any other Suitable arrangement, or any combination thereof. The light source and detector may be arranged such that a portion of the light emitted from the light source interacts with, and is partially attenuated by, the tissue of the subject and is detected by the detector. The light source may be pulsed, such that a detected ambient signal is detected by the detector between the pulses, and a detected light signal is detected during the pulses including both a detected ambient light signal and a detected emitted photonic signal. In deter mining a physiological parameter, the detected ambient light signal may be, for example, Subtracted from the detected light signal. The detected ambient signal may exhibit certain char acteristic behavior during a probe-off condition, but may remain relatively constant with respect to other changes. For example, during a probe-off condition, the detected ambient light signal may be relatively insensitive to changes in physi ological conditions. Addison-788 4:10-31 In some embodiments, a detected light signal (e.g., an IR signal) and a detected ambient signal may have similar or equal amplitudes. This may be referred to as mimicking equal behavior. In some embodiments, the system may iden tify mimicking-equal behavioras being indicative of a probe off condition. This may occur, for example, when only ambient light is reaching the detector. In this case, the detected ambient and detected light signals are of the same level because they both correspond to the ambient light level. That is to say, the same amount of light is reaching the detector during the “on” and “off” states of the

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	emitters. Mimicking-equal behavior may be identified, for example, when the subtracted difference of one signal from the other is constant within a particular tolerance. Addison-788 4:40-53 In some embodiments, a detected light signal (e.g., an IR signal) and a detected ambient signal may show similar or parallel variations, referred to as mimicking-parallel behavior. This may be identified, for example, when a first signal is subtracted from a second signal and the result is substantially constant. The difference may be evaluated by its derivative, by changes within a time window, by any other suitable technique, or any combination thereof. In some embodiments, the system may identify mimicking-parallel behavior as being indicative of a probe-off condition Addison-788 at 4:54-63 Ambient Subtractor 162 may operate on the digital signal. In some embodiments, ambient subtractor 162 may remove ambient values from the Red and IR components. In some embodiments, the system may subtract the ambient values from the Red and IR components to generate adjusted Red and IR signals. For example, ambient Subtractor 162 may determine a subtraction amount from the ambient signal por tion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the ambient signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red drive pulse 202 may be adjusted by determining the amount of ambient signal during the “off period 220 preceding red drive pulse 202. The ambient signal amount determined in this manner may be subtracted from the detector peak corre sponding to red drive pulse 202. Alternatively, the “off period 220 after red drive pulse 202 may be used to correct red drive pulse 202 rather than the “off period 220 preceding it. Additionally, an average of the “off periods 220 before and after “on” periods of red drive pulse 202 may be used. In some embodiments, ambient Subtractor 162 may output an ambient signal for further processing. Ambient Subtractor 162 may average the ambient signal from multiple “off periods 220, may apply filters to the ambient signal Such as averaging filters, integration filters, delay filters, buffers, counters, any other Suitable filters or processing, or any combination thereof. Addison-788 10:41-67

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	It will be understood that in some embodiments, ambient subtractor 162 may be omitted. It will also be understood that in Some embodiments, the system may not subtract the ambi ent contribution of the signal. It will also be understood that the functions of demultiplexer 154 and ambient subtractor 162 may be complementary, overlapping, combined into a signal function, combined or separated in any Suitable arrangement, or any combination thereof. For example, the received light signal may include an ambient signal, an IR light signal, and a red light signal. The system may use any suitable arrangement of demultiplexer 154 and ambient sub tractor 162 to determine or generate any combination of a red signal, an IR signal, a red ambient signal, an IR ambient signal, an average ambient signal, a red with ambient signal, an IR with ambient s Addison-788 11:1-16 In some embodiments, the system may adjust or compensate a received light signal depending in part on a light drive setting. Drive settings may include the LED drive signal, the detector gain, other suitable system parameters, or any combination thereof. For example, increasing the gain on a detected signal may result in an increased level of the detected ambient signal. The system may compensate for this increase in the ambient light signal that is not correlated with a change in the sensor positioning, in part so that the gain change is distinguished from a change in sensor positioning. In a further example, the system may change the LED emitter brightness, resulting in a change in the detected light signal. The system may compensate for these changes in the detected signal amplitude to distinguish them from a change in the sensor positioning. It will be understood that the system may make any adjustments in gain, amplification, frequency, wavelength, amplitude, any other suitable adjustments, or any combination thereof. It will be understood that the adjustments may be made to the emitted photonic signal, the received signal, any signal following a number of processing steps, any other suitable signals, or any combination thereof. Addison-788 at 17:64-18:17

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	 FIG. 5 Addison-788 at Fig. 5 In step 510, the system may analyze the first and second signals to identify similar behavior. For example, the analysis may include a comparison of the first signal (e.g., the detected ambient light) to the second signal (e.g., the detected light signal). Comparisons may include subtraction, division, multiplication, integration, any other suitable function, or any combination thereof. Comparisons may also include time-domain comparisons. Similar behavior may include, for example, signals at equal amplitudes, signals showing parallel changes, signals with the same or similar trends, signals with equal or similar slopes, signals changing in a non-linear but parallel trend, any other suitable similar behavior, or any combination thereof. For example, a detected ambient signal level may be compared to the moving average of the signal corresponding to the emitted photonic signal. In some embodiments, comparing multiple signals may help identify a sensor-off or other undesirable system condition from an external, unrelated change. For example, a large increase in ambient light caused by switching on an examination room light source may cause the ambient light signal to cross a threshold, but, for example, may not cause the same change in the detected emitted light signal. Thus, comparing the detected ambient signal

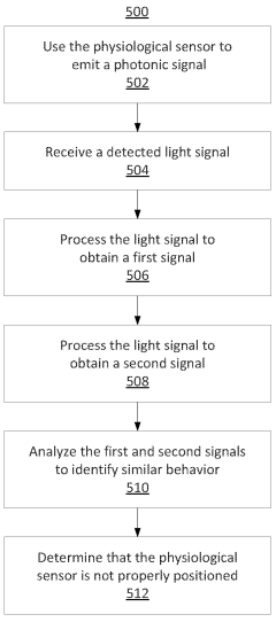
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	to another signal may help classify an ambient signal change. In another example, an external detector, for example, on the monitor, may be used to determine an ambient light level that could be used to normalize changes in the detected ambient signal of the sensor. system may determine characteristics of the first sig nal, the second signal, any other Suitable signal, or any com bination thereof. Characteristics may include the signal level, amplitude, rate of change, slope, moving average, other trend, any other Suitable characteristic, or any combination thereof. For example, a trend may include a first derivative of the amplitude signal. A characteristic may include a combination of parameters. For example, a trend may include the magni tude and polarity of the first derivative. In another example, the characteristic may include the signal amplitude and the polarity of the first derivative. Characteristics may be relative, absolute, or any combination thereof. For example, the signal level may be the absolute amplitude. In another example, the signal level may be relative to a baseline or to another signal. Determining the signal level may include any Suitable pro cessing equipment described above. The system may apply to the light signal filtering, Smoothing, averaging, any other Suitable technique, or any combination thereof. For example, the light signal may be filtered to remove noise. In another example, the signal may be smoothed or averaged to remove transient signals. Addison-788 at 18:45-19:25 In some embodiments, signal noise, ringing, and/or transients may occur at or near the point in time when a sensor is attached or removed from a subject. This can be seen, for example in detected light signal 642 at time point 618. The noise may be related to, for example, changes in signal processing, changes in front end amplification, increased amounts of reflected light when the sensor is partially out of proper position, any other suitable sources of noise, or any combination thereof. In some embodiments, this noise may be identified and ignored by the system in determining a probe-off condition. Addison-788 at 21:64-22:7 In time interval 710, the sensor may be removed at time point 718 and reattached at time point 720, as indicated by sensor positioning signal 784. The sensor may be operating in an illuminated environment, as indicated by environmental light level signal 782. In region 744, the level of detected light signal 742 may be relatively higher than the level of detected ambient signal 762 because, for example, the sensor is properly positioned and some or all of the ambient light is blocked from reaching the detector by the sensor body. In region 746 following time point 718 where the sensor is removed from the Subject and directly exposed to environmental light, detected light signal 742 and detected ambient signal 762 may go to a relatively higher, common level. This common movement may be referred to as mimicking-equal

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	behavior, and may be recognized as being indicative of a probe-off condition. The behavior may be identified, for example, by subtracting detected light signal 742 from ambient detected light signal 762 and generating a substantially Zero amplitude signal within a time window. A certain amount of deviation from Zero may be permitted in identifying the mimicking equal behavior. Deviations may arise from line noise, equip ment noise, any other source, or any combination thereof. In Some embodiments, the signals in region 746 may be indica tive of mimicking-parallel behavior. Following time point 720, where the sensor is reattached as indicated by sensor positioning signal 784, the levels of both detected light signal 742 and detected ambient signal 762 return to levels similar to those in region 744 prior to time point 718. In some embodi ments, this behavior may not be recognized if only changes in detected light signal 742 were analyzed to detect a probe-off condition. The movement of both signals to a common, higher level with common movement indicates that both the detected emitted signal and the detected ambient signal are comprised substantially of environmental light. For example, the sensor receiving no, or a small amount of light corre sponding to the emitted photonic signals. The system may identify this behavior as indicating that the sensor is not properly positioned on the patient. Addison-788 26:62-27:32 In some embodiments, offset 810 may be determined by subtracting detected ambient signal 862 from detected light signal 842. This subtraction would, for the illustrated signals, result in a small, relatively constant signal. This signal, or variations in the signal, may be compared to a threshold or target value to identify a probe-off condition. A threshold may be defined at a predetermined value, by user input, by histori cal information, by information related to the equipment, by any other suitable criteria, or any combination thereof. For example, the threshold may allow parallel behavior to be recognized within a tolerance level. Such that signals that display a certain degree of parallel behavior are identified as indicating a probe-off condition. Variations in the offset or any other signal may be analyzed using, for example, slope, fractal dimension, any other suitable technique, or any com bination thereof. In some embodiments, the system may use more complex mathematical comparisons of the two or more signals, as described above. Addison-788 29:11-28 In some embodiments, the detected ambient signal may, for example, include ambient signal 222 of FIG.2B. In some embodiments, the system may subtract ambient signal 222 or a signal derived from ambient signal 222 from the received signal to generate an adjusted signal. The adjusted signal may be used to determine physiological parameters. In some embodiments, the system may determine an

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	ambient signal for probe-off analysis before generating the adjusted signal. Separation of the ambient signal from the received signal may include, for example, demultiplexer 154 of FIG. 1, any other Suitable equipment, or any combination thereof. Signal pro cessing of the ambient component and emitted light compo nent may include any Suitable components of physiological monitoring system 100 of FIG. 1, physiological monitoring system 310 of FIG.3, signal processing system 400 of FIG.4, any other Suitable components, or any combination thereof. Addison-788 30:25-40 1. A method for determining whether a physiological sensor is properly positioned on a subject, the method comprising: receiving a light signal using the physiological sensor; processing, using processing equipment, the light signal to obtain a first signal corresponding to ambient light; processing, using the processing equipment, the light signal to obtain a second signal corresponding to an emitted photonic signal and ambient light; analyzing, using the processing equipment, the first signal and the second signal to identify similar signal amplitude behavior; and determining, using the processing equipment, that the physiological sensor is not properly positioned based on the analysis. Addison-788 at Claim 1 15. A system for determining whether a physiological sensor is properly positioned on a subject, the system comprising: processing equipment configured to: receive a light signal from the physiological sensor; process the light signal to obtain a first signal corresponding to ambient light; process the light signal to obtain a second signal corresponding to an emitted photonic signal and ambient light; analyze the first signal and the second signal to identify similar signal amplitude behavior; and determine that the physiological sensor is not properly positioned based on the analysis. Addison-788 at Claim 15

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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user.	Addison-788 discloses or renders obvious wherein the apparatus is at least in part configured to determine, based at least in part on the output signal, that the apparatus is being worn by the user. Methods and systems are provided for determining whether a physiological sensor is properly positioned on a Subject. In some embodiments, a detected light signal may be received using the physiological sensor. The detected light signal may be processed to obtain a first signal corresponding to ambient light and a second signal corresponding to an emitted photonic signal and ambient light. The first and sec ond signal may be analyzed to determine similar behavior, and it may be determined that the physiological sensor is not properly positioned based on the analysis. In some embodiments, similar behaviors may include mimicking-equal behavior, mimicking-parallel behavior, nonlinear Scaling, any other Suitable behavior, or any combi nation thereof. For example, mimicking-equal or mimicking parallel behavior may be identified when both the first and second signals move together or with a constant offset. In some embodiments, this behavior may be identified as a probe-off condition, and may be indicative of the same amount of light reaching the detector irrespective of light emitted by the system. In some embodiments, the system may identify a constant amplitude or signal flatness. A constant amplitude may be used alone or in combination with other signals to determine a probe-off condition. Addison-788 1:9-34. ff condition. In some embodiments, a signal may include a substantially constant amplitude. The Substantially constant amplitude may, for example, be identified by the derivative of a signal within a time window. This substantially constant amplitude may be referred to as flatness. In some embodiments, the system may identify flatness as being indicative of a probe-off condition. For example, a detected light signal from a prop erly positioned probe may normally fluctuate with patient physiological parameters, and thus flatness may indicate that the probe is not properly positioned. Flatness may be identi fied in a detected light signal, a detected ambient signal, any other Suitable signal, or any combination thereof.

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	Addison-788 5:12-23 In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and detection received from one or more sensor units such as sensor unit 312. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen Saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxy genated, and/or total), any other Suitable physiological parameters, or any combination thereof. In some embodi ments, calculations may be performed on the sensor units or an intermediate device and the result of the calculations may be passed to monitor 314. Further, monitor 314 may include display 320 configured to display the physiological param eters or other information about the system. In the embodi ment shown, monitor 314 may also include a speaker 322 to provide an audible sound that may be used in various other embodiments, such as for example, Sounding an audible alarm in the event that a Subject's physiological parameters are not within a predefined normal range or when a sensor is not properly positioned. In some embodiments, physiological monitoring system 310 may include a stand-alone monitor in communication with the monitor 314 via a cable or a wireless network link. In some embodiments, monitor 314 may be implemented as display 184 of FIG. 1. Addison-788 13:30-58

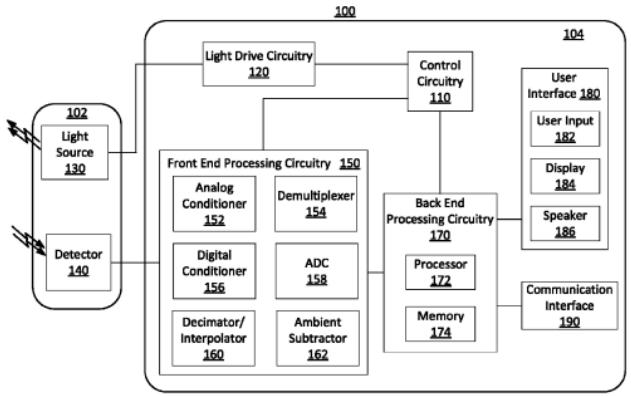
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	 FIG. 5 Addison-788 at Fig. 5 In step 512, the system may determine that the physiological sensor is not properly positioned. The system may determine this based on the analysis of step 510. For example, if a particular similar behavior or relationship is identified between the signals or signal characteristics, a probe-off condition may be identified. Similar behaviors may include mimicking-equal behavior, mimicking-parallel behavior, nonlinear scaling, any other suitable behavior, or any combination thereof. In some embodiments, a behavior based on a single characteristic (which may be derived from one or more signals) may be used to identify flatness, low signal level, high signal level, strong ambient behavior, any other suitable behavior, or any combination thereof. The system may identify the aforementioned behaviors as being indicative of a probe-off condition. Addison-788 at 20:3-18 In a Subsequent step (not shown), the system may provide an indicator that the physiological sensor is not properly positioned. The indication may be based on any of the deter minations that the sensor is

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	improperly positioned as described herein. Indicators may include audible indications Such as a voice alert, beep, or siren. Indicators additionally or alternatively may include visual indications such as lights, LEDs, computer screen readouts, mechanical flags, blinking or patterned use of any of the aforementioned, the use of particular colors, any other Suitable visual indicator, or any combination thereof. Indicators may additionally or alterna tively include communications such as communications sent to a cellphone, pager, text message, internet terminal, email, phone, fax, remote server, any other Suitable communication, or any combination thereof. For example, a blinking red mes sage may appear on a remote nurse's station computer in a hospital setting. In another example, a bedside monitor may emit a beeping Sound when a probe-off condition is detected. In some embodiments, any or all of the aforementioned indi cators may be graduated or otherwise altered based on a confidence that there is a probe-off condition, the duration of the probe-off condition, a sensitivity setting, any other suitable parameters, or any combination thereof. Addison-788 20:30-52 In some embodiments, signal noise, ringing, and/or transients may occur at or near the point in time when a sensor is attached or removed from a subject. This can be seen, for example in detected light signal 642 at time point 618. The noise may be related to, for example, changes in signal processing, changes in front end amplification, increased amounts of reflected light when the sensor is partially out of proper position, any other suitable sources of noise, or any combination thereof. In some embodiments, this noise may be identified and ignored by the system in determining a probe-off condition. Addison-788 at 21:64-22:7 Plot 680 includes sensor positioning signal 684. Sensor positioning signal 684 may include information related to the proper or desired positioning of a sensor, as controlled during test conditions used in generating the signals of plots 640 and 660. For example, changes in the levels of sensor positioning signal 684 may be indicative of manual changes in the sensor position during test conditions used to generate the signals of plots 640 and 660. In some embodiments, sensor positioning signal 684 at signal level “On” may be indicative of the sensor being properly positioned. In some embodiments, sensor positioning signal 684 at signal level “Off” may be indicative of the sensor being improperly positioned. For example, an improperly positioned sensor may be a probe-off condition. It will be understood that the use of “Off” and “On” values for sensor positioning signal 684 is merely exemplary.

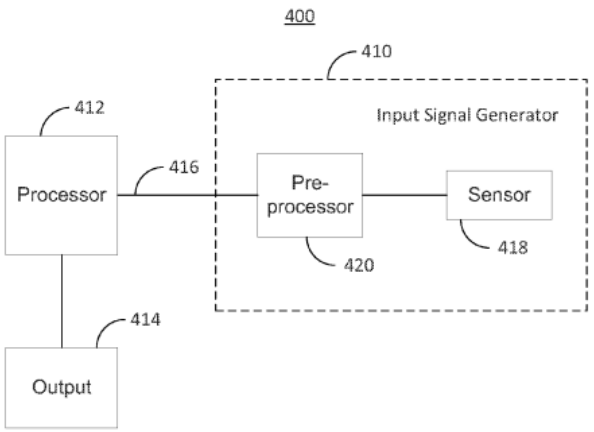
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	In time interval 602, the system may be under constant natural light conditions from a window with a properly attached forehead sensor. Accordingly, environmental light level signal 682 is “On and sensor positing signal 684 is “On.” The signal levels of time interval 602 may, for example, be indicative of signals received for 30 seconds. In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 602 may be indicative of a baseline behavior in the system. In time interval 602, environmental light level signal 682 remains constant and the sensor is properly positioned. As illustrated the signal levels of both detected light signsal 642 and detected ambient signal 662 remain relatively constant. In some embodiments, this baseline behavior may be used to establish a baseline noise threshold, to establish alarm thresholds, to reset parameters, for any other Suitable purpose, or any com bination thereof. In time interval 604, environmental light level signal 682 is varied and sensor positioning signal 684 is “On” indicative of the sensor being properly positioned. For example, the system may be operated in a room with the room lights switched off and a window shade rapidly opened and closed, while the sensor is properly positioned. The signal levels of time inter val 604 may, for example, be indicative of signals received for 30 seconds. In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 604 may be indicative of an insensitivity to changing ambient light conditions when the sensor is properly positioned. In time interval 604, environmental light level signal 682 varies between “Off” and “On.” As illustrated, the signal levels of both detected light signal 642 and detected ambient signal 662 remain relatively constant, despite this variation. In some cases, stronger ambient light may result in a change in the detected light levels. It is expected, however, that a properly positioned sensor will reduce the impact of varying ambient light conditions on detected signals. That is, when the sensor is properly positioned, changes in ambient light may have little effect on the detected light signal 642 and the detected ambient signal 662. In time interval 606, environmental light level signal 682 is “Off” For example, the system may be operated in a dark room. In time interval 606, sensor positioning signal 684 is “On indicative of the sensor being properly positioned. The signal levels of time interval 606 may, for example, be indica tive of signals received for 30 seconds under dark conditions with a properly attached forehead sensor. In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 606 may be indicative of a baseline behavior in a dark room of the system. In time interval 606, environmental light level signal 682 remains “Off” and the sensor positioning signal remains at “On.” As illustrated the signal levels of both detected light signal 642 and detected ambient signal 662 remain relatively constant. As illustrated, both the detected light signal 642 and detected ambient signal 662 are received at substantially the same amplitudes as in time interval 602 where the environ mental light level was higher. This may be, for example, indicative of a properly positioned sensor's ability to exclude

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	ambient light effects. In time interval 608, environmental light level signal 682 is varied. For example, the system may be operated in a room with the room lights switched on and off. In time interval 608, sensor positioning signal 684 is “On indicative of the sensor being properly positioned. In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 608 may be indicative of an insensitivity to changing environmental light conditions when the sensor is properly positioned. In some embodiments, the conditions in time interval 608 may be similar to those in time interval 604, except a level of electric light is varying as opposed to the amount of Sunlight entering the room. As illustrated, the signal levels of both detected light signal 642 and detected ambient signal 662 remain relatively constant, despite the variations in environmental light. This may indicate that the sensor is properly positioned. In time interval 610, environmental light level signal 682 may be “On For example, the system may be operated in a room with the room lights switched on. In time interval 610, the sensor may be removed and reapplied. Sensor positioning signal 684 may be “On” during the beginning of time interval 610, “Off” between time point 618 and time point 620, and “On” following time point 620. For example, the sensor may have been removed at time point 618 and reapplied at time point 620. In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 610 may be indicative of the sensor being removed and reattached while operating in an illuminated room. In time interval 610, the sensor (e.g., a forehead sensor) may be removed from the patient at time point 618. The level of detected light signal 642 may increase from a relatively lower level in region 644 to a relatively higher level in region 646 substantially coincident with the removal of the sensor at time point 618. The level of detected ambient signal 662 may increase from a relatively lower level in region 664 to a relatively higher level in region 668 substantially coincident with the removal of the sensor at time point 618. The increase in both detected light signal 642 and detected ambient signal 662 may be indicative of an increased amount of light reaching the detector. In some embodiments, shielding or lightblocking structures may have prevented ambient light from reaching the detector while it was properly positioned, but not while it is removed from the Subject. In some embodiments, the changes in signal levels may be in part attributed to increased ambient light reaching the detector, light from the emitters that is not attenuated as much as it would have been in a properly positioned sensor arrangement reaching the detector, sensor noise, other suitable signal sources, or any combination thereof. Addison-788 at 22:41-24:36 1. A method for determining whether a physiological sensor is properly positioned on a subject, the method comprising:

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	receiving a light signal using the physiological sensor; processing, using processing equipment, the light signal to obtain a first signal corresponding to ambient light; processing, using the processing equipment, the light signal to obtain a second signal corresponding to an emitted photonic signal and ambient light; analyzing, using the processing equipment, the first signal and the second signal to identify similar signal amplitude behavior**;** and determining, using the processing equipment, that the physiological sensor is not properly positioned based on the analysis. Addison-788 at Claim 1 15. A system for determining whether a physiological sensor is properly positioned on a subject, the system comprising: processing equipment configured to: receive a light signal from the physiological sensor; process the light signal to obtain a first signal corresponding to ambient light; process the light signal to obtain a second signal corresponding to an emitted photonic signal and ambient light; analyze the first signal and the second signal to identify similar signal amplitude behavior; and determine that the physiological sensor is not properly positioned based on the analysis. Addison-788 at Claim 15 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 5	
5. The apparatus of claim 1, wherein the apparatus	See claim 1 above.

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further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal.	Addison-788 discloses or renders obvious the apparatus of claim 1, wherein the apparatus further comprises a processor configured to be coupled to a non-transitory computer readable medium, and wherein the apparatus including the processor is configured to use artificial intelligence in making decisions associated with at least a portion of the output signal..  FIG. 1 Addison-788 at Fig. 1 In the embodiment shown, monitor 104 includes control circuitry 110, light drive circuitry 120, front end processing circuitry 150, back end processing circuitry 170, user inter face 180, and communication interface 190. Monitor 104 may be communicatively coupled to sensor 102. Addison-788 7:50-54 Referring back to FIG. 1, front end processing circuitry 150 may receive a detection signal from detector 140 and provide one or more processed signals to back end processing circuitry 170. The term “detection signal.” as used herein, may refer to any of the signals generated within front end processing circuitry 150 as it processes the output signal of detector 140. Front end processing circuitry 150 may perform various analog and digital processing of the detector signal. One suitable detector signal that may be received by front end processing circuitry 150 is shown in FIG. 2B. Addison-788 9:4-14

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	Back end processing circuitry 170 may include processor 172 and memory 174. Processor 172 may be adapted to execute software, which may include an operating system and one or more applications, as part of performing the functions described herein. Processor 172 may receive and further process physiological signals received from front end processing circuitry 150. For example, processor 172 may determine one or more physiological parameters based on the received physiological signals. Memory 174 may include any suitable computer-readable media capable of storing information that can be interpreted by processor 172. This information may be data or may take the form of computer-executable instructions, such as software applications, that cause the microprocessor to perform certain functions and/or computer-implemented methods. Depending on the embodiment, such non-transitory computer-readable media may include computer storage media and communication media. Computer storage media may include volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. Computer storage media may include, but is not limited to, RAM, ROM, EPROM, EEPROM, flash memory or other solid state memory technology, CD-ROM, DVD, or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by components of the system. Back end processing circuitry 170 may be communicatively coupled with user interface 180 and communication interface 190. Addison-788 at 11:43-12:6 It will be understood that the components of physiological monitoring system 100 that are shown and described as separate components are shown and described as such for illustrative purposes only. In some embodiments the functionality of some of the components may be combined in a single component. For example, the functionality of front end processing circuitry 150 and back end processing circuitry 170 may be combined in a single processor system. Additionally, in some embodiments the functionality of some of the components of monitor 104 shown and described herein may be divided over multiple components. For example, some or all of the functionality of control circuitry 110 may be performed in front end processing circuitry 150, in back end processing circuitry 170, or both. In other embodiments, the functionality of one or more of the components may be performed in a different order or may not be required. In some embodiments, all of the components of physiological monitoring system 100 can be realized in processor circuitry. Addison-788 at 12:54-13:4

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	 FIG. 4 Addison-788 at Fig. 4 FIG. 4 shows illustrative signal processing system 400 in accordance with some embodiments of the present disclosure. Signal processing system 400 includes input signal generator 410, processor 412 and output 414. In the illustrated embodiment, input signal generator 410 may include pre-processor 420 coupled to sensor 418. As illustrated, input signal generator 410 generates an input signal 416. In some embodiments, input signal 416 may include one or more intensity signals based on a detector output. In some embodiments, pre-processor 420 may be an oximeter and input signal 416 may be a PPG signal. In an embodiment, pre-processor 420 may be any suitable signal processing device and input signal 416 may include PPG signals and one or more other physiological signals, such as an electrocardiogram (ECG) signal. It will be understood that input signal generator 410 may include any suitable signal source, signal generating data, signal generating equipment, or any combination thereof to produce input signal 416. Input signal 416 may be a single signal, or may be multiple signals transmitted over a single pathway or multiple pathways. Addison-788 at 14:50-15:2

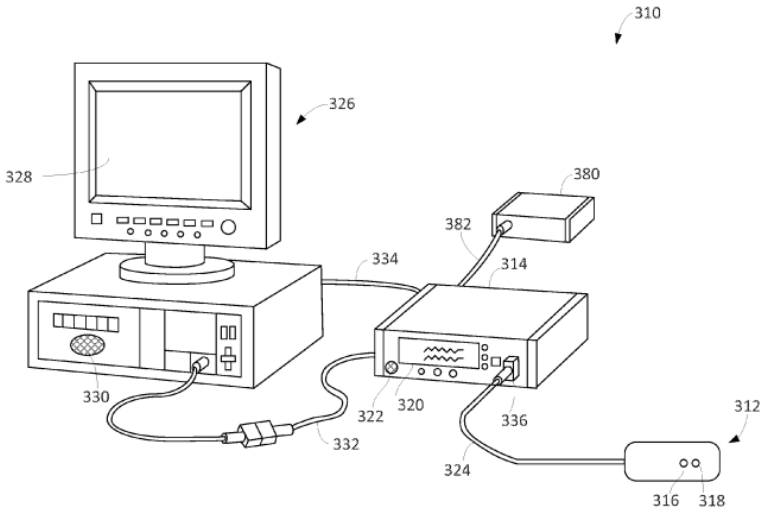
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	Pre-processor 420 may apply one or more signal processing operations to the signal generated by sensor 418. For example, pre-processor 420 may apply a pre-determined set of processing operations to the signal provided by sensor 418 to produce input signal 416 that can be appropriately interpreted by processor 412, such as performing A/D conversion. In some embodiments, A/D conversion may be performed by processor 412. Pre-processor 420 may also perform any of the following operations on the signal provided by sensor 418: reshaping the signal for transmission, multiplexing the signal, modulating the signal onto carrier signals, compressing the signal, encoding the signal, and filtering the signal. In some embodiments, pre-processor 420 may include a current-to-voltage converter (e.g., to convert a photocurrent into a voltage), an amplifier, a filter, and A/D converter, a de-multiplexer, any other suitable pre-processing components, or any combination thereof. In some embodiments, pre-processor 420 may include one or more components from front end processing circuitry 150 of FIG. 1. Addison-788 at 15:2-21 In some embodiments, input signal 416 may be coupled to processor 412. Processor 412 may be any suitable software, firmware, hardware, or combination thereof for processing input signal 416. For example, processor 412 may include one or more hardware processors (e.g., integrated circuits), one or more software modules, non-transitory computer-readable media such as memory, firmware, or any combination thereof. Processor 412 may, for example, be a computer or may be one or more chips (i.e., integrated circuits). Processor 412 may, for example, include an assembly of analog electronic components. Processor 412 may calculate physiological information. For example, processor 412 may compute one or more of a pulse rate, respiration rate, blood pressure, or any other suitable physiological parameter. Processor 412 may perform any suitable signal processing of input signal 416 to filter input signal 416, such as any suitable band-pass filtering, adaptive filtering, closed-loop filtering, any other suitable filtering, and/or any combination thereof. Processor 412 may also receive input signals from additional sources (not shown). For example, processor 412 may receive an input signal containing information about treatments provided to the subject. Additional input signals may be used by processor 412 in any of the calculations or operations it performs in accordance with processing system 400. Addison-788 at 15:34-57 In some embodiments, all or some of pre-processor 420, processor 412, or both, may be referred to collectively as processing equipment. Processor 412 may be coupled to one or more memory devices (not shown) or incorporate one or more memory devices such as any Suitable volatile memory device (e.g., RAM, registers, etc.), non-volatile memory device (e.g., ROM, EPROM, magnetic storage device,

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	optical storage device, flash memory, etc.), or both. The memory may be used by processor 412 to, for example, store fiducial information or initialization information corresponding to physiological monitoring. In some embodiments, processor 412 may store physiological measurements or previously received data from input signal 416 in a memory device for later retrieval. In Some embodiments, processor 412 may store calculated val ues, such as a pulse rate, a blood pressure, a blood oxygen saturation, a fiducial point location or characteristic, an ini tialization parameter, or any other calculated values, in a memory device for later retrieval. Processor 412 may be coupled to output 414. Output 414 may be any Suitable output device such as one or more medi cal devices (e.g., a medical monitor that displays various physiological parameters, a medical alarm, or any other Suit able medical device that either displays physiological param eters or uses the output of processor 412 as an input), one or more display devices (e.g., monitor, PDA, mobile phone, any other suitable display device, or any combination thereof), one or more audio devices, one or more memory devices (e.g., hard disk drive, flash memory, RAM, optical disk, any other Suitable memory device, or any combination thereof), one or more printing devices, any other Suitable output device, or any combination thereof. It will be understood that system 400 may be incorporated into physiological monitoring system 100 of FIG. 1. For example, input signal generator 410 may be implemented as part of sensor 102. In another example, system 400 may be incorporated into physiological monitoring system 310 of FIG. 3, where input signal generator 410 may be imple mented as part of sensor unit 312 of FIG. 3. Processor 412 may be implemented as part of monitor 104 of FIG. 1 or as part of monitor 314 or multi-parameter physiological monitor 326 of FIG.3. Output 414 may be implemented as display 320 or 328 of FIG. 3. Furthermore, all or part of system 400 may be embedded in a small, compact object carried with or attached to the Subject (e.g., a watch, other piece of jewelry, or a Smartphone). In some embodiments, a wireless transceiver (not shown) may also be included in system 400 to enable wireless communication with other components of physi ological monitoring systems 100 of FIG. 1 and 310 of FIG.3. As such, physiological monitoring systems 100 of FIG. 1 and 310 of FIG.3 may be part of a fully portable and continuous Subject monitoring Solution. In some embodiments, a wire less transceiver (not shown) may also be included in System 400 to enable wireless communication with other compo nents of physiological monitoring systems 100 of FIG. 1 and 310 of FIG. 3. For example, pre-processor 420 may commu nicate input signal 416 over BLUETOOTH, 802.11, WiFi, WiMax, cable, satellite, Infrared, or any other suitable trans mission scheme. In some embodiments, a wireless transmis sion scheme may be used between any communicating com ponents of system 400. In some embodiments, system 400 may include one or more communicatively coupled modules configured to perform particular tasks. In some embodiments, system 400 may be included as a module communicatively coupled to one or more other modules.

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	It will be understood that the components of signal pro cessing system 400 that are shown and described as separate components are shown and described as Such for illustrative purposes only. In other embodiments the functionality of Some of the components may be combined in a single com ponent. For example, the functionality of processor 412 and pre-processor 420 may combined in a single processor sys tem. Additionally, the functionality of some of the compo nents shown and described herein may be divided over mul tiple components. Additionally, signal processing system 400 may perform the functionality of other components not show in FIG. 4. For example, some or all of the functionality of control circuitry 110 of FIG. 1 may be performed in signal processing system 400. In other embodiments, the function ality of one or more of the components may not be required. In an embodiment, all of the components can be realized in processor circuitry. Addison-788 15:58-17:5 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 6	
6. The apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc.	See claim 1 above. Addison-788 discloses or renders obvious the apparatus of claim 1, wherein the plurality of light emitting diodes comprises six light emitting diodes, and wherein the detection system comprises the plurality of detectors arranged along an arc. In some embodiments, the system may analyze a first signal and a second signal to identify similar behavior. For example, a level or trend of the detected ambient signal may be compared to a level or trend of a detected light signal (e.g., an IR signal). In some embodiments, the detected light signal may include light from a red light emitting diode, an infrared light emitting diode, ambient light, any other suitable light source, or any combination thereof. Addison-788 at 4:32-39

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	Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g. Red and IR) into a subjects tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light Source, e.g. Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodi ments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Addison-788 7:3-19 FIG. 2A shows an illustrative plot of a light drive signal including red drive pulse 202 and IR drive pulse 204 in accordance with some embodiments of the present disclosure. Red drive pulse 202 and IR drive pulse 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, drive pulses may refer to switching power or other components on and off, high and low output states, high and low values within a continuous modulation, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red drive pulse 202 and IR drive pulse 204 to drive red and IR light emitters, respectively, within light source 130. Red drive pulse 202 may have a higher amplitude than IR drive pulse 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. In some embodiments, the output levels may be the equal, may be adjusted for nonlinearity of emitters, may be modulated in any other suitable technique, or any combination thereof. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary any that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. Addison-788 at 8:17-47

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	FIG. 2B shows an illustrative plot of detector current waveform 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals provided by a detector, such as detector 140 of FIG. 1, when light is being emitted from a light source. The amplitude of detector current waveform 214 may be proportional to the light incident upon the detector. The peaks of detector current waveform 214 may be synchronous with drive pulses driving one or more emitters of a light source, such as light source 130 of FIG. 1. For example, detector current waveform 214 may be generated in response to a light source being driven by the light drive signal of FIG. 2A. The valleys of detector current waveform 214 may be synchronous with periods of time during which no light is being emitted by the light source. While no light is being emitted by a light source during the valleys, detector current waveform 214 may not decrease to zero. Rather, ambient signal 222 may be present in the detector waveform, as well as other background amplitude contributions. In some embodiments, the shapes of the pulses in detector current waveforms may include distortions, clipping, delayed switching, relatively slow rising and falling edges, and other non-idealities due in part to switching of the light drive, switching of the LEDs, switching in the detector, stabilization of the detector, stabilization of the detected signal, parasitic inductance and/or capacitances, any other suitable signal contribution, or any combination thereof. In some embodiments, ambient signal 222 may be used to determine a probe-off condition. In some embodiments, ambient signal 222 may be removed from a processed signal to facilitate determination of physiological parameters. Addison-788 at 9:15-45 Referring back to FIG. 1, front end processing circuitry 150, which may receive a detection signal, such as detector current waveform 214, may include analog conditioner 152, demultiplexer 154, digital conditioner 156, analog-to-digital converter (ADC) 158, decimator/interpolator 160, and ambient subtractor 162. Addison-788 at 9:46-51 In some embodiments, front end processing circuitry 150 may include a second analog-to-digital converter (not shown) configured to sample the unprocessed detector signal. This signal may be used to detect changes in the ambient light level without applying the signal condition and other steps that may improve the quality of determined physiological parameters but may reduce the amount of information regarding a probe-off condition. Addison-788 at 9:53-59

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	 FIG. 3 Addison-788 at Fig. 3 FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. Physiological monitoring system 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue**.** One or more detectors 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Physiological monitoring system 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit

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	as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two or more different locations on a subject's body. Addison-788 at 13:5-29 In step 502, the system may use the physiological sensor to emit an emitted photonic signal. The system may emit the emitted photonic signal including one wavelength of light, multiple wavelengths of light, a broad spectrum light (e.g., white light), or any combination thereof. For example, the emitted photonic signal may include light from a red LED and light from an IR LED. The emitted photonic signal may be emitted, for example, by light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the emitted photonic signal may include a light drive modulation. For example, when the emitted photonic signal includes a red light source and an IR light source, the light drive modulation may include a red drive pulse followed by an “off” period followed by an IR drive pulse followed by an off period. It will be understood that this drive cycle modulation is merely exemplary and that any suitable drive cycle modulation or combination of modulations may be used. In some embodiments, the emitted photonic signal may include a cardiac cycle modulation, where the brightness, duty cycle, or other parameters of one or more emitters are varied at a rate substantially related to the cardiac cycle. Addison-788 at 17:19-42 In some embodiments, the system may adjust or compensate a received light signal depending in part on a light drive setting. Drive settings may include the LED drive signal, the detector gain, other suitable system parameters, or any combination thereof. For example, increasing the gain on a detected signal may result in an increased level of the detected ambient signal. The system may compensate for this increase in the ambient light signal that is not correlated with a change in the sensor positioning, in part so that the gain change is distinguished from a change in sensor positioning. In a further example, the system may change the LED emitter brightness, resulting in a change in the detected light signal. The system may compensate for these changes in the detected signal amplitude to distinguish them from a change in the sensor positioning. It will be understood that the system may make any adjustments in gain, amplification, frequency, wavelength, amplitude, any other suitable adjustments, or any combination thereof. It will be understood that the adjustments may be made to the emitted photonic signal, the received signal, any signal following a number of processing steps, any other suitable signals, or any combination thereof.

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	Addison-788 at 17:64-18:17 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 7	
7. The apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen.	See claim 6 above. Addison-788 discloses or renders obvious the apparatus of claim 6, wherein the apparatus is further configured to communicate with a smart phone or a tablet, the smart phone or the tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, one or more buttons or knobs, a microprocessor, and a touch screen. FIG. 1 is a block diagram of an illustrative physiological monitoring system 100 in accordance with some embodi ments of the present disclosure. System 100 may include a sensor 102 and a monitor 104 for generating and processing physiological signals of a subject. In some embodiments, sensor 102 and monitor 104 may be part of an oximeter. Addison-788 6:64-7:2. In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In Some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subjects tissue. Detector 140 may convert the intensity of the received light into an electri cal signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed, scat tered, or reflected, less light of that wavelength is typically received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection sig nal may be processed and physiological parameters may be determined (e.g., based on

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	the absorption of the Red and IR wavelengths in the Subjects tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. In the embodiment shown, monitor 104 includes control circuitry 110, light drive circuitry 120, front end processing circuitry 150, back end processing circuitry 170, user inter face 180, and communication interface 190. Monitor 104 may be communicatively coupled to sensor 102. Addison-788 7:31-54 User interface 180 may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device. The inputs received by user input 182 can include information about the subject, such as age, weight, height, diagnosis, medications, treatments, and so forth. In an embodiment, the subject may be a medical patient and display 184 may exhibit a list of values which may generally apply to the patient, such as, for example, age ranges or medication families, which the user may select using user inputs 182. Additionally, display 184 may display, for example, an estimate of a subject's blood oxygen saturation generated by monitor 104 (referred to as an “SpO2” measurement), pulse rate information, respiration rate information, blood pressure, sensor condition, any other parameters, and any combination thereof. Display 184 may include any type of display such as a cathode ray tube display, a flat panel display such a liquid crystal display or plasma display, or any other suitable display device. Speaker 186 within user interface 180 may provide an audible sound that may be used in various embodiments, such as for example, sounding an audible alarm in the event that a patient's physiological parameters are not within a predefined normal range. Addison-788 at 12:7-30 Communication interface 190 may enable monitor 104 to exchange information with external devices. Communication interface 190 may include any suitable hardware, software, or both, which may allow monitor 104 to communicate with electronic circuitry, a device, a network, a server or other workstations, a display, or any combination thereof. Communication interface 190 may include one or more receivers, transmitters, transceivers, antennas, plug-in connectors, ports, communications buses, communications protocols, device identification protocols, any other suitable hardware or software, or any combination thereof. Communication interface 190 may be configured to allow wired communication (e.g., using USB, RS-232 or other standards), wireless communication (e.g., using WiFi, IR, WiMax, BLUETOOTH, UWB, or other standards), or both. For example, communication interface 190 may be

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	configured using a universal serial bus (USB) protocol (e.g., USB 2.0, USB 3.0), and may be configured to couple to other devices (e.g., remote memory devices storing templates) using a four-pin USB standard Type-A connector (e.g., plug and/or socket) and cable. In some embodiments, communication interface 190 may include an internal bus such as, for example, one or more slots for insertion of expansion cards. Addison-788 at 12:31-53 FIG. 3 is a perspective view of an embodiment of a physi ological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodi ments, one or more components of physiological monitoring system 310 may include one or more components of physi ological monitoring system 100 of FIG. 1. Physiological monitoring system 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include one or more light source 316 for emitting light at one or more wavelengths into a subjects tissue. One or more detectors 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subjects tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light Sources and detectors, which may be spaced apart. Physiological monitoring system 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a pho toacoustic sensor). Multiple sensor units may be capable of being positioned at two or more different locations on a subjects body. Addison-788 13:5-29 In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and detection received from one or more sensor units such as sensor unit 312. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxygenated, and/or total), any other suitable physiological parameters, or any combination thereof. In some embodiments, calculations may be performed on the sensor units or an intermediate device and the result of the calculations may be passed to monitor 314. Further, monitor 314 may include display 320

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	configured to display the physiological parameters or other information about the system. In the embodiment shown, monitor 314 may also include a speaker 322 to provide an audible sound that may be used in various other embodiments, such as for example, sounding an audible alarm in the event that a subject's physiological parameters are not within a predefined normal range or when a sensor is not properly positioned. In some embodiments, physiological monitoring system 310 may include a stand-alone monitor in communication with the monitor 314 via a cable or a wireless network link. In some embodiments, monitor 314 may be implemented as display 184 of FIG. 1. Addison-788 at 13:30-58 In some embodiments, sensor unit 312 may be communi catively coupled to monitor 314 via a cable 324. Cable 324 may include electronic conductors (e.g., wires for transmit ting electronic signals from detector 318), optical fibers (e.g., multi-mode or single-mode fibers for transmitting emitted light from light source 316), any other Suitable components, any suitable insulation or sheathing, or any combination thereof. In some embodiments, a wireless transmission device (not shown) or the like may be used instead of or in addition to cable 324. Monitor 314 may include a sensor interface configured to receive physiological signals from sensor unit 312, provide signals and power to sensor unit 312, or otherwise communicate with sensor unit 312. The sensor interface may include any suitable hardware, software, or both, which may be allow communication between monitor 314 and sensor unit 312. In some embodiments, physiological monitoring system 310 may include calibration device 380. Calibration device 380, which may be powered by monitor 314, a battery, or by a conventional power Source such as a wall outlet, may include any suitable calibration device. Calibration device 380 may be communicatively coupled to monitor 314 via communicative coupling 382, and/or may communicate wirelessly (not shown). In some embodiments, calibration device 380 is completely integrated within monitor 314. In some embodiments, calibration device 380 may include a manual input device (not shown) used by an operator to manually input reference signal measurements obtained from Some other source (e.g., an external invasive or non-invasive physiological measurement system). In the illustrated embodiment, physiological monitoring system 310 includes a multi-parameter physiological monitor 326. The display 328 of multi-parameter physiological moni tor 326 may include a cathode ray tube display, a flat panel display (as shown) such as a liquid crystal display (LCD) or a plasma display, or may include any other type of monitor now known or later developed. Multi-parameter physiological monitor 326 may be configured to calculate physiological parameters and to provide information from monitor 314 and from other medical monitoring devices or systems (not shown) using display 328. For example, multi-parameter physiological monitor 326 may be configured to display an

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	estimate of a Subject's blood oxygen saturation and hemoglo bin concentration generated by monitor 314. Multi-parameter physiological monitor 326 may include a speaker 330. Monitor 314 may be communicatively coupled to multi parameter physiological monitor 326 via a cable 332 or 334 that is coupled to a sensor input port or a digital communica tions port, respectively and/or may communicate wirelessly (not shown). In addition, monitor 314 and/or multi-parameter physiological monitor 326 may be coupled to a network to enable the sharing of information with servers or other work stations (not shown). Monitor 314 may be powered by a battery (not shown) or by a conventional power source Such as a wall outlet. In some embodiments, all or some of monitor 314 and multi-parameter physiological monitor 326 may be referred to collectively as processing equipment. Addison-788 13:59-14:49 Processor 412 may be coupled to output 414. Output 414 may be any suitable output device such as one or more medical devices (e.g., a medical monitor that displays various physiological parameters, a medical alarm, or any other suitable medical device that either displays physiological parameters or uses the output of processor 412 as an input), one or more display devices (e.g., monitor, PDA, mobile phone, any other suitable display device, or any combination thereof), one or more audio devices, one or more memory devices (e.g., hard disk drive, flash memory, RAM, optical disk, any other suitable memory device, or any combination thereof), one or more printing devices, any other suitable output device, or any combination thereof. Addison-788 at 16:10-22 It will be understood that system 400 may be incorporated into physiological monitoring system 100 of FIG. 1. For example, input signal generator 410 may be implemented as part of sensor 102. In another example, system 400 may be incorporated into physiological monitoring system 310 of FIG. 3, where input signal generator 410 may be implemented as part of sensor unit 312 of FIG. 3. Processor 412 may be implemented as part of monitor 104 of FIG. 1 or as part of monitor 314 or multi-parameter physiological monitor 326 of FIG. 3. Output 414 may be implemented as display 320 or 328 of FIG. 3. Furthermore, all or part of system 400 may be embedded in a small, compact object carried with or attached to the subject (e.g., a watch, other piece of jewelry, or a smart phone). In some embodiments, a wireless transceiver (not shown) may also be included in system 400 to enable wireless communication with other components of physiological monitoring systems 100 of FIG. 1 and 310 of FIG. 3. As such, physiological monitoring systems 100 of FIG. 1 and 310 of FIG. 3 may be part of a fully portable and

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	continuous subject monitoring solution. In some embodiments, a wireless transceiver (not shown) may also be included in system 400 to enable wireless communication with other components of physiological monitoring systems 100 of FIG. 1 and 310 of FIG. 3. For example, pre-processor 420 may communicate input signal 416 over BLUETOOTH, 802.11, WiFi, WiMax, cable, satellite, Infrared, or any other suitable transmission scheme. In some embodiments, a wireless transmission scheme may be used between any communicating components of system 400. In some embodiments, system 400 may include one or more communicatively coupled modules configured to perform particular tasks. In some embodiments, system 400 may be included as a module communicatively coupled to one or more other modules. Addison-788 at 16:23-55 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A wearable device configured to be worn by a user, the wearable device comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Addison-788 discloses or renders obvious a wearable device configured to be worn by a user, the wearable device comprising. See above at claim 1[pre] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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8[a]. a light source configured to be on or off, responsive to the light source being on, the light source generates an output light,	Addison-788 discloses or renders obvious a light source configured to be on or off, responsive to the light source being on, the light source generates an output light. See above at claim 1[c], 1[j], 1[k] The probe-off condition may be detected by the system. In some embodiments, the system may use a detected ambient signal and a detected light signal to determine a probe-off condition. As used herein, the emitted photonic signal is a light signal emitted by the system. As used herein, a received light signal is a light signal received by a detector of the system. As used herein, a detected light signal is a light signal corresponding to light detected during the “on” period of a multiplexed drive. As used herein, a detected emitted light signal is a light signal corresponding to light from the emitted photonic signal. As used herein, a detected ambient light signal is a light signal corresponding to light detected during the “off” period of a multiplexed drive signal. In some embodiments, the received light signal is split into one or more detected light signals and one or more ambient light signals by demultiplexing. It will be understood that in some embodiments, the detected light signal may be the same or similar to the detected emitted light signal (e.g., when there is no ambient light or when the ambient light is filtered out prior to detection). Addison-788 at 2:51-3:3 As will be described in detail below, a detected ambient signal may include information related to the amount of light a detector receives when one or more associated light sources are in an “off” state. Detected ambient signals may be time division multiplexed in a drive pulse modulation technique. In some embodiments where a detector receives light from light sources coupled to the system and from light sources not coupled to the system, the detected ambient signal may include the light from the light sources not coupled to the system. Ambient light sources may include sunlight, incandescent room lights, fluorescent room lights, fireplaces, candles, naked flames, LED room lights, instrument panel lighting, heat sources, any other suitable light sources not intended for determining a physiological parameter, or any combination thereof. It will be understood that heat sources may generate non-visible IR light that may be detected by the system. It will be understood that any visible or non-visible source of electromagnetic radiation may be included in the detected ambient signal including, for example, radio waves, microwave, IR, visible, UV, X-ray, gamma ray. In some arrangements, the detected ambient signal may include decaying LED light from the system light sources. For example, it may take a particular amount of time for the light output from a light source to decrease to zero following the light

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	drive signal being switched off. A portion of this emitted light may be included in the detected ambient signal. In some arrangements, the detected ambient signal may not contain physiological information. Addison-788 at 3:4-31 Control circuitry 110 may be coupled to light drive cir cuitry 120, front end processing circuitry 150, and back end processing circuitry 170, and may be configured to control the operation of these components. In some embodiments, con trol circuitry 110 may be configured to provide timing control signals to coordinate their operation. For example, light drive circuitry 120 may generate a light drive signal, which may be used to turn on and off the light source 130, based on the timing control signals. The front end processing circuitry 150 may use the timing control signals of control circuitry 110 to operate synchronously with light drive circuitry 120. For example, front end processing circuitry 150 may synchronize the operation of an analog-to-digital converter and a demultiplexer with the light drive signal based on the timing control signals. In addition, the back end processing circuitry 170 may use the timing control signals of control circuitry 110 to coordindate its operation with front end processing circuitry 150. Light drive circuitry 120, as discussed above, may be con figured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of switching light source 130 on and off. When light source 130 is configured to emit two or more wavelengths of light, the light drive signal may be configured to control the operation of each wavelength of light. The light drive signal may comprise a single signal or may comprise multiple sig nals (e.g., one signal for each wavelength of light). An illus trative light drive signal is shown in FIG. 2A. FIG. 2A shows an illustrative plot of a light drive signal including red drive pulse 202 and IR drive pulse 204 in accordance with some embodiments of the present disclo sure. Red drive pulse 202 and IR drive pulse 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, drive pulses may refer to Switching power or other components on and off, high and low output states, high and low values within a continuous modulation, other Suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red drive pulse 202 and IR drive pulse 204 to drive red and IR light emitters, respectively, within light source 130. Red drive pulse 202 may have a higher amplitude than IR drive pulse 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into lightenergy. In some embodiments, the output levels may be the equal, may be adjusted for nonlinearity of emitters, may be modulated in any other Suitable technique, or any combination thereof. Additionally, red light may be absorbed and scattered more than IR light when passing through per fused tissue. When the red

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	and IR light sources are driven in this manner they emit pulses of light at their respective wave lengths into the tissue of a subject in order generate physi ological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary any that any suitable amplitudes or com bination of amplitudes may be used, and may be based on the light sources, the Subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. The light drive signal of FIG. 2A may also include “off periods 220 between the Red and IR light drive pulse. “Off periods 220 are periods during which no drive current may be applied to light source 130. “Off” periods 220 may be pro vided, for example, to prevent overlap of the emitted light, since light source 130 may require time to turn completely on and completely off. Similarly, the signal from detector 140 may require time to decay completely to a final State after light source 130 is switched off. The period from time 216 to time 218 may be referred to as a drive cycle, which includes four segments: a red drive pulse 202, followed by an “off period 220 in FIG. 2A, followed by an IR drive pulse 204, and followed by an “off” period 220. After time 218, the drive cycle may be repeated (e.g., as long as a light drive signal is provided to light source 130). It will be understood that the starting point of the drive cycle is merely illustrative and that the drive cycle can start at any location within FIG. 2A, provided the cycle spans two drive pulses and two “off periods. Thus, each red drive pulse 202 and each IR drive pulse 204 may be understood to be surrounded by two “off” periods 220 in FIG. 2A. “Off” periods may also be referred to as dark periods, in that the emitters are dark or returning to dark during that period. Addison-788 7:55-8:5 Ambient Subtractor 162 may operate on the digital signal. In some embodiments, ambient subtractor 162 may remove ambient values from the Red and IR components. In some embodiments, the system may subtract the ambient values from the Red and IR components to generate adjusted Red and IR signals. For example, ambient Subtractor 162 may determine a subtraction amount from the ambient signal por tion of the detection signal and subtract it from the peak portion of the detection signal in order to reduce the effect of the ambient signal on the peak. For example, in reference to FIG. 2A, a detection signal peak corresponding to red drive pulse 202 may be adjusted by determining the amount of ambient signal during the “off period 220 preceding red drive pulse 202. The ambient signal amount determined in this manner may be subtracted from the detector peak corre sponding to red drive pulse 202. Alternatively, the “off period 220 after red drive pulse 202 may be used to correct red drive pulse 202 rather than the “off period 220 preceding it. Additionally, an average of the “off periods 220 before

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	and after "on" periods of red drive pulse 202 may be used. In some embodiments, ambient Subtractor 162 may output an ambient signal for further processing. Ambient Subtractor 162 may average the ambient signal from multiple "off periods 220, may apply filters to the ambient signal Such as averaging filters, integration filters, delay filters, buffers, counters, any other Suitable filters or processing, or any combination thereof. Addison-788 10:41-67 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user;	Addison-788 discloses or renders obvious a lens positioned to direct at least a portion of the output light towards a bodily tissue of the user. See above at claim 1[d] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. a detector; and	Addison-788 discloses or renders obvious a detector. See above at claim 1[e] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

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	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio; and,	Addison-788 discloses or renders obvious a processor configured to: (i) responsive to the light source being on and the detector receiving at least a portion of the output light that is reflected from the bodily tissue of the user, generate a first output signal having a first signal-to-noise ratio. See above at claim 1[e], 1[k], [5] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio;	Addison-788 discloses or renders obvious (ii) responsive to the light source being off and the detector receiving ambient light, generate a second output signal having a second signal-to-noise ratio. See above at claim 1[e], 1[j], [5] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. (iii) generate a third output signal using at least a portion of the first output signal and at least a portion	Addison-788 discloses or renders obvious (iii) generate a third output signal using at least a portion of the first output signal and at least a portion of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user.

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of the second output signal, the third output signal having a third signal-to-noise ratio that is greater than the first signal-to-noise ratio and greater than the second signal-to-noise ratio, the third output signal being associated with a physiological parameter of the user; and	See above at claim 1[b], 1[e], 1[l], [5] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user.	Addison-788 discloses or renders obvious (iv) determine, based at least in part on the third output signal, that the wearable device is being worn by the user. Methods and systems are provided for determining whether a physiological sensor is properly positioned on a Subject. In some embodiments, a detected light signal may be received using the physiological sensor. The detected light signal may be processed to obtain a first signal corresponding to ambient light and a second signal corresponding to an emitted photonic signal and ambient light. The first and sec ond signal may be analyzed to determine similar behavior, and it may be determined that the physiological sensor is not properly positioned based on the analysis. In some embodiments, similar behaviors may include mimicking-equal behavior, mimicking-parallel behavior, nonlinear Scaling, any other Suitable behavior, or any combination thereof. For example, mimicking-equal or mimicking parallel behavior may be identified when both the first and second signals move together or with a constant offset. In some embodiments, this behavior may be identified as a probe-off condition, and may be indicative of the same amount of light reaching the detector irrespective of light emitted by the system. In some embodiments, the system may identify a constant amplitude or signal flatness. A constant amplitude may be used alone or in combination with other signals to determine a probe-off condition. Addison-788 1:9-34 In some embodiments, a signal may include a substantially constant amplitude. The Substantially constant amplitude may, for example, be identified by the derivative of a signal within a time window. This substantially constant amplitude may be referred to as flatness. In some embodiments, the system may identify flatness as being indicative of a probe-off condition. For example, a detected light signal from a prop erly positioned probe may normally fluctuate with patient physiological parameters, and

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	thus flatness may indicate that the probe is not properly positioned. Flatness may be identi fied in a detected light signal, a detected ambient signal, any other suitable signal, or any combination thereof. Addison-788 5:12-23 In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and detection received from one or more sensor units such as sensor unit 312. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen Saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxy genated, and/or total), any other Suitable physiological parameters, or any combination thereof. In some embodi ments, calculations may be performed on the sensor units or an intermediate device and the result of the calculations may be passed to monitor 314. Further, monitor 314 may include display 320 configured to display the physiological param eters or other information about the system. In the embodi ment shown, monitor 314 may also include a speaker 322 to provide an audible sound that may be used in various other embodiments, such as for example, Sounding an audible alarm in the event that a Subject's physiological parameters are not within a predefined normal range or when a sensor is not properly positioned. In some embodiments, physiological monitoring system 310 may include a stand-alone monitor in communication with the monitor 314 via a cable or a wireless network link. In some embodiments, monitor 314 may be implemented as display 184 of FIG. 1. Addison-788 13:30-58 In step 510, the system may analyze the first and second signals to identify similar behavior. For example, the analysis may include a comparison of the first signal (e.g., the detected ambient light) to the second signal (e.g., the detected light signal). Comparisons may include Subtraction, division, mul tiplication, integration, any other Suitable function, or any combination thereof. Comparisons may also include time domain comparisons. Similar behavior may include, for example, signals at equal amplitudes, signals showing paral lel changes, signals with the same or similar trends, signals with equal or similar slopes, signals changing in a non-linear but parallel trend, any other suitable similar behavior, or any combination thereof. For example, a detected ambient signal level may be compared to the moving average of the signal corresponding to the emitted photonic signal. In some embodiments, comparing multiple signals may help identify a sensor-off or other undesirable system condition from an external,

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	unrelated change. For example, a large increase in ambient light caused by Switching on an examination room light source may cause the ambient light signal to cross a threshold, but, for example, may not cause the same change in the detected emitted light signal. Thus, comparing the detected ambient signal to another signal may help classify an ambient signal change. In another example, an external detec tor, for example, on the monitor, may be used to determine an ambient light level that could be used to normalize changes in the detected ambient signal of the sensor. Addison-788 18:45-19:4 In step 512, the system may determine that the physiological sensor is not properly positioned. The system may determine this based on the analysis of step 510. For example, if a particular similar behavior or relationship is identified between the signals or signal characteristics, a probe-off condition may be identified. Similar behaviors may include mimicking-equal behavior, mimicking-parallel behavior, nonlinear scaling, any other suitable behavior, or any combination thereof. In some embodiments, a behavior based on a single characteristic (which may be derived from one or more signals) may be used to identify flatness, low signal level, high signal level, strong ambient behavior, any other suitable behavior, or any combination thereof. The system may identify the aforementioned behaviors as being indicative of a probe-off condition. Addison-788 at 20:3-18 In a Subsequent step (not shown), the system may provide an indicator that the physiological sensor is not properly positioned. The indication may be based on any of the deter minations that the sensor is improperly positioned as described herein. Indicators may include audible indications Such as a voice alert, beep, or siren. Indicators additionally or alternatively may include visual indications such as lights, LEDs, computer screen readouts, mechanical flags, blinking or patterned use of any of the aforementioned, the use of particular colors, any other Suitable visual indicator, or any combination thereof. Indicators may additionally or alterna tively include communications such as communications sent to a cellphone, pager, text message, internet terminal, email, phone, fax, remote server, any other Suitable communication, or any combination thereof. For example, a blinking red mes sage may appear on a remote nurse's station computer in a hospital setting. In another example, a bedside monitor may emit a beeping Sound when a probe-off condition is detected. In some embodiments, any or all of the aforementioned indi cators may be graduated or otherwise altered based on a confidence that there is a probe-off condition, the duration of the probe-off condition, a sensitivity setting, any other suitable parameters, or any combination thereof.

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	Addison-788 20:30-53 In some embodiments, signal noise, ringing, and/or transients may occur at or near the point in time when a sensor is attached or removed from a subject. This can be seen, for example in detected light signal 642 at time point 618. The noise may be related to, for example, changes in signal processing, changes in front end amplification, increased amounts of reflected light when the sensor is partially out of proper position, any other suitable sources of noise, or any combination thereof. In some embodiments, this noise may be identified and ignored by the system in determining a probe-off condition. Addison-788 at 21:64-22:7 Plot 680 includes sensor positioning signal 684. Sensor positioning signal 684 may include information related to the proper or desired positioning of a sensor, as controlled during test conditions used in generating the signals of plots 640 and 660. For example, changes in the levels of sensor positioning signal 684 may be indicative of manual changes in the sensor position during test conditions used to generate the signals of plots 640 and 660. In some embodiments, sensor positioning signal 684 at signal level “On” may be indicative of the sensor being properly positioned. In some embodiments, sensor positioning signal 684 at signal level “Off” may be indicative of the sensor being improperly positioned. For example, an improperly positioned sensor may be a probe-off condition. It will be understood that the use of “Off” and “On” values for sensor positioning signal 684 is merely exemplary. In time interval 602, the system may be under constant natural light conditions from a window with a properly attached forehead sensor. Accordingly, environmental light level signal 682 is “On and sensor positing signal 684 is “On.” The signal levels of time interval 602 may, for example, be indicative of signals received for 30 seconds. In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 602 may be indicative of a baseline behavior in the system. In time interval 602, environmental light level signal 682 remains constant and the sensor is properly positioned. As illustrated the signal levels of both detected light signsal 642 and detected ambient signal 662 remain relatively constant. In some embodiments, this baseline behavior may be used to establish a baseline noise threshold, to establish alarm thresholds, to reset parameters, for any other Suitable purpose, or any com bination thereof. In time interval 604, environmental light level signal 682 is varied and sensor positioning signal 684 is “On” indicative of the sensor being properly positioned. For example, the system may be operated in a room with the room lights switched off and a window shade rapidly opened and closed, while the sensor

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	is properly positioned. The signal levels of time inter val 604 may, for example, be indicative of signals received for 30 seconds. In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 604 may be indicative of an insensitivity to changing ambient light conditions when the sensor is properly positioned. In time interval 604, environmental light level signal 682 varies between “Off” and “On.” As illustrated, the signal levels of both detected light signal 642 and detected ambient signal 662 remain relatively constant, despite this variation. In some cases, stronger ambient light may result in a change in the detected light levels. It is expected, however, that a properly positioned sensor will reduce the impact of varying ambient light conditions on detected signals. That is, when the sensor is properly positioned, changes in ambient light may have little effect on the detected light signal 642 and the detected ambient signal 662. In time interval 606, environmental light level signal 682 is “Off” For example, the system may be operated in a dark room. In time interval 606, sensor positioning signal 684 is “On indicative of the sensor being properly positioned. The signal levels of time interval 606 may, for example, be indica tive of signals received for 30 seconds under dark conditions with a properly attached forehead sensor. In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 606 may be indicative of a baseline behavior in a dark room of the system. In time interval 606, environmental light level signal 682 remains “Off” and the sensor positioning signal remains at “On.” As illustrated the signal levels of both detected light signal 642 and detected ambient signal 662 remain relatively constant. As illustrated, both the detected light signal 642 and detected ambient signal 662 are received at substantially the same amplitudes as in time interval 602 where the environ mental light level was higher. This may be, for example, indicative of a properly positioned sensor's ability to exclude ambient light effects. In time interval 608, environmental light level signal 682 is varied. For example, the system may be operated in a room with the room lights switched on and off. In time interval 608, sensor positioning signal 684 is “On indicative of the sensor being properly positioned. In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 608 may be indicative of an insensitivity to changing environmental light conditions when the sensor is properly positioned. In some embodiments, the conditions in time interval 608 may be similar to those in time interval 604, except a level of electric light is varying as opposed to the amount of Sunlight entering the room. As illustrated, the signal levels of both detected light signal 642 and detected ambient signal 662 remain relatively constant, despite the variations in environmental light. This may indicate that the sensor is properly positioned. In time interval 610, environmental light level signal 682 may be “On For example, the system may be operated in a room with the room lights switched on. In time interval 610, the sensor may be removed and reapplied. Sensor positioning signal 684 may be “On” during the beginning of time

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	interval 610, “Off” between time point 618 and time point 620, and “On” following time point 620. For example, the sensor may have been removed at time point 618 and reapplied at time point 620. In some embodiments, the behavior of detected light signal 642 and detected ambient signal 662 in time interval 610 may be indicative of the sensor being removed and reattached while operating in an illuminated room. In time interval 610, the sensor (e.g., a forehead sensor) may be removed from the patient at time point 618. The level of detected light signal 642 may increase from a relatively lower level in region 644 to a relatively higher level in region 646 substantially coincident with the removal of the sensor at time point 618. The level of detected ambient signal 662 may increase from a relatively lower level in region 664 to a relatively higher level in region 668 substantially coincident with the removal of the sensor at time point 618. The increase in both detected light signal 642 and detected ambient signal 662 may be indicative of an increased amount of light reaching the detector. In some embodiments, shielding or lightblocking structures may have prevented ambient light from reaching the detector while it was properly positioned, but not while it is removed from the Subject. In some embodiments, the changes in signal levels may be in part attributed to increased ambient light reaching the detector, light from the emitters that is not attenuated as much as it would have been in a properly positioned sensor arrangement reaching the detector, sensor noise, other suitable signal sources, or any combination thereof. Addison-788 at 22:41-24:36 1. A method for determining whether a physiological sensor is properly positioned on a subject, the method comprising: receiving a light signal using the physiological sensor; processing, using processing equipment, the light signal to obtain a first signal corresponding to ambient light; processing, using the processing equipment, the light signal to obtain a second signal corresponding to an emitted photonic signal and ambient light; analyzing, using the processing equipment, the first signal and the second signal to identify similar signal amplitude behavior; and determining, using the processing equipment, that the physiological sensor is not properly positioned based on the analysis. Addison-788 at Claim 1

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	15. A system for determining whether a physiological sensor is properly positioned on a subject, the system comprising: processing equipment configured to: receive a light signal from the physiological sensor; process the light signal to obtain a first signal corresponding to ambient light; process the light signal to obtain a second signal corresponding to an emitted photonic signal and ambient light; analyze the first signal and the second signal to identify similar signal amplitude behavior; and determine that the physiological sensor is not properly positioned based on the analysis. Addison-788 at Claim 15 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 11	
11. The wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers.	See claim 8 above. Addison-788 discloses or renders obvious the wearable device of claim 8, wherein at least a portion of the output light has an optical wavelength between about 700 nanometers and about 2500 nanometers. A physiological monitoring system may determine a probe-off condition. A physiological sensor may be used to emit one or more wavelengths of light. A received light signal may be processed to obtain a light signal corresponding to the emitted light and an ambient signal. The signals may be analyzed to identify similar behavior. The system may determine whether the physiological sensor is properly positioned based on the analysis. Addison-788 at [Abstract]

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	In some embodiments, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Red and infrared (IR) wavelengths may be used because it has been observed that highly oxygenated blood will absorb relatively less red light and more IR light than blood with a lower oxygen saturation. By comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen saturation of hemoglobin in arterial blood. Addison-788 at 6:16-25 The system may process data to determine physiological parameters using techniques well known in the art. For example, the system may determine blood oxygen saturation using two wavelengths of light and a ratio-of-ratios calculation. The system also may identify pulses and determine pulse amplitude, respiration, blood pressure, other suitable parameters, or any combination thereof, using any suitable calculation techniques. In some embodiments, the system may use information from external sources (e.g., tabulated data, secondary sensor devices) to determine physiological parameters. Addison-788 at 6:26-36 Sensor 102 of physiological monitoring system 100 may include light source 130 and detector 140. Light source 130 may be configured to emit photonic signals having one or more wavelengths of light (e.g. Red and IR) into a subject's tissue. For example, light source 130 may include a Red light emitting light source and an IR light emitting light source, e.g. Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm**.** It will be understood that light source 130 may include any number of light sources with any suitable characteristics. In embodiments where an array of sensors is used in place of single sensor 102, each sensor may be configured to emit a single wavelength. For example, a first sensor may emit only a Red light while a second may emit only an IR light. Addison-788 at 7:3-19 It will be understood that, as used herein, the term “light' may refer to energy produced by radiative sources and may include one or more of ultrasound, radio, microwave, milli meter wave, infrared, visible, ultraviolet, gamma ray or X-ray electromagnetic radiation. As used herein, light may also include any wavelength within the radio, microwave, infra red, visible, ultraviolet, or X-ray spectra, and that any

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	suitable wavelength of electromagnetic radiation may be appropriate for use with the present techniques. Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130. Addison-788 7:20-30 In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single wavelength. In operation, light may enter detector 140 after passing through the subject's tissue. Detector 140 may convert the intensity of the received light into an electrical signal. The light intensity may be directly related to the absorbance and/or reflectance of light in the tissue. That is, when more light at a certain wavelength is absorbed, scattered, or reflected, less light of that wavelength is typically received from the tissue by detector 140. After converting the received light to an electrical signal, detector 140 may send the detection signal to monitor 104, where the detection signal may be processed and physiological parameters may be determined (e.g., based on the absorption of the Red and IR wavelengths in the subject's tissue). In some embodiments, the detection signal may be preprocessed by sensor 102 before being transmitted to monitor 104. Addison-788 at 7:31-49 Light drive circuitry 120, as discussed above, may be configured to generate a light drive signal that is provided to light source 130 of sensor 102. The light drive signal may, for example, control the intensity of light source 130 and the timing of switching light source 130 on and off. When light source 130 is configured to emit two or more wavelengths of light, the light drive signal may be configured to control the operation of each wavelength of light. The light drive signal may comprise a single signal or may comprise multiple signals (e.g., one signal for each wavelength of light). An illustrative light drive signal is shown in FIG. 2A. Addison-788 at 8:6-16 FIG. 3 is a perspective view of an embodiment of a physiological monitoring system 310 in accordance with some embodiments of the present disclosure. In some embodiments, one or more components of physiological monitoring system 310 may include one or more components of physiological monitoring system 100 of FIG. 1. Physiological monitoring system 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of an oximeter. Sensor unit 312 may include

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	one or more light source 316 for emitting light at one or more wavelengths into a subject's tissue. One or more detectors 318 may also be provided in sensor unit 312 for detecting the light that is reflected by or has traveled through the subject's tissue. Any suitable configuration of light source 316 and detector 318 may be used. In an embodiment, sensor unit 312 may include multiple light sources and detectors, which may be spaced apart. Physiological monitoring system 310 may also include one or more additional sensor units (not shown) that may, for example, take the form of any of the embodiments described herein with reference to sensor unit 312. An additional sensor unit may be the same type of sensor unit as sensor unit 312, or a different sensor unit type than sensor unit 312 (e.g., a photoacoustic sensor). Multiple sensor units may be capable of being positioned at two or more different locations on a subject's body. Addison-788 at 13:5-29 FIG. 5 is flow diagram 500 showing illustrative steps for determining whether a sensor is properly positioned in accordance with some embodiments of the present disclosure. Addison-788 at 17:19-21 In step 502, the system may use the physiological sensor to emit an emitted photonic signal. The system may emit the emitted photonic signal including one wavelength of light, multiple wavelengths of light, a broad spectrum light (e.g., white light), or any combination thereof. For example, the emitted photonic signal may include light from a red LED and light from an IR LED. The emitted photonic signal may be emitted, for example, by light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the emitted photonic signal may include a light drive modulation. For example, when the emitted photonic signal includes a red light source and an IR light source, the light drive modulation may include a red drive pulse followed by an “off” period followed by an IR drive pulse followed by an off period. It will be understood that this drive cycle modulation is merely exemplary and that any suitable drive cycle modulation or combination of modulations may be used. In some embodiments, the emitted photonic signal may include a cardiac cycle modulation, where the brightness, duty cycle, or other parameters of one or more emitters are varied at a rate substantially related to the cardiac cycle. Addison-788 at 17:22-42 In step 508, the system may process the received light signal to obtain a second signal. In some embodiments, the second signal may correspond to the detected light signal, that is, the combination of

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	the detected emitted photonic signal and the detected ambient light. In some embodiments, the second signal need not include the ambient light component. The second signal may correspond to one or more wavelengths of emitted light, for example, an IR signal, a red signal, any other suitable signal, or any combination thereof. The processing of the light signal to obtain the first signal may be implemented using any suitable components of physiological monitoring system 100 of FIG. 1, physiological monitoring system 310 of FIG. 3, processing system 400 of FIG. 4, any other suitable components, or any combination thereof. Addison-788 at 18:30-44 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 12	
12. The wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user.	See claim 8 above. Addison-788 discloses or renders obvious the wearable device of claim 8, wherein the physiological parameter of the user is associated with a blood constituent or a blood flow of the user. The foregoing probe-off techniques may be implemented in an oximeter. An oximeter is a medical device that may determine the oxygen saturation of an analyzed tissue. One common type of oximeter is a pulse oximeter, which may non-invasively measure the oxygen saturation of a patient's blood (as opposed to measuring oxygen saturation directly by analyzing a blood sample taken from the patient). Pulse oximeters may be included in patient monitoring systems that measure and display various blood flow characteristics including, but not limited to, the oxygen saturation of hemoglobin in arterial blood. Such patient monitoring systems may also measure and display additional physiological parameters, such as a patient's pulse rate and blood pressure. Addison-788 at 5:37-49

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	An oximeter may include a light sensor that is placed at a site on apatient, typically a fingertip, toe, forehead or earlobe, or in the case of a neonate, across a foot or hand. The oximeter may use a light source to pass light through blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically understood to be optimal for pulse oximetry serve as suitable sensor locations for the blood pressure monitoring processes described herein, including any location on the body that has a strong pulsatile arterial flow. For example, additional Suit able sensor locations include, without limitation, the neck to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patient’s thigh to monitor femoral artery pulsatile flow, the ankle to monitor tibial artery pulsatile flow, and around or in front of the ear. Suitable sensors for these locations may include sensors for sensing absorbed light based on detecting reflected light. In all suitable locations, for example, the oximeter may measure the intensity of light that is received at the light sensor as a function of time. The oximeter may also include sensors at multiple locations. A signal representing light intensity ver sus time or a mathematical manipulation of this signal (e.g., a scaled version thereof, a log taken thereof, a scaled version of a log taken thereof, etc.) may be referred to as the photopl ethysmograph (PPG) signal. In addition, the term “PPG signal” as used herein, may also refer to an absorption signal (i.e., representing the amount of light absorbed by the tissue) or any Suitable mathematical manipulation thereof. The light intensity or the amount of light absorbed may then be used to calculate any of a number of physiological parameters, including an amount of a blood constituent (e.g., oxyhemoglobin) being measured as well as a pulse rate and when each individual pulse occurs. In some embodiments, the photonic signal interacting with the tissue is selected to be of one or more wavelengths that are attenuated by the blood in an amount representative of the blood constituent concentration. Red and infrared (IR) wave lengths may be used because it has been observed that highly oxygenated blood will absorb relatively less red light and more IR light than blood with a lower oxygen saturation. By comparing the intensities of two wavelengths at different points in the pulse cycle, it is possible to estimate the blood oxygen Saturation of hemoglobin in arterial blood. Addison-788 5:50-6:25. User interface 180 may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device. The inputs received by user input 182 can include information about the subject, such as age, weight, height, diagnosis, medications, treatments, and so forth. In an embodiment, the subject may be a medical patient and display 184 may exhibit a list of values which may generally apply to the patient, such as, for example, age ranges or medication families, which the user may select using user inputs 182. Additionally, display 184 may display, for example, an estimate of a subject's blood oxygen saturation generated by monitor 104

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	(referred to as an “SpO2” measurement), pulse rate information, respiration rate information, blood pressure, sensor condition, any other parameters, and any combination thereof. Display 184 may include any type of display such as a cathode ray tube display, a flat panel display such a liquid crystal display or plasma display, or any other suitable display device. Speaker 186 within user interface 180 may provide an audible sound that may be used in various embodiments, such as for example, sounding an audible alarm in the event that a patient's physiological parameters are not within a predefined normal range. Addison-788 at 12:7-30 In some embodiments, sensor unit 312 may be connected to monitor 314 as shown. Sensor unit 312 may be powered by an internal power source, e.g., a battery (not shown). Sensor unit 312 may draw power from monitor 314. In another embodiment, the sensor may be wirelessly connected to monitor 314 (not shown). Monitor 314 may be configured to calculate physiological parameters based at least in part on data relating to light emission and detection received from one or more sensor units such as sensor unit 312. For example, monitor 314 may be configured to determine pulse rate, blood pressure, blood oxygen saturation (e.g., arterial, venous, or both), hemoglobin concentration (e.g., oxygenated, deoxygenated, and/or total), any other suitable physiological parameters, or any combination thereof. In some embodiments, calculations may be performed on the sensor units or an intermediate device and the result of the calculations may be passed to monitor 314. Further, monitor 314 may include display 320 configured to display the physiological parameters or other information about the system. In the embodiment shown, monitor 314 may also include a speaker 322 to provide an audible sound that may be used in various other embodiments, such as for example, sounding an audible alarm in the event that a subject's physiological parameters are not within a predefined normal range or when a sensor is not properly positioned. In some embodiments, physiological monitoring system 310 may include a stand-alone monitor in communication with the monitor 314 via a cable or a wireless network link. In some embodiments, monitor 314 may be implemented as display 184 of FIG. 1. Addison-788 at 13:30-58 In the illustrated embodiment, physiological monitoring system 310 includes a multi-parameter physiological monitor 326. The display 328 of multi-parameter physiological moni tor 326 may include a cathode ray tube display, a flat panel display (as shown) such as a liquid crystal display (LCD) or a plasma display, or may include any other type of monitor now known or later developed. Multi-parameter physiological monitor 326 may be configured to calculate physiological parameters and to provide

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	information from monitor 314 and from other medical monitoring devices or systems (not shown) using display 328. For example, multi-parameter physiological monitor 326 may be configured to display an estimate of a Subject’s blood oxygen saturation and hemoglo bin concentration generated by monitor 314. Multi-parameter physiological monitor 326 may include a speaker 33 Addison-788 14:22-36 FIG. 4 shows illustrative signal processing system 400 in accordance with some embodiments of the present disclosure. Signal processing system 400 includes input signal generator 410, processor 412 and output 414. In the illustrated embodiment, input signal generator 410 may include pre-processor 420 coupled to sensor 418. As illustrated, input signal generator 410 generates an input signal 416. In some embodiments, input signal 416 may include one or more intensity signals based on a detector output. In some embodiments, pre-processor 420 may be an oximeter and input signal 416 may be a PPG signal. In an embodiment, pre-processor 420 may be any suitable signal processing device and input signal 416 may include PPG signals and one or more other physiological signals, such as an electrocardiogram (ECG) signal. It will be understood that input signal generator 410 may include any suitable signal source, signal generating data, signal generating equipment, or any combination thereof to produce input signal 416. Input signal 416 may be a single signal, or may be multiple signals transmitted over a single pathway or multiple pathways. Addison-788 at 14:50-15:2 In some embodiments, input signal 416 may be coupled to processor 412. Processor 412 may be any suitable software, firmware, hardware, or combination thereof for processing input signal 416. For example, processor 412 may include one or more hardware processors (e.g., integrated circuits), one or more software modules, non-transitory computer-readable media such as memory, firmware, or any combination thereof. Processor 412 may, for example, be a computer or may be one or more chips (i.e., integrated circuits). Processor 412 may, for example, include an assembly of analog electronic components. Processor 412 may calculate physiological information. For example, processor 412 may compute one or more of a pulse rate, respiration rate, blood pressure, or any other suitable physiological parameter. Processor 412 may perform any suitable signal processing of input signal 416 to filter input signal 416, such as any suitable band-pass filtering, adaptive filtering, closed-loop filtering, any other suitable filtering, and/or any combination thereof. Processor 412 may also receive input signals from additional sources (not shown). For example, processor 412 may receive an input signal containing

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	information about treatments provided to the subject. Additional input signals may be used by processor 412 in any of the calculations or operations it performs in accordance with processing system 400. Addison-788 at 15:34-57 Processor 412 may be coupled to one or more memory devices (not shown) or incorporate one or more memory devices such as any suitable volatile memory device (e.g., RAM, registers, etc.), non-volatile memory device (e.g., ROM, EPROM, magnetic storage device, optical storage device, flash memory, etc.), or both. The memory may be used by processor 412 to, for example, store fiducial information or initialization information corresponding to physiological monitoring. In some embodiments, processor 412 may store physiological measurements or previously received data from input signal 416 in a memory device for later retrieval. In some embodiments, processor 412 may store calculated values, such as a pulse rate, a blood pressure, a blood oxygen saturation, a fiducial point location or characteristic, an initialization parameter, or any other calculated values, in a memory device for later retrieval. Addison-788 at 15:61-16:9 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 13	
13. The wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency.	See claim 8 above. Addison-788 discloses or renders obvious the wearable device of claim 8, wherein the processor is further configured to modulate the light source with a modulation frequency. In some embodiments, a light drive modulation may be used. For example, a first light source may be turned on for a first drive pulse, followed by an off period, followed by a second light source for a second drive pulse, followed by an off period. The first and second drive pulses may be used to determine

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	physiological parameters. The off periods may be used to determine detected ambient signal levels, reduce overlap of the light drive pulses, allow time for light sources to stabilize, allow time for detected light signals to stabilize or settle, reduce heating effects, reduce power consumption, for any other suitable reason, or any combination thereof. Addison-788 at 6:37-47 FIG. 2A shows an illustrative plot of a light drive signal including red drive pulse 202 and IR drive pulse 204 in accordance with some embodiments of the present disclosure. Red drive pulse 202 and IR drive pulse 204 may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, drive pulses may refer to switching power or other components on and off, high and low output states, high and low values within a continuous modulation, other suitable relatively distinct states, or any combination thereof. The light drive signal may be provided to light source 130, including red drive pulse 202 and IR drive pulse 204 to drive red and IR light emitters, respectively, within light source 130. Red drive pulse 202 may have a higher amplitude than IR drive pulse 204 since red LEDs may be less efficient than IR LEDs at converting electrical energy into light energy. In some embodiments, the output levels may be the equal, may be adjusted for nonlinearity of emitters, may be modulated in any other suitable technique, or any combination thereof. Additionally, red light may be absorbed and scattered more than IR light when passing through perfused tissue. When the red and IR light sources are driven in this manner they emit pulses of light at their respective wavelengths into the tissue of a subject in order generate physiological signals that physiological monitoring system 100 may process to calculate physiological parameters. It will be understood that the light drive amplitudes of FIG. 2A are merely exemplary any that any suitable amplitudes or combination of amplitudes may be used, and may be based on the light sources, the subject tissue, the determined physiological parameter, modulation techniques, power sources, any other suitable criteria, or any combination thereof. Addison-788 at 8:17-47 In step 502, the system may use the physiological sensor to emit an emitted photonic signal. The system may emit the emitted photonic signal including one wavelength of light, multiple wavelengths of light, a broad spectrum light (e.g., white light), or any combination thereof. For example, the emitted photonic signal may include light from ared LED and light from an IR LED. The emitted photonic signal may be emitted, for example, by light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the emitted photonic signal may include a light drive modulation. For example, when the emitted photonic signal includes a red light source and an IR light source, the light drive modulation may include

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	a red drive pulse followed by an “off period followed by an IR drive pulse followed by an off period. It will be understood that this drive cycle modulation is merely exemplary and that any Suitable drive cycle modulation or combination of modulations may be used. In some embodi ments, the emitted photonic signal may include a cardiac cycle modulation, where the brightness, duty cycle, or other parameters of one or more emitters are varied at a rate Sub stantially related to the cardiac cycle. Addison-788 17:22-42 In step 902, the system may use the physiological sensor to emit a photonic signal. The system may emit a photonic signal including one wavelength of light, multiple wavelengths of light, a broad spectrum light (e.g., white light), or any combination thereof. For example, the photonic signal may include light from a red LED and light from an IR LED. The emitted photonic signal may be emitted, for example, by light source 130 of FIG. 1. In some embodiments, the emitted photonic signal may include a light drive modulation. For example, where the photonic signal includes a red light source and an IR light source, the light drive modulation may include a red drive pulse followed by an “off” period followed by an IR drive pulse followed by an off period. It will be understood that this drive cycle modulation is merely exemplary and that any suitable drive cycle modulation or combination of modulations may be used. In some embodiments, the photonic signal may include a cardiac cycle modulation, where the brightness, duty cycle, or other parameters of one or more emitters are varied at a rate substantially related to the cardiac cycle. Addison-788 at 29:52-30:4 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Addison-788 it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Addison-788 those elements, as known to them or as disclosed by other prior art identified in the cover pleading