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

DEFENDANTS' INVALIDITY AND
SUBJECT MATTER ELIGIBILITY CONTENTIONS

Pursuant to Patent Rules 3-3 and 3-4 and the Docket Control Order entered by the Court (Dkt. 46), Defendants Samsung Electronics, Co. Ltd., Samsung Electronics America, Inc. (collectively "Samsung"), Fossil Group, Inc., Fossil Stores I, Inc., Fossil Partners, L.P. (collectively "Fossil"), and Ōura Health Oy ("Oura") (collectively "Defendants") hereby provide their Invalidity Contentions to Omni MedSci, Inc. ("Omni" or "Plaintiff").

Defendants' 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") (collectively the "Asserted Patents").[1]

Defendants also submit their Subject Matter Eligibility Contentions concerning the

[1] The '484, '455, and '790 Patents are asserted against only Samsung and Fossil, not Oura.

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Asserted Patents in accordance with the Court's July 25, 2019, Standing Order Regarding Subject Matter Eligibility Contentions Applicable to All Patent Infringement Cases Assigned to Chief District Judge Rodney Gilstrap ("Standing Order") and the Docket Control Order.

I. Introduction

As disclosed in its respective P. R. 3-1 Infringement Contentions served on Defendants, Plaintiff asserts the following patents and claims:

Patent	**Asserted Claims**[2]	**Omni's Alleged Priority Date**	**Chart Prefix**
'868 Patent	Samsung: 7, 9 Fossil: 7-9 Oura: 7, 9	September 3, 2002	A
'533 Patent	Samsung: 11, 12 Fossil: 12 Oura: 11, 12	December 31, 2012	B
'484 Patent	Samsung: 8-10 Fossil: 8-9 Oura: n/a	December 31, 2012	C
'304 Patent	Samsung: 11, 14-16, 19-22 Fossil: 11, 14, 19-20 Oura: 11-14, 19-20	December 31, 2012	D
'455 Patent	Samsung: 1-3, 8-10, 15 Fossil: 1, 8 Oura: n/a	December 31, 2012	E
'790 Patent	Samsung: 7 Fossil: 7 Oura: n/a	December 31, 2012	F

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, Defendants do not concede that Omni's claims of priority are correct.

[2] *See* n.1.

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Further, the citation of prior art herein and the accompanying exhibits are not intended to reflect Defendants' claim construction contentions, which will be disclosed in due course in accordance with the Docket Control Order. Instead, Defendants' 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 Defendants disagree.

As further detailed in and supported by these Invalidity Contentions, Defendants contend that each of the Asserted Claims is invalid under at least 35 U.S.C. §§ 101, 102, 103, and/or 112.[3] Defendants reserve 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.

II. Amendment / Supplementation

Defendants' 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, Defendants reserve 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 Defendants' 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*

[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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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 Defendants 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, Defendants do not admit that the claim limitations are capable of construction, do not admit that any claim limitations are supported with an appropriate written description and enabling disclosure in the applicable patent specifications, and do not adopt Plaintiff's apparent claim constructions or admit the accuracy of any particular claim construction.[4] Defendants reserve all 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.

Defendants further reserve 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. Defendants further reserve the right to supplement their accompanying P.R. 3-4(b) document productions should they later discover additional prior art documents, information, testimony, prior art systems and related documentation, and/or software or hardware

[4] Defendants do not concede that Plaintiff's apparent interpretation of the claims is correct, but rather assert 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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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, Defendants have based their 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, Defendants contend 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, Defendants reserve 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.

Defendants 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. Defendants reserve the right to contend that one or more of the Asserted Claims are invalid under 35 U.S.C. § 102(f) in the event Defendants obtain 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 Defendants, may become relevant. Defendants are 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

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Subject Matter Eligibility Contentions. Accordingly, Defendants reserve 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 of the Asserted Patents). Moreover, Defendants reserve 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.

Because discovery has just recently begun, Defendants anticipate that additional prior art and invalidity bases may be found. Defendants' investigation and analysis of the prior art is continuing, and thus Defendants reserve the right to supplement, amend, and/or revise the information provided herein as Defendants conduct 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, Defendants reserve 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

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invalidity under 35 U.S.C. §§ 102(c), (d), or (f). For example, Defendants expect 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), Defendants also incorporate 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 ("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, Defendants identify, as prior art upon which they may rely to show the invalidity of the Asserted Claims, the prior art references disclosed by parties in 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 Defendants all relevant documents

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

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from any Other Omni Proceedings, including but not limited to all prior art, invalidity contentions, and expert reports on invalidity (among other relevant items).

Defendants reserve 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). Defendants also reserve 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 Defendants' reservations of rights, Defendants identify 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.

[6] Defendants' disclosure of prior art is premised on the alleged priority dates of the Asserted Patents as identified in Plaintiff's Infringement Contentions. Defendants contend 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, Defendants also reserve the right to argue that they have 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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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
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

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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 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
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

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 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, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are 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, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-A.

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

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Defendants' 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. Defendants' 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, Defendants reserve 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 '868 Patent. Defendants have obtained, and are 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 Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in

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Defendants' possession, custody, or control available for inspection by Plaintiff.

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

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

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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

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	At least as early as 2004 (Rad-5/ Rad-5v), 2007 (Radical), 2008 (Rad-

[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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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Extraction Pulse Oximeters, Radical, Rad-57™, SET® Pulse Oximetry Devices and Rainbow SET™ Devices, and their accessories (e.g., sensor probe)	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 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	At least as early as 2007

Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Systems, including but not limited to M4529A DigitalHandheld Pulse Oximeter, and its accessories (e.g., sensor probe)	
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, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are 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, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-B.

Discovery is ongoing, and Defendants may serve third parties with document subpoenas. One or more of these devices, along with related documentation, may be invalidating, and

Defendants reserve the right to supplement these contentions accordingly. Defendants continue to investigate each of the identified devices, including through potential discovery needed to be obtained via third party subpoenas, and reserve the right to supplement these contentions and accompanying claim charts after further investigation.

Defendants' 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. Defendants' 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 '533 Patent. As such, Defendants reserve 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. Defendants have obtained, and are 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

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lawsuit, which Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in Defendants' possession, custody, or control available for inspection by Plaintiff.

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

In addition, Defendants identify, 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 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 Defendants have not yet completed discovery in this case, including taking

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depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, Defendants reserve 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
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,	At least as early as 1988

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	
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, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008

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 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, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are 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, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-C.

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

Defendants' 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 '484 Patent. Defendants' 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, Defendants reserve 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. Defendants have obtained, and are 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 Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in Defendants' possession, custody, or control available for inspection by Plaintiff.

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

In addition, Defendants identify, 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

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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 Defendants have not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, Defendants reserve 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.

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

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Patent No. or Title (Primary Inventor/Author)	Date of Issue/ Publication	Filing Date
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 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	At least as early as 2002 (OxiMax Pulse Oximeters and OmniMax N-595), 2011 (OxiMax N-600X)

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
N-595 Pulse Oximter, Nellcor OxiMax N-600X Pulse Oximeter, and their accessories (e.g., sensor probe)	
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

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 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, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are 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, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-D.

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

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Defendants' 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. Defendants' 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, Defendants reserve 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. Defendants have obtained, and are 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 Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in

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Defendants' possession, custody, or control available for inspection by Plaintiff.

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

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

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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
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,	At least as early as 1988

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Name of System or Invention	Date of Sale / Offer for Sale / Public Use / Known by Others
Inc., including but not limited to Criticare 504, and its accessories (e.g., sensor probe)	
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, including but not limited to BCI 3304 Oximeter, and its accessories (e.g., sensor probe)	At least as early as 2008

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 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, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are 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, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-E.

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

Defendants' 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. Defendants' 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 or not any of the third-party prior art systems anticipate or render obvious the Asserted Claims of the '455 Patent. As such, Defendants reserve 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. Defendants have obtained, and are 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 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 Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in Defendants' possession, custody, or control available for inspection by Plaintiff.

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

In addition, Defendants identify, 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 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

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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 Defendants have not yet completed discovery in this case, including taking depositions of the named inventors, and otherwise obtaining discovery from Plaintiff and third parties, Defendants reserve 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
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

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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)
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, Defendants have listed and produced documents as evidence of the relevant features and functionality to the extent that they are presently available and have been located. Defendants have obtained or are 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, Defendants are actively searching for information regarding at least the systems, devices, and/or inventions listed above in Table 2-F.

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

Defendants' 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 '790 Patent. Defendants' 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 '790 Patent. As such, Defendants reserve 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. Defendants have obtained, and are 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 Defendants reserve the right to rely upon to corroborate the prior art status of the prior art identified herein. Defendants reserve the right to modify, amend, or supplement these contentions if additional information becomes available during the course of this lawsuit. Furthermore, Defendants will make all such devices, software programs, or other products in Defendants' possession, custody, or control available for inspection by Plaintiff.

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

In addition, Defendants identify, 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

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

G. State of the Art

Defendants identify, responsive to Plaintiff’s infringement contentions, the references listed in Tables 1-A through 1-F, Tables 2-A through 2-F, 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

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- 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
- 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

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- 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
- 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

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- "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

IV. P. R. 3-3(b) – Invalidity Grounds

Pursuant to P.R. 3-3(b), Defendants contend 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, Defendants contend 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.

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A. Anticipation

As stated above, Defendants incorporate by reference all other invalidity contentions related 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), Defendants identify 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, Defendants indicate 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, Defendants further contend 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, Defendants continue 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

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explicit disclosures of the prior art references cited in the claim charts of Appendix A, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend 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).

Defendants' 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, Defendants 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.

Defendants incorporate 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.

Defendants further identify and hereby incorporate 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. Defendants reserve 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

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the components, functionality, and capabilities of the devices and systems disclosed in the references charted.

Where Defendants identify 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), Defendants' 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. Defendants therefore reserve 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.

Defendants also reserve 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

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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 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), Defendants identify 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, Defendants indicate 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, Defendants further contend 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, Defendants continue 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, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend 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

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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).

Defendants' 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, Defendants 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.

Defendants incorporate 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.

Defendants further identify and hereby incorporate 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. Defendants reserve 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 Defendants identify 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

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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), Defendants' 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. Defendants therefore reserve 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.

Defendants also reserve 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

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art. Pursuant to P.R. 3-3(a), Defendants identify the prior art references that anticipate or render obvious the '484 Patent Asserted Claims in the claim charts of Exhibits C1 through C14 (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, Defendants indicate 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, Defendants further contend 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, Defendants continue 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, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend 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).

Defendants' 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

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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 product. In addition, Defendants 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.

Defendants incorporate 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.

Defendants further identify and hereby incorporate 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. Defendants reserve 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 Defendants identify 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), Defendants' citations to specific statements, figures, or disclosures in a prior art reference are

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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. Defendants therefore reserve 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.

Defendants also reserve 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), Defendants identify 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

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every element of the ’304 Patent Asserted Claims. For each reference or combination of references suggested by each chart and/or herein, Defendants indicate whether the prior art renders the claim 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, Defendants further contend 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, Defendants continue 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, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend 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).

Defendants’ 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, Defendants 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

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program(s), device(s), or product(s) that are referenced in the charts.

Defendants incorporate by reference, as if set forth fully herein, all prior art cited during the 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.

Defendants further identify and hereby incorporate 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. Defendants reserve 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 Defendants identify 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), Defendants' 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

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art reference, a person of ordinary skill in the art would rely upon other information including other publications and general scientific or engineering knowledge. Defendants therefore reserve 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.

Defendants also reserve 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), Defendants identify 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, Defendants indicate 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

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prior art references cited in the claim charts of Appendix E, Defendants further contend that the '455 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, Defendants continue 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, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend 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).

Defendants' 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, Defendants 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.

Defendants incorporate 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,

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and all prior art disclosed during previous litigation proceedings.

Defendants further identify and hereby incorporate 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 '455 Patent, its foreign counterparts, or any parent or child patent of the '455 Patent. Defendants reserve 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 Defendants identify 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), Defendants' 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. Defendants therefore reserve 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

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identified portions.

Defendants also reserve 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 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), Defendants identify 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, Defendants indicate 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, Defendants further contend 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, Defendants

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continue 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 '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, Defendants further contend that the knowledge of skill evidenced by those references render those claims invalid. Defendants further contend 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).

Defendants' 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 component, circuit, software program, device, or product. In addition, Defendants 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.

Defendants incorporate 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.

Defendants further identify and hereby incorporate 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

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counterparts, or any parent or child patent of the '790 Patent. Defendants reserve 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 Defendants identify 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), Defendants' 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. Defendants therefore reserve 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.

Defendants also reserve 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

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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 F.

B. Obviousness

As stated above, Defendants incorporate 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, Defendants assert 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

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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.

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

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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 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 combiation 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

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a puzzle." *KSR*, 550 U.S. at 420-21.

Nevertheless, in addition to the information contained immediately above and elsewhere in these contentions, Defendants identify 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 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

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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.

Defendants reserve 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. Defendants 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, Defendants reserve 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, Defendants note 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. Defendants are 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, Defendants reserve all rights to rebut those contentions if and when

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Omni identifies them. In the meantime, Defendants note the complete lack of any such evidence in the record. Moreover, Defendants further contend that, in any event, the evidence of obviousness for each asserted claim is so overwhelming that secondary considerations are necessarily insufficient to rebut Defendants' 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 secondary indicia are frequently deemed inadequate to establish non-obviousness.").

While Defendants reserve the right to rely on any combination of the references reflected in their charts or incorporated herein by reference, Defendants provide 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), Defendants identify 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

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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.

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. Defendants 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, Defendants have not yet completed their search or discovery concerning additional prior art. As such, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating

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combinations as appropriate, and Defendants reserve 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. Defendants further believe 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, Defendants identify 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

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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 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 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.

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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 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 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

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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 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.

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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 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].

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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

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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 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."

[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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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 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

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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 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

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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.

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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 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

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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 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.

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 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

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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,

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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 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

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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 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

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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 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

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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 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) <u>Mault Combined with Jeng, Pologe, Shigeki, Abreu and/or Scharf</u>

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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, 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

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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 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

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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 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.

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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 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.

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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 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), Defendants identify 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. 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

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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 therefore invalid) each of Omni's Asserted Claims. Defendants 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, Defendants have not yet completed their search or discovery concerning additional prior art. As such, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendants reserve 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

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extent not anticipated, the ’533 Patent Asserted Claims represent no more than the result of ordinary variations of the prior art. Defendants further believe 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, Defendants identify 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

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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 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

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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 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

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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 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

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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 "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

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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 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

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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 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.

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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 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, 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

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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 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

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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, and those using filters, 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 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

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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

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

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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.

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), Defendants identify in Appendix C the prior art references that render obvious the Asserted Claims of the '484 Patent and include below exemplary

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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 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

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of the references disclosed above may be combined with one another to render obvious (and therefore invalid) each of Omni's Asserted Claims. Defendants 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, Defendants have not yet completed their search or discovery concerning additional prior art. As such, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendants reserve 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. Defendants further believe 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.

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Nevertheless, in addition to the information contained elsewhere in these contentions, Defendants identify 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.

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

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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 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

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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 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.

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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 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

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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 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.,

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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 references provide numerous methods for increasing a light intensity and increasing a pulse rate

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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 ratio in optical measurement systems. These methods are known to be effective in improving the

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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 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

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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 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

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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 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 inteligence. 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.

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 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, 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

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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 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

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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) Carlson, Lisgurski, Chandersekar, Soller, Tran, and Sakai combined with References disclosing smart phone or tablet

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. 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 and/or increased processing capabilities. 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

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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 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

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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.

(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 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

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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 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

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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, 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

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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 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

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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 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

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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, 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

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Pursuant to P.R. 3-3(a) and (b), Defendants identify 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 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

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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. Defendants 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, Defendants have not yet completed their 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, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendants reserve 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. Defendants further believe 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, Defendants identify 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 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.

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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 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

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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 '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 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.

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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 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

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improving signal-to-noise ratio through various methods, including increasing light intensity, increasing pulse rate, differencing detected signals, and applying multivariate techniques. 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," and performing "measurement algorithms" on "multivariate input data" of measurement signals in order to "better the measurement accuracy a.k.a. SNR." Marbach, 17:1-7, 12:19-27. **LeBoeuf** teaches "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 … noise information. … The filter 203 properties are updated to minimize the difference between Channel A and the post-processed

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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 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)

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

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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.

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 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

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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 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

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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 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

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"[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, **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 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 time these references were known. Each of the Reflective Surface References provide means—

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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**, and **LeBoeuf** relate to physiological monitoring systems which use various methods for improving

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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) 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

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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," such as a "smart 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,

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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.

(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 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

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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 Optical Detection 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), 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

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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 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

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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 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

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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.

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

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Pursuant to P.R. 3-3(a) and (b), Defendants identify 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. Defendants 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, Defendants have not yet completed their 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, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendants reserve 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. Defendants further believe 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, Defendants identify 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), Defendants identify 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. Defendants 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, Defendants have not yet completed their search or discovery concerning additional prior art. As such, Defendants' inclusion of exemplary combinations does not preclude them from identifying other invalidating combinations as appropriate, and Defendants reserve 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. Defendants further believe 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, Defendants identify 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

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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.

(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

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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, 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

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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, 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

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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 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.

V. P.R. 3-3(c) – Claim Charts

Pursuant to Rule 3-3(c), Defendants identify 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), and Appendix F ('790 Patent).

Defendants have 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

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limitations. Defendants 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-F, Defendants provide exemplary citations showing where references disclose subject matter recited in preambles of the Asserted Claims, regardless of whether the preambles limit the claims. Defendants reserve 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 limitation, including under 35 U.S.C. § 112 ¶ 6, and whether any particular limitation is governed by 35 U.S.C. § 112 ¶ 6. Defendants' contentions are based on the information presently available,

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and Defendants reserve 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), Defendants hereby identify 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 Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants 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. Defendants' 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, Defendants only identify the issues under 35 U.S.C. § 112 of which they are 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. *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 '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 limtiations 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 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).

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

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"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
"wireless data"	7
"voice input signals and manually entered input signals"	7
"at least a portion of the status or associated information"	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)
"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), Defendants hereby identify 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 Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants 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. Defendants' 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, Defendants only identify the issues under 35 U.S.C. § 112 of which they are 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 at the time the '533 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 '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 limtiations 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 and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus.,*

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

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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
"the processed output signal"	5
"one of more detectors"	11

[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)
"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), Defendants hereby identify 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 Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants 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. Defendants' 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, Defendants only identify the issues under 35 U.S.C. § 112 of which they are 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 those skilled in the art that the inventor had possession of the claimed subject matter as of the filing

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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 limtiations 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 and distinctness, *i.e.*, the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus.,*

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

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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
"increase the signal-to-noise ratio by comparing the first signal and the second signal"	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)
"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), Defendants hereby identify 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 Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants 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. Defendants' 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, Defendants only identify the issues under 35 U.S.C. § 112 of which they are 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 inventors were in possession of the alleged inventions recited in the '304 Patent Asserted Claims

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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
wherein the measurement system is further configured to improve the signal-to-noise ratio by differencing the first signal and the second signal	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 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 description of the invention, at least as the claim elements are being asserted by Plaintiff, or

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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), Defendants hereby identify 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 Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants 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. Defendants' 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, Defendants only identify the issues under 35 U.S.C. § 112 of which they are 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 limtiations 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), Defendants hereby identify 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 Defendants in this case is in any way inconsistent, flawed, or erroneous. Nor should these contentions prevent Defendants 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. Defendants' 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, Defendants only identify the issues under 35 U.S.C. § 112 of which they are 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 limtiations 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.

Independently, under § 112, ¶ 2, "a patent is invalid for indefiniteness if its claims, read in

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

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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

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-F, and in Exhibits A101, B101, C101, D101, E101, and F101 (collectively "Appendix 101"), which are hereby incorporated by reference as if fully set forth herein, Defendants contend 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

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

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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-F, and together with the material described, referenced, or cited in the charts, further provide a description of the indsutry, 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 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, Defendants are concurrently producing or making available for inspection and copying the materials on which Defendants presently seek to rely for subject-matter eligibility purposes. These prior art references and other materials are cited herein or in Appendices 101, A-F. For the avoidance of doubt, Defendants 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, Defendants reserve the right to further rely on expert testimony to be disclosed in accordance with the Docket Control Order. Defendants' search for prior art references, additional documentation, and/or corroborating evidence concerning prior art systems and devices is ongoing. Accordingly, Defendants reserve the right to supplement their production as Defendants obtain additional prior art references, documentation, and/or corroborating evidence concerning subject matter eligibility

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during the course of discovery.

Defendants reserve 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. 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

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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 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

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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, Defendants provide 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 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 Defendants' 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

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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.

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

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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 for patent protection.

Finally, pursuant to section (a)(2)(A) of the Order Regarding Eligibility, Defendants provide 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 Defendants' contentions that the Asserted Claims of the '533 Patent do not qualify as patent-eligible subject matter are contained in Exhibit B101.

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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.*, ’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

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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 (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, Defendants provide 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

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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 Defendants’ 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.

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

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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.

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, Defendants provide the following description of the relevant industry at the relevant time. As of the alleged

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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 Defendants’ contentions that the Asserted Claims of the ’304 Patent 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

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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 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

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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, Defendants provide 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 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 Defendants' 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

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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 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

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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, Defendants provide 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 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 Defendants' contentions that the Asserted Claims of the '790 Patent do not qualify as patent-eligible subject matter are contained in Exhibit F101.

VIII. P. R. 3-4 – Productions

Pursuant to P.R. 3-4(a), each Defendant is concurrently producing and/or making available for inspection 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.

Additionally, and pursuant to P.R. 3-4(b), Defendants are concurrently producing a copy

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of each item of prior art identified herein. These prior art references and corroborating evidence are cited in attached invalidity claim charts in Appendices 101, A-F. Defendants will also make available for inspection any prior art systems or devices upon request to the extent Defendants acquire such systems or devices. References that were cited during prosecution of the Asserted Patents may not be contained in Defendants' production as they are not required to be under the local patent rules. Defendants' search for prior art references, additional documentation, and/or corroborating evidence concerning prior art systems and devices is ongoing. Accordingly, Defendants reserve the right to supplement their production as Defendants obtain additional prior art references, documentation, and/or corroborating evidence concerning invalidity during the course of discovery.

Defendants reserve the right to supplement their P. R. 3-4 document production pursuant to the Patent Local Rules and the orders of the Court.

Dated: June 3, 2025 Respectfully Submitted,

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EXHIBIT E101

Preliminary Eligibility Contentions for U.S. Patent No. 11,160,455

Based on Omni's apparent positions, as best they can be deciphered, as to the scope of asserted claims of U.S. Patent No. 11,160,455, 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, claims 1-3, 8-10, and 15, are drawn to patent-ineligible subject matter under 35 U.S.C. § 101. The claims are generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. And none of the claims contain 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* '455 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, claims 2 and 3 merely narrow claim 1. Claim 2 provides detail as to the number and arrangement of "semiconductor sources" in Claim 1. *Id.* at cl. 2. Claim 3 specifies wavelength range and target biomarkers of the "output optical light." *Id.* at cl. 2. And claims 8, 9, 10, and 15 largely restate Claim 1. *See id.* at cls. 8–10, 15. They target similar structure and functionality but modify minor details, including the placement of the wearable device (teeth/wrist/ear v.

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ear/wrist), terminology ("semiconductor sources" v. "light emitting diodes"), and wavelength description ("plurality of optical wavelengths" v. "one or more" wavelengths). *Id.*

Because none of the limitations outside of Claim 1 are meaningful for purposes of § 101, none require 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: The asserted claims are generally directed to the abstract idea of collecting, processing, and storing 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 '455 patent alleges an "unmet need for non-invasive glucose monitoring" with "adequate sensitivity and selectivity, along with repeatability of the results." *See* '455 patent at 2:66–3:3. According to the patent, 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 3:6–25. The '455 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 the interference." *Id.* at 21:36–57. The patent further explains that the "measurement device may also benefit from communicating the data to the 'cloud'" to provide a "panoramic, high-definition, relatively comprehensive view of a patient" that doctors and patients can analyze. *Id.* at 35:66–36:17.

Claim 1 is thus directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis. The claimed system is configured to measure a physiological parameter by observing its relationship to light—specifically, it measures the correlation between two naturally occurring phenomena, which is an abstract natural law. *See, e.g.*, *id.* at cl. 1, 21:36–57; *Cleveland*

Clinic, 859 F.3d at 1361 (holding claims directed to measuring the relationship between naturally occurring phenomena are directed to an abstract natural law); *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 system is adapted to improve the signal-to-noise ratio during the measurement process 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"). And once the light-based data is collected, the system can transmit it to a smart phone or tablet, which processes, stores, and displays the data.

Claim 1 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; data transmission or remote storage; or any sort of measurement technique. 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" (e.g., measuring natural phenomena). *See RecogniCorp, LLC v. Nintendo Co., Ltd.*, 855 F.3d 1322, 1327 (Fed. Cir. 2017). And collecting, processing, storing, and transmitting information have long been held abstract. *See, e.g.*, *Elec. Power Grp., LLC v. Alstom S.A.*, 830 F.3d 1350, 1353–54 (Fed. Cir. 2016) (collecting cases); *Content Extraction*, 776 F.3d at 1347 ("The concept of data collection, recognition, and storage is undisputedly well-known.").

Although Claim 1 requires concrete, tangible components such as a "wearable device," "semiconductor sources," and a "smart phone or tablet," "the specification makes clear that the recited physical components merely provide a generic environment in which to carry out the abstract idea" of collecting, processing, and storing data. *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, processing, and storing light-based physiological data through conventional technology and result-oriented steps. *See In re Gopalan*, 809 F. App'x 942, 945–46 (Fed. Cir. 2020).

***Alice* Step Two: The asserted claims do 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. 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* Ex. E1-E18; Cover Pleading at § III.G; *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").

Claim 1, moreover, does not recite any new or improved algorithm, measurement method, or hardware design. *See Elec. Power Grp.*, 830 F.3d at 1354 ("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, 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."). In other words, the claim does not offer any specific technological solution to improve the functioning of the sensors, hardware, or anything else, but instead describes an interconnected system of conventional components that mirrors existing fitness tracking paradigms.

Finally, Claim 1 follows a generic data-processing pipeline, describing a system that: (1) collects, (2) processes, (3) transmits, and (4) stores data. This is a classic data-processing and transmission sequence—the kind the Federal Circuit has consistently held to be ineligible when implemented using generic computing equipment. *See, e.g.*, *Two-Way Media Ltd. v. Comcast Cable Commc'ns, LLC*, 874 F.3d 1329, 1339 (Fed. Cir. 2017) (holding that a "conventional ordering of steps . . . with conventional technology to achieve its desired result" is insufficient to provide an inventive concept). And 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.*, '455 patent at 16:66–17:3 ("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 45:43–62 (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"). At bottom, Claim 1, whether considered limitation-by-limitation or as a whole, does not sufficiently transform the abstract idea of collecting, processing, and storing physiological data into a patentable invention.

'455 Patent – Claim 1	**Subject Matter Eligibility Contentions**
[1pre] A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	Claim 1 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 is generally directed to the abstract idea of collecting, processing, and storing 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. 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. E1-E18 at all disclosures for [1pre]; Cover Pleading at § III.G.
[1a] a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, and	As explained above, Claim 1 is generally directed to the abstract idea of collecting, processing, and storing 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. E1-E18 at all disclosures for [1a]; Cover Pleading at § III.G.
[1b] including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	As explained above, Claim 1 is generally directed to the abstract idea of collecting, processing, and storing 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. E1-E18 at all disclosures for [1b]; Cover Pleading at § Cover Pleading at § III.G.
[1c] the 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;	As explained above, Claim 1 is generally directed to the abstract idea of collecting, processing, and storing 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. E1-E18 at all disclosures for [1c]; Cover Pleading at § III.G.
[1d] the wearable device further comprising 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, processing, and storing 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. E1-E18 at all disclosures for [1d]; Cover Pleading at § III.G.

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[1e] 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, processing, and storing 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. E1-E18 at all disclosures for [1e]; Cover Pleading at § III.G.
[1f] 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 spatially separated detectors;	As explained above, Claim 1 is generally directed to the abstract idea of collecting, processing, and storing 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. E1-E18 at all disclosures for [1f]; Cover Pleading at § III.G.
[1g] the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	As explained above, Claim 1 is generally directed to the abstract idea of collecting, processing, and storing 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. E1-E18 at all disclosures for [1g]; Cover Pleading at § III.G.
[1h] wherein the output signal is indicative of one or more of the physiological parameters;	As explained above, Claim 1 is generally directed to the abstract idea of collecting, processing, and storing 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. E1-E18 at all disclosures for [1h]; Cover Pleading at § III.G.

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[1i] 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;	As explained above, Claim 1 is generally directed to the abstract idea of collecting, processing, and storing 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. E1-E18 at all disclosures for [1i]; Cover Pleading at § III.G.
[1j] the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off,	As explained above, Claim 1 is generally directed to the abstract idea of collecting, processing, and storing 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. E1-E18 at all disclosures for [1j]; Cover Pleading at § III.G.
[1k] generate a second signal responsive to light received while at least one of the semiconductor sources is on; and	As explained above, Claim 1 is generally directed to the abstract idea of collecting, processing, and storing 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. E1-E18 at all disclosures for [1k]; Cover Pleading at § III.G.
[1l] 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, processing, and storing 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. E1-E18 at all disclosures for [1l]; Cover Pleading at § III.G.
[1m] wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	As explained above, Claim 1 is generally directed to the abstract idea of collecting, processing, and storing light-based physiological data for analysis.

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	At the time of the alleged invention, this element was well-understood, routine, and/or conventional. *See, e.g.*, Ex. E1-E18 at all disclosures for [1m]; Cover Pleading at § III.G.

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EXHIBIT E1

U.S. Pat. No. 11,160,455 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 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 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 E2-E18, 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 '455 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 '455 Patent.

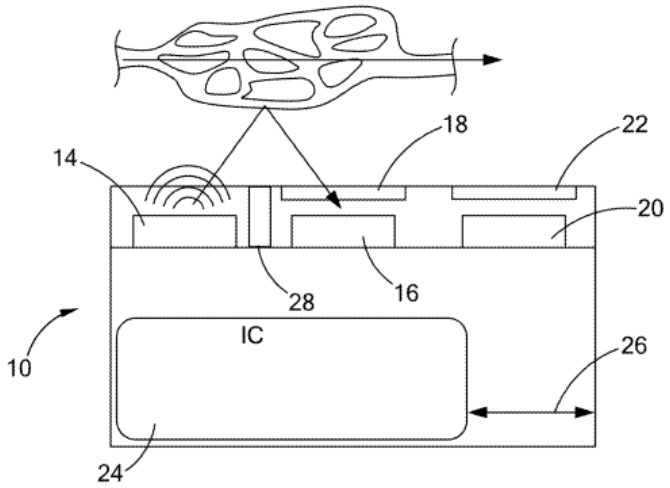
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that 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.

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EXHIBIT E1

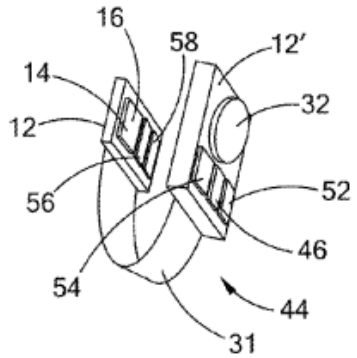
’455 Patent	Basu
Claim 1	
1[pre] A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Basu discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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]

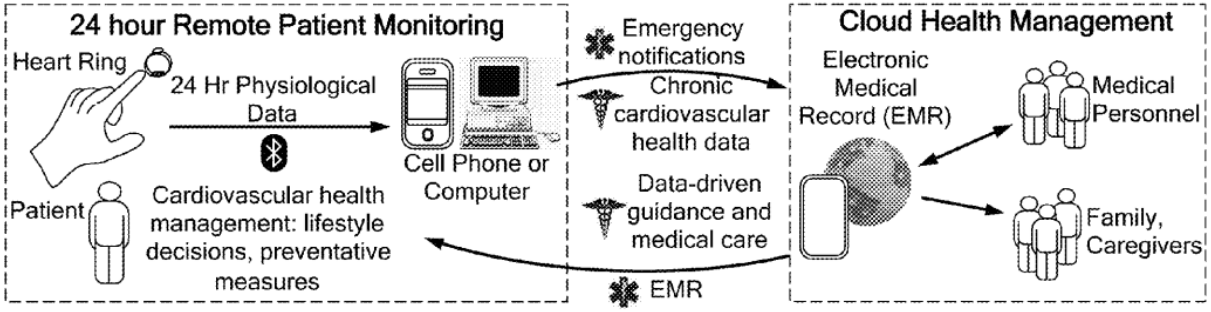
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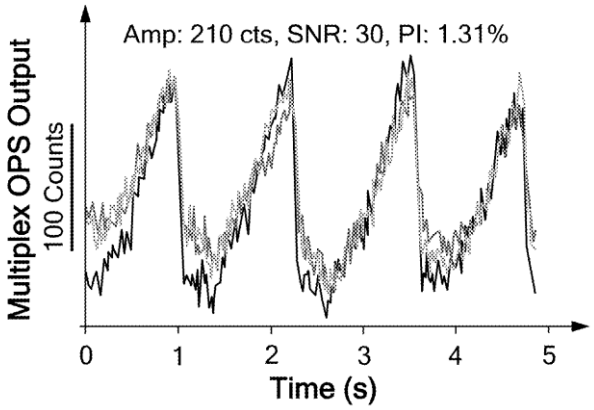
’455 Patent	Basu
	In a first approach, this device utilizes electronic optical proximity sensors (OPS) 10 to sense a patient's heart rate. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. Variations of OPS are widely 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]  FIG. 1 Basu at Fig. 1 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

’455 Patent	Basu
	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] 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] In another example shown in FIG. 13, a miniature OPS device for an earlobe in the form of an ear clip 44 may have PCB boards on both sides of the earlobe. In the example of FIG. 13, the sensors are configured to be arranged on the underside of the earlobe, facing the earlobe. The wireless communication devices are arranged on the outside. The boards may, for example, be connected as shown with a clip 31 with embedded electrical connections. Alternatively, a post connected to one board may snap into a receiving socket connected to the other board. The latter solution provides a secure attachment of the sensor for individuals with pierced ears. Use of the ear as a sensor location may be preferred for minimizing motion artifacts though use of accelerometers and other motion correction

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	measurements are possible. In addition to a clip the OPS sensors could be placed against the anterior auricular region or posterior auricular region instead of the lobe itself incorporated into a discrete accessory. Note the OPS sensor also could be integrated into multifunctional earpiece devices such as blue-tooth headsets. Basu at [0072]  FIG. 13 Basu at Fig.13 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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	 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. 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 [0064 & 0066]

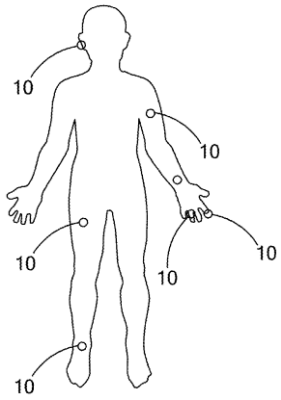
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	 FIG. 16 Basu at Fig. 16. For pulse oximetry, the Silicon Labs Si1143 was used, a triple-LED digital OPS 10, as is schematically indicated in FIG. 17. The chip 48 includes a photodiode 50 with FWHM spectral bandwidth of 600-1000 nm, 3 LED drivers, 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

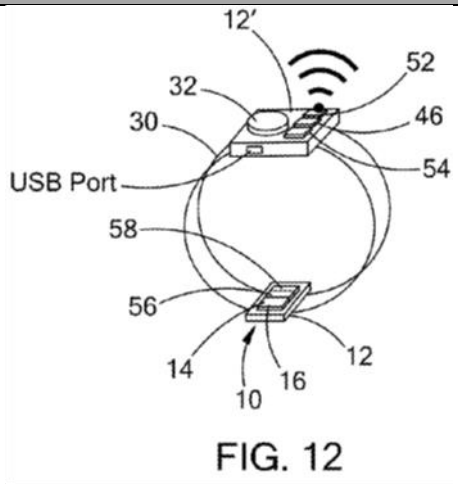
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	photoplethysmography waveforms are shown in the same graph. The signal-to-noise ratio is somewhat lower than similar measurements taken with the VCNL4000, but this is likely due to the smaller LED current used (30 mA vs. 100 mA). The pulsation index 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). The measurement protocol for the Si1143 is identical to the single-LED experiment. Although commercially available VCNL4000 and Si1143 sensors were used for the OPS 10, this technique can be used with any suitable digital OPS 10, reflective light sensor, photo interrupter, or similar component. Examples include (but are not limited to) the OSRAM 770/773, the Avago APDS-9190, and the Intersil ISL29011/21/27/28. Examples of Multi-LED optical proximity sensors include the Rohm BH1771GLC, as well as the Si1141/42/43 series. While the schematic setup shown in FIG. 17 for operating a pulse oximetry sensor according to the present invention depicts three LEDs 14, 14′, and 15, two LEDs, for example LED 14 and LED 15, are sufficient for performing the required measurements as discussed above. Basu at [0104]-]0108]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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] a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Basu discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. 1.An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having

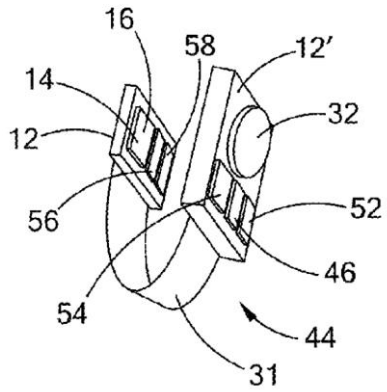
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	a first IR LED emitting light having an infrared wavelength, a first IR photo detector sensitive to the infrared wavelength; and an electronic integrated circuit with an amplifier for amplifying a signal detected by the photo detector, an analog to 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. 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] 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]. 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] The OPS 10 was placed with fixed pressure in multiple locations, including the fingertip, an earlobe, and upper finger (to simulate a ring sensor). A metal backing was added to the OPS 10 on the opposite side of the earlobe to improve the reflectance signal. One example of an OPS formed as an ear clip 44 is shown in FIG. 13. Those elements that are placed on the board 12′ of the battery 32 in FIG. 12 are placed

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	on the outside of the ear clip 44 and face away from the person's head, shown in FIG. 13 on the right side. The battery 32 may additionally be arranged to provide a reflective surface for the light emitted by the LED 14 toward the photodiode 16. A button cell battery is well suited for this purpose due to its planar metallic end facing the LED 14 and the photodiode 16. The OPS 10 is placed on the inside of the ear clip 44, facing the earlobe from the side of the person's head. It is evident, that the locations may also be reversed without leaving the scope of the present invention. Basu at [0088]. 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]  FIG. 8 Basu at Fig. 8.

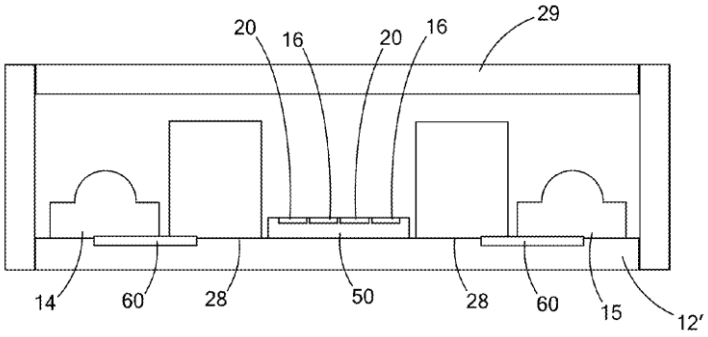
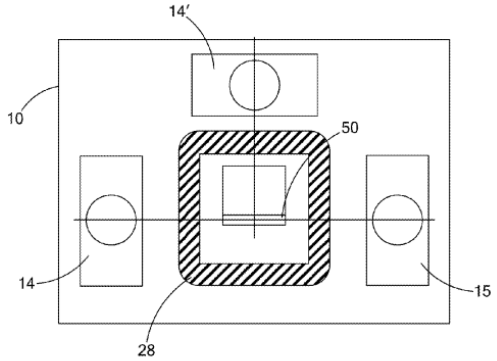
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	 FIG. 12 Basu at Fig. 12. FIG. 12: A schematic of an alternative proposed sensor system for heart rate monitoring, with parts drawn approximately to scale; Basu at [0026].

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	 FIG. 13 Basu at Fig. 13. FIG. 13: A schematic of a further alternative proposed sensor system for heart rate monitoring, with parts drawn approximately to scale; Basu at [0027]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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] including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources	Basu discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;

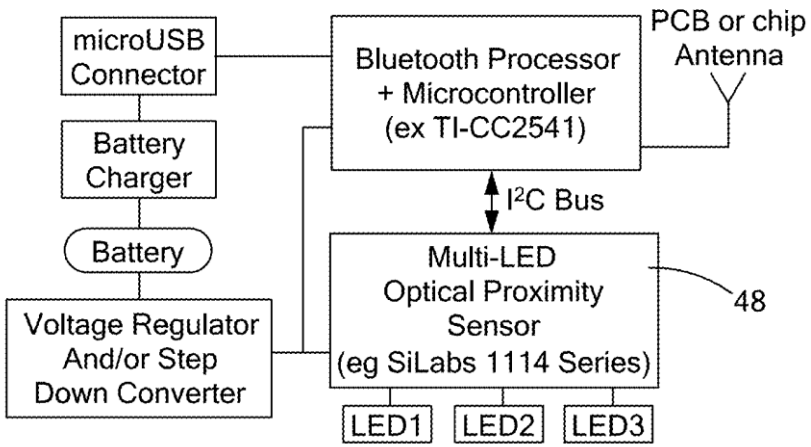
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configured to generate an output optical light having a plurality of optical wavelengths;	1.An optical proximity sensor assembly for cardiovascular monitoring, the optical proximity sensor assembly comprising: an optical proximity sensor having a first 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. 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] 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

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	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] 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 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]

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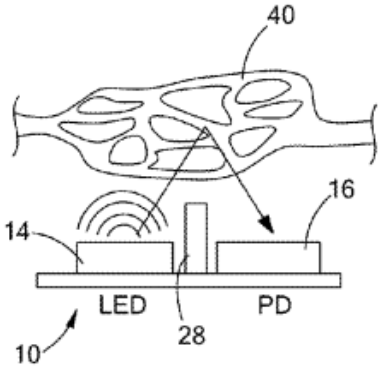
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	 FIG. 14 Basu at Fig. 14  FIG. 15 Basu at Fig. 15. Thus, suitable wavelengths for pulse oximetry are in the range of about 600 nm to 700 nm for the red LED 15, preferably between about 650 nm and 670 nm, and about 850 nm to 950 nm, preferably about 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

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	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] 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] While the schematic setup shown in FIG. 17 for operating a pulse oximetry sensor according to the present invention depicts three LEDs 14, 14′, and 15, two LEDs, for example LED 14 and LED 15, are sufficient for performing the required measurements as discussed above. Basu at [0108]

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	 FIG. 17 Basu at Fig. 17 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 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.

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	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.
1[c] the 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;	Basu discloses or renders obvious the 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 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 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

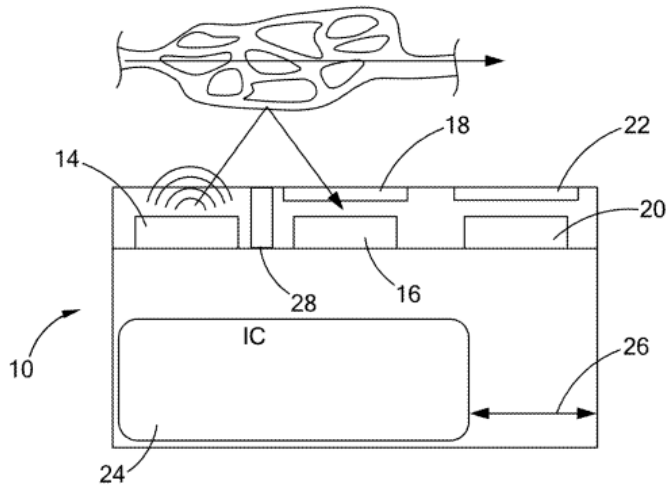
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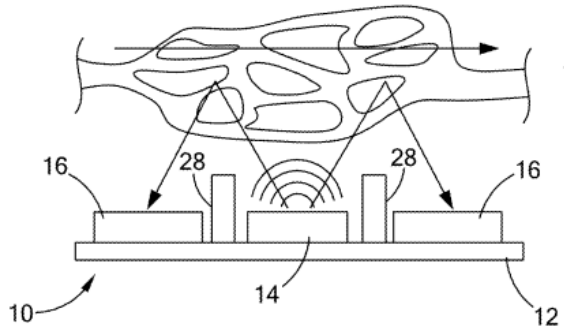
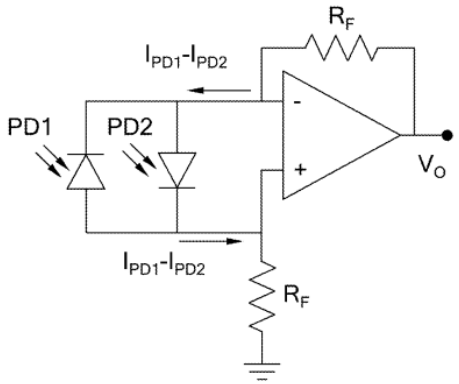
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	to improve the reflectance signal. In some embodiments, the metal backing may be provided by the battery 32. Basu at [0045]  FIG. 3D Basu at Fig. 3D The light travels from the LED 14 through the finger to the blood vessel and tissue, where it is partially 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] 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

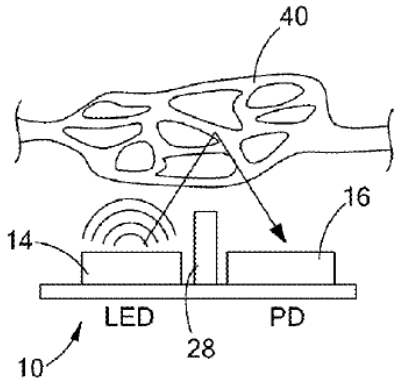
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	red LED 15 and one IR LED 14 are arranged on opposite sides of a photo detector 50 that includes photodiodes 16 and 20 sensitive to different spectral ranges, here red for photodiode 20 and near IR for photodiode 16. Each of the LEDs 14 and 15 is 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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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] the wearable device further comprising 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 the wearable device further comprising 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

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	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 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. 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].

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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] The OPS 10 further includes an IR photodiode 16, a visible light blocking filter 18, an optical barrier 28. An optional second photodiode 20, sensitive to visible light, may serve as an ambient lights sensor (ALS), useful for ambient noise cancellation. Basu at [0038]

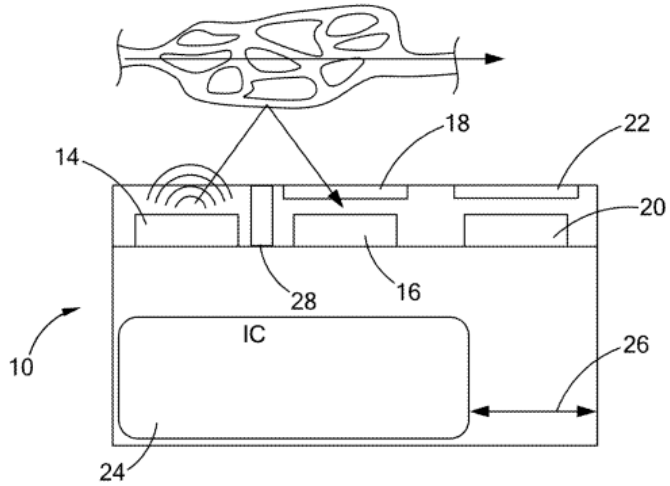
’455 Patent	Basu
	 FIG. 1 Basu at Fig. 1. An OPS 10 for detecting pulse wave velocity uses a novel sensor setup which detects how fast a pulse wave travels from one side of the sensor to the other side of the sensor (FIGS. 6A and 7). This approach can be robust to environmental noise and to drift of 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]

’455 Patent	Basu
	 FIG. 6A Basu at Fig. 6.  FIG. 7 Basu at Fig. 7. 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

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	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]  FIG. 3D Basu at Fig. 3D 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.

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	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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]wherein the detection system is configured to be synchronized to the light source;	Basu discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. 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.

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	Basu at [0036]  FIG. 1 Basu at Fig. 1. 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] 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,

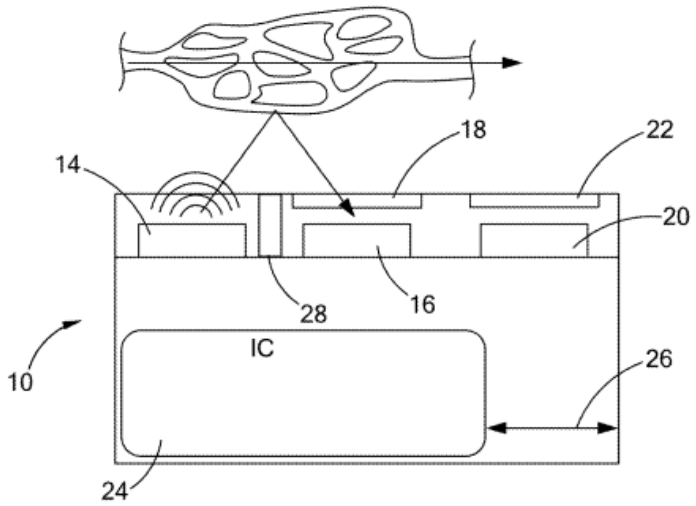
’455 Patent	Basu
	and the on-chip signal processing utilizes a bandpass or lock-in filtering scheme to remove all the other signal components. This technique effectively eliminates both high and low frequency noise without limiting the bandwidth. It also diminishes the impact of sunlight, which occurs 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] Abstract One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 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 spatially separated 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 spatially separated 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 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

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	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. 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 photo detector 50 includes photodiodes sensitive to all three wavelengths. Basu at [0109] 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

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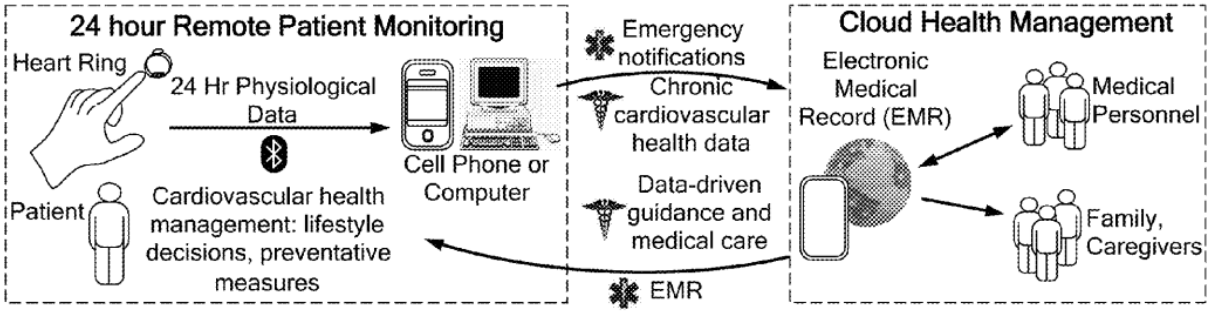
’455 Patent	Basu
	with blood pressure. The device works in the near infrared (˜950 nm) range. By putting two generally identical photodiodes 16 in two different locations on a circuit board 12 symmetrically on opposite sides of an IR LED 14, the time it takes for a pulse wave to move through the vessel 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 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 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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of 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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’455 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.
1[g] the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Basu discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. 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]

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	 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. 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 [0064 & 0066] 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

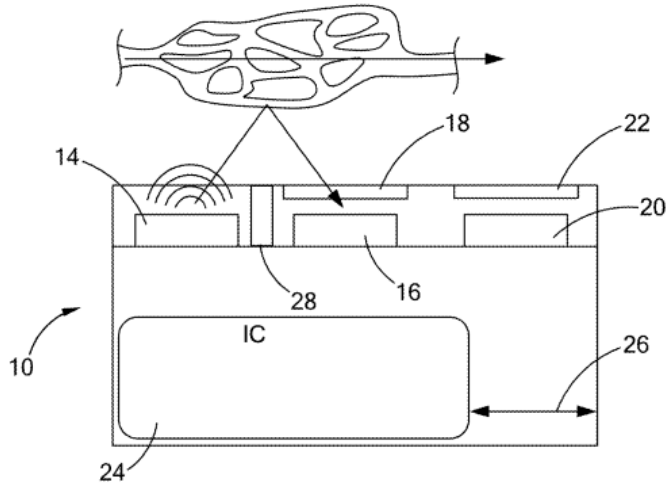
’455 Patent	Basu
	Basu at [0078] In summary, OPS 10 have traditionally been used in robotics and smart phones, but here we show that OPS 10 perform all photoplethysmography functions in a single, 4 mm-by-4 mm package which links directly to a microcontroller via a standard serial interface. Basu at [0110] 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.
1[h] wherein the output signal is indicative of one or more of the physiological parameters;	Basu discloses or renders obvious the output signal is indicative of one or more of the 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

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	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] 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.

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	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). 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. 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.
1[i] 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;	Basu discloses or renders obvious 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. 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

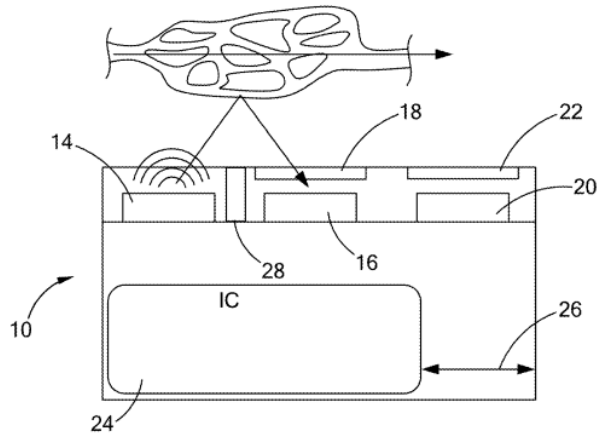
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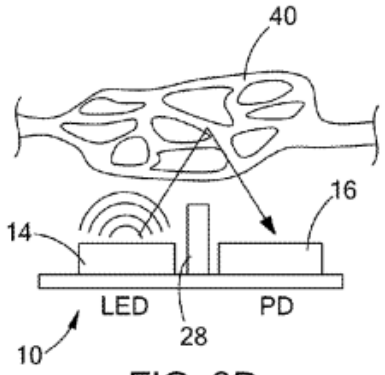
’455 Patent	Basu
	The influx of ambient light can be measured during OFF phases of the LED 14. The ambient light component can then be subtracted from the photo detector signal during ON phases to provide a sensitivity offset for proper calibration. This technique being similar in concept to lock-in 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] 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]  FIG. 1 Basu at Fig. 1.

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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. 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. Basu at Para [0093] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 semiconductor sources are off,	Basu discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off. 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] The OPS 10 further includes an IR photodiode 16, a visible light blocking filter 18, an optical barrier 28. An optional second photodiode 20, sensitive to visible light, may serve as an ambient lights sensor (ALS), useful for ambient noise cancellation. Basu at [0038]. 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

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	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[k] generate a second signal responsive to light received while at least one of the semiconductor sources is on; and	Basu discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on; and. 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.

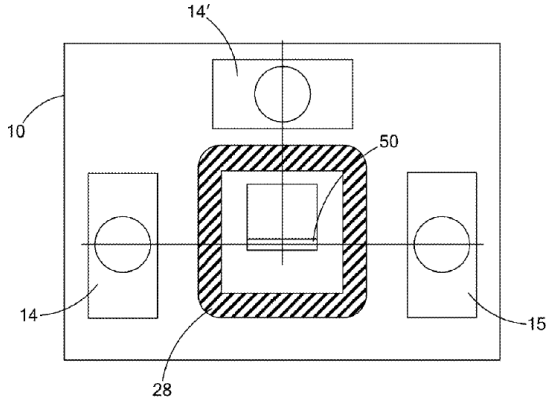
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	Basu at Abstract As, for example, shown in FIG. 1, An OPS 10 includes an infrared (IR) light emitter, such as an IR LED 14, and an integrated circuit (IC) 24 providing LED drivers modulating the infrared light emitter at a fixed or varying frequency. 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]  FIG. 1 Basu at Fig. 1. 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

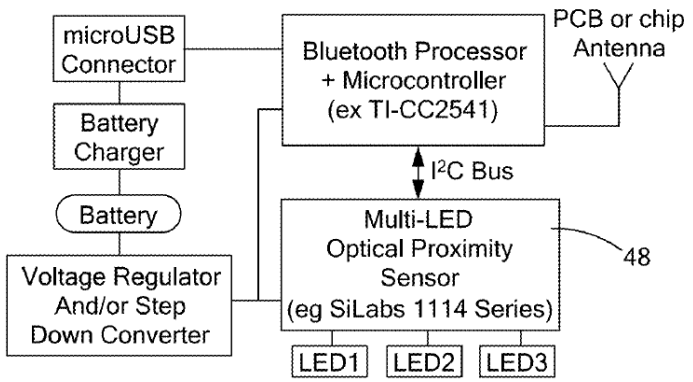
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	sensitivity offset for proper calibration. This technique being similar in concept to lock-in detection or to electronic noise cancellation, it improves the signal to noise ratio and reduces the impact of noise and ambient light. Basu at [0037] FIGS. 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]  FIG. 3D Basu at Fig. 3D

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	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] 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[l] increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Basu discloses the detection system further configured to: increase the signal-to-noise ratio by comparing the first signal and the second signal.

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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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Basu discloses or renders obvious wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible 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

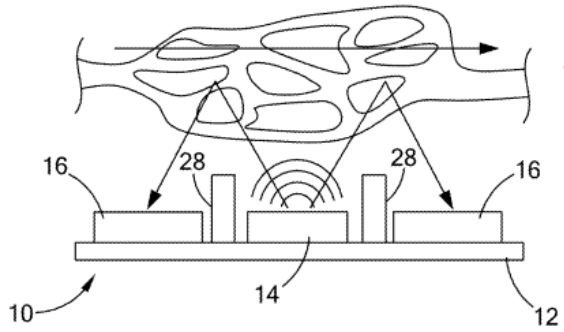
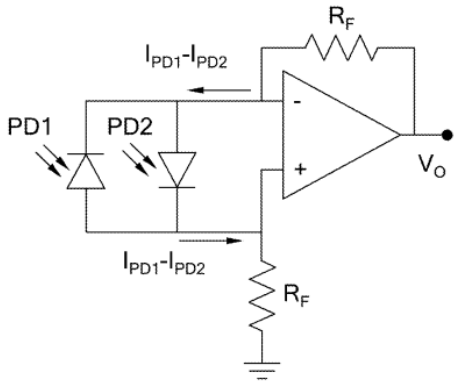
’455 Patent	Basu
	Also, several sensors may be placed on a person's skin along a vascular path to obtain data relating to blood flow and artery or vascular stiffness this type of measurement is referred to as pulse wave velocity and is an indicator of cardiovascular health. Basu at [0009] This invention 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 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 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.

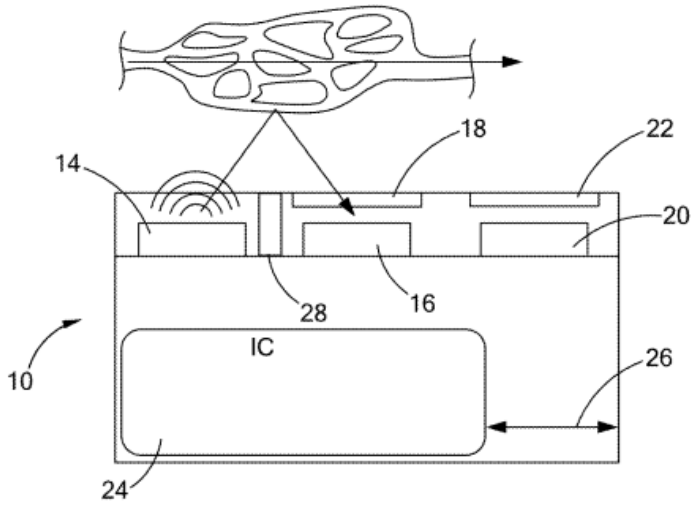
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	Results from the Multi-LED are shown in FIG. 16. This experiment used three LEDs 14, 14′, and 15 placed 3 mm from a photo detector 50 formed by a Si1143 sensor as indicated in FIG. 15. A single measurement was taken at the fingertip at a fixed, moderate 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). Basu at [0103-0105]  FIG. 15 Basu at Fig. 15

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	 FIG. 17 Basu at Fig. 17 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 2	
2. The system of claim 1, wherein the plurality of	See claim 1 above.

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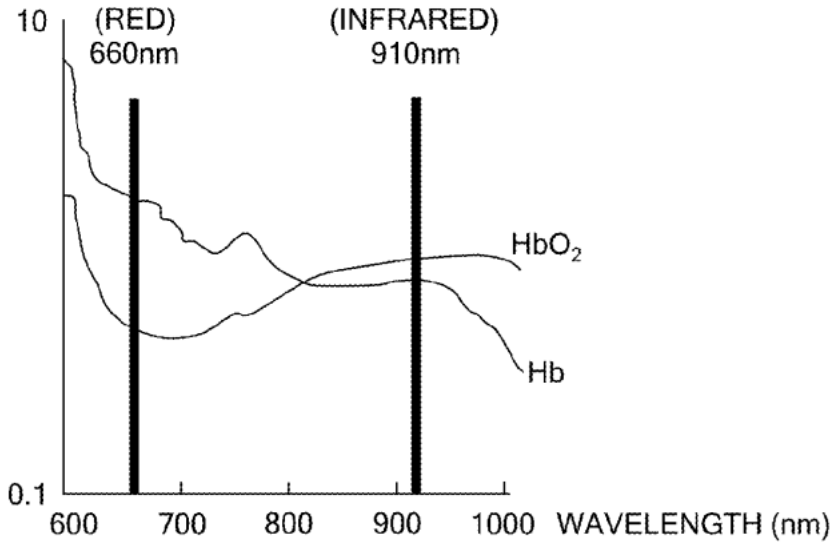
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semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	Basu discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. The photo detector 50 includes photodiodes sensitive to all three wavelengths. Basu at [0109] 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]

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	 FIG. 6A Basu at Fig. 6.  FIG. 7 Basu at Fig. 7. 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.

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	Basu at [0093]  FIG. 1 Basu at Fig. 1. 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] Abstract

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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 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	See claim 2 above. Basu discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. 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. Basu at [0047] 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] 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. 18 Basu at Fig. 18 For pulse oximetry, a minimum of two LEDs 14 and 15 is required, typically in the 650-950 nm range, with one LED 14 emitting in the near IR and the other LED 15 emitting in the red spectral range as illustrated in FIG. 14. A wide spectral sensitivity in the photo detector 50 is preferable. Alternatively, two photodiodes may be used with different spectral sensitivity ranges. Basu at [0097] 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

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	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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Basu discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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

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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 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 wearable device adapted to be placed on a wrist or an ear of a user,	Basu discloses or renders obvious a wearable device adapted to be placed on a wrist or an ear of a user. See above at claim 1[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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] including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Basu discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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] the wearable device comprising one or more	Basu discloses or renders obvious the 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.

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lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue;	See above at claim 1[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 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] the wearable device further comprising 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 the wearable device further comprising 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. 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 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] wherein the detection system is configured to be synchronized to the light source;	Basu discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. See above at claim 1[e]

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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.
8[f] 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 spatially separated 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 spatially separated detectors. See above at claim 1[f] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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] the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is	Basu discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; See above at claim 1[g] One of ordinary skill would find this limitation disclosed either expressly 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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configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[h] wherein the output signal is indicative of one or more of the physiological parameters;	Basu discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[i] 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; and	Basu discloses or renders obvious 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. See above at claim 1[i] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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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’455 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.
8[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. See above at claim 1[j] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[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. See above at claim 1[k] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[l] increase the signal-to-noise ratio by comparing the	Basu discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal.

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'455 Patent	**Basu**
first signal and the second signal; and	See above at claim 1[l] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[m] wherein the plurality of semiconductor sources comprises six light emitting diodes.	Basu discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. See above 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 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 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 8 above. Basu discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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.
Claim 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	See claim 9 above. Basu discloses or renders obvious the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. See above at claim 1[m] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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 15	
15[pre] A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Basu discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. See above at claim 1[pre]

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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.
15[a] a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Basu discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, See above at claim 1[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[b]including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Basu discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;, See above at claim 1[b] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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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15[c] the 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;	Basu discloses or renders obvious the 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. See above at claim 1[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 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.
15[d] the wearable device further comprising 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 the wearable device further comprising 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,. 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 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.
15[e] wherein the detection system is configured to be synchronized to the light source;	Basu discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. 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

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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 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.
15[f] 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 spatially separated detectors;	Basu discloses 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 spatially separated detectors. See above at claim 1[f] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.
15[g] the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed	Basu discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link See above at claim 1[g] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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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output signal is configured to be transmitted over a wireless transmission link;	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.
15[h] wherein the output signal is indicative of one or more of the physiological parameters;	Basu discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[i] 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; and	Basu discloses or renders obvious 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. See above at claim 1[i] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[j] the detection system further configured to:	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.

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generate a first signal responsive to light received while the light emitting diodes are off,	See above at claim 1[j] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[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 semiconductor sources is on;and See above at claim 1[k] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[l] increase the signal-to-noise ratio by comparing the first signal and the second signal;	Basu discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l]

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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.
15[m] wherein the plurality of semiconductor sources comprises six light emitting diodes,	Basu discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, See above 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 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.
15[n] wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and	Basu discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 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.
15[o] wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Basu discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. See above at claim 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 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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EXHIBIT E2

U.S. Pat. No. 11,160,455 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 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 B2 (the "'455 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 E1 and E3-E18, 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 '455 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 '455 Patent.

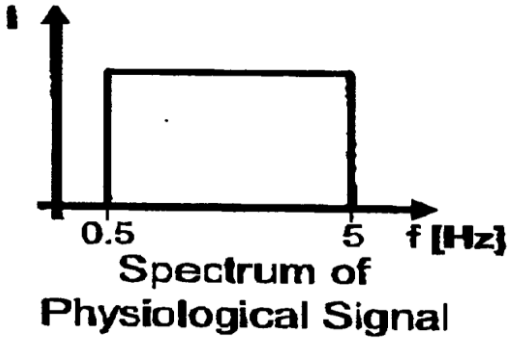
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that 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.

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EXHIBIT E2

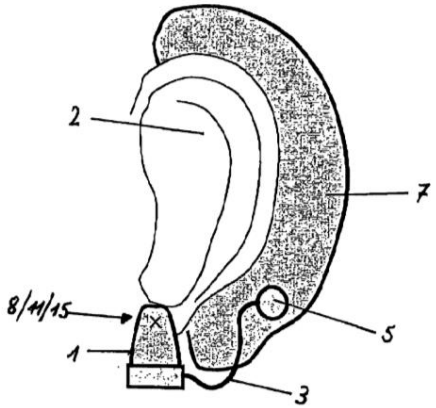
’455 Patent	Carlson
Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Carlson discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. The present invention refers to a configuration for the acquisition and/or monitoring of medical data according to the introduction of claim 1 and a method for the acquisition and/or monitoring of the state of health or of medical data of a person or an animal. Carlson at [0001] 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] 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: Carlson at [0022] 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]

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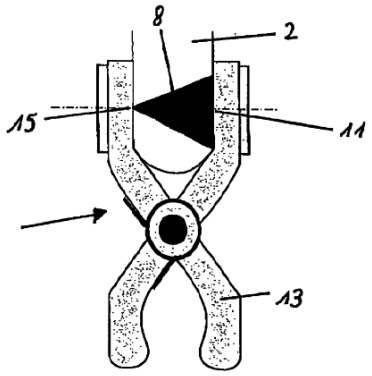
’455 Patent	Carlson
	 Figure 7a Carlson at Fig. 7a Furthermore, all the above mentioned means for improving the measurement of the oxygen saturation of blood using a light source can, of course, also be used by any further kind of measurements using a light source such as, e.g., non-invasive monitoring 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

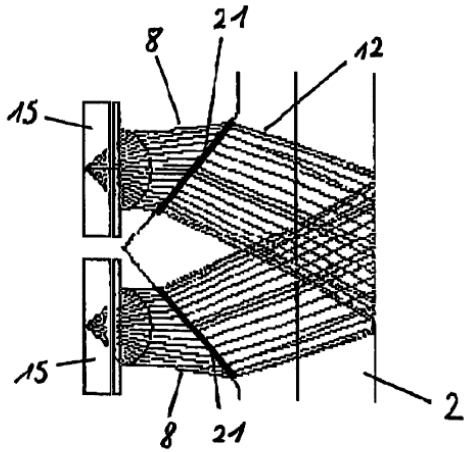
’455 Patent	Carlson
	help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person using the pulsoximetric sensor monitoring configuration. Carlson at [0078] One of ordinary skill would find this limitation disclosed either 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]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, and	Carlson discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. 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] Further preferred embodiment variants, in particular of an ear sensor employed for measurements by means of pulsoximeter, are found in the international patent application WO 02/089 663 which herewith is included as an integral component of the present patent application. Carlson at [0029]

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	FIG. 1 schematically the arrangement of an ear clip for oximetric measurement; Carlson at [0032]  Figure 1 Carlson at Fig. 1 FIG. 2 schematically the ear clip of FIG. 1 in cross section view; Carlson at [0033]

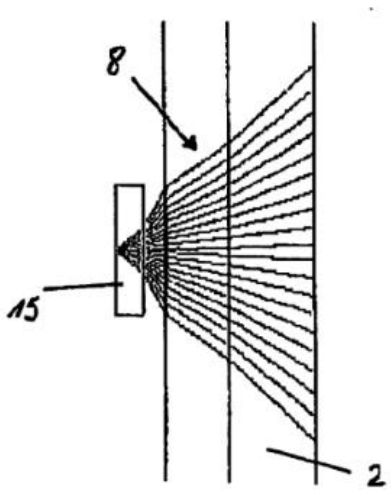
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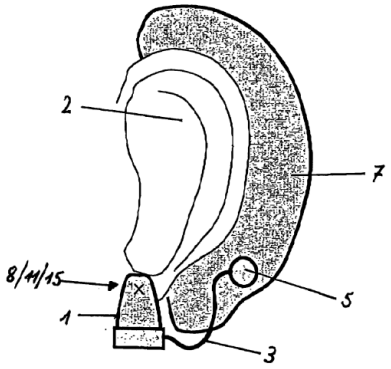
’455 Patent	Carlson
	 Figure 2 Carlson at Fig. 2 FIG. 1 shows schematically the arrangement of an ear sensor 1 which can be arranged in form of an ear clip. This sensor 1 can be arranged e.g. at an earlobe of ear 2. Furthermore, the sensor or ear clip is connected via a wire 3 and the connection 5 with 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 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] 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

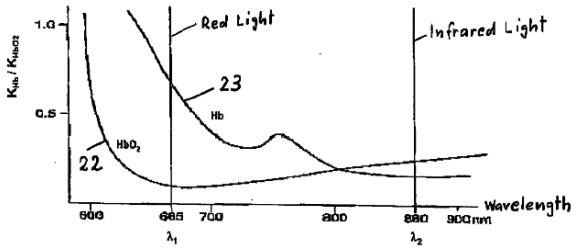
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	influence of environmental light or noise, respectively, can be reduced substantially by increasing the S/B ratio. First or all, the light beam is bundled and, in addition, the optical signal power can be increased. Carlson at [0054]  Figure 4 Carlson at Fig. 4 14. Configuration according to one of the claims 1 to 13, comprising mechanical fixing means for arranging the configuration at a human or animal tissue as e.g. at an earlobe of an ear, the means guaranteeing that the beam path between the light emitter and the light receiver is always co-linear with the optical axis of the light emitter and the light receiver. Carlson at Claim 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 Carlson, it

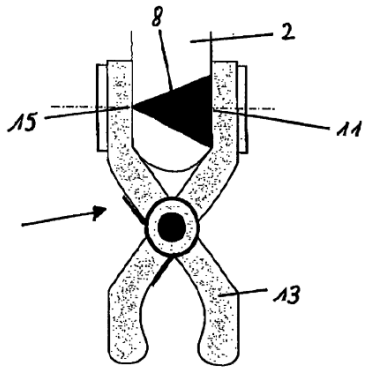
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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths	Carlson discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. 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 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. 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.

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	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, andnat 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. 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 [0011-0020] 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,

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	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. 3 schematically a light source to be used in an oximetric sensor without beam shaping optics; Carlson at [0034]  Figure 3 Carlson at Fig. 3

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	 Figure 1 Carlson at Fig. 1 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

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	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 λ_1 and λ_2 are indicated at which the pulsoximetric sensor is operated. Carlson at [0055]  Figure 5a Carlson at Fig. 5a 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

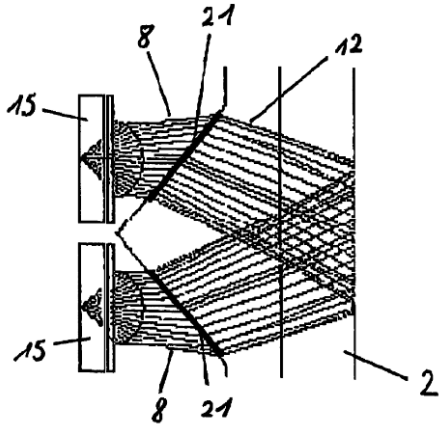
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	the various above mentioned and proposed means for improving the pulsoximetric monitoring to survey the health condition are not restricted to the measurement of transmitted light through a human or animal tissue. All the proposed means according 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. 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 [0075-0076]  Figure 2 Carlson at Fig. 2 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

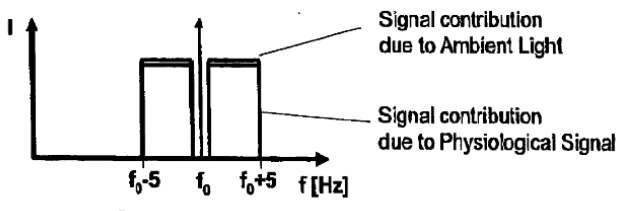
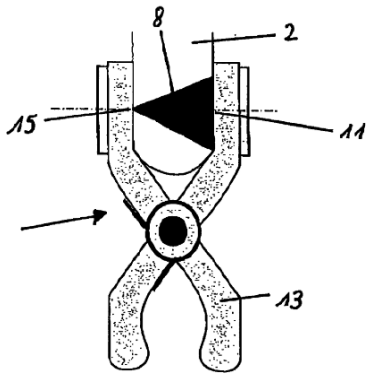
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	generated which can be transmitted to a respective person, to a medical doctor, to a hospital, etc. so that help can be organised. Furthermore, it is possible to include e.g. a so-called GPS device which at any time gives the location of the person 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[c]. the wearable device comprising one or more lenses to receive at least a portion of the output optical light and to deliver a lens output light to tissue;	Carlson discloses or renders obvious the wearable device comprising one or more lenses to receive at least a portion of the output optical light and to deliver a lens output light to tissue. 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] 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. 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;

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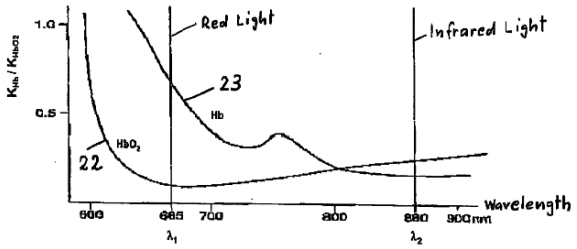
’455 Patent	Carlson
	at least one beam shaping optical element to direct the emitted light to a human or animal tissue and the light receiver in order to increase the optical signal power. The basic idea therefore is to use a beam-shaping element, such as e.g. diffractive or refractive lenses, to direct 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 [0010]-[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]. FIG. 4 schematically two light emitting sources for an oximetric sensor including beam shaping optics; Carlson at [0035]

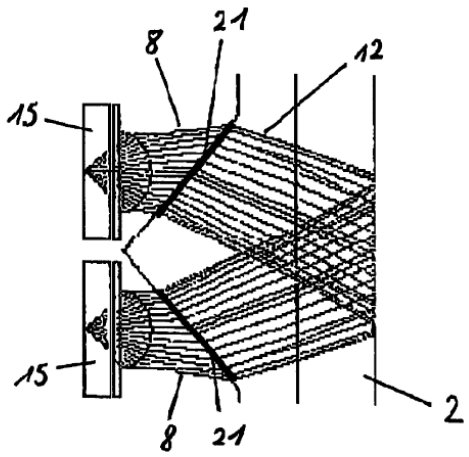
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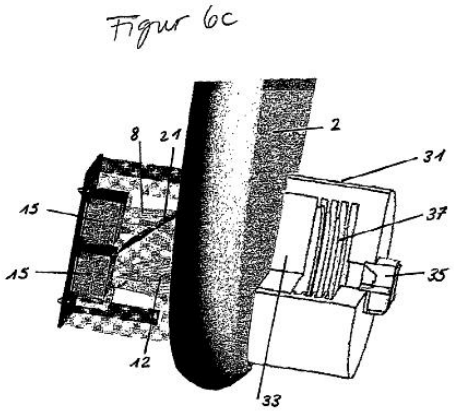
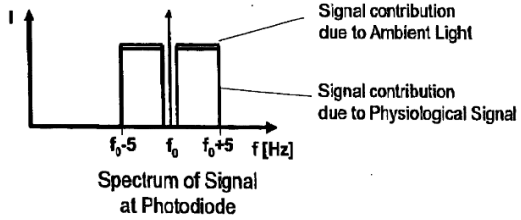
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	 Figure 4 Carlson at Fig. 4 FIG. 6 c an oximetric sensor in perspective view, containing optical lenses, filters and geometrical baffles; Carlson at [0041] FIG. 8 a diagram showing power spectrum of physiological signals and ambient light with phase shifting or modulation of the light source of a sensor; Carlson at [0045]

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	 Figure 8 Carlson at Fig. 8 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]  Figure 2

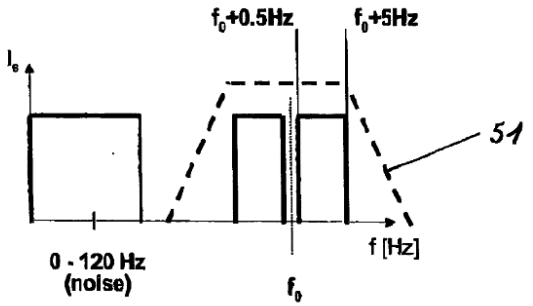
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	Carlson at Fig. 2 Therefore, it is proposed, as shown in FIG. 4, to use beam shaping optics 20 to direct the emitted optical radiation 8 emitted from the two LEDs 15 to the middle of the earlobe. As it is shown clearly in FIG. 4, using the beam shaping 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. 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 [0054]-[0055].  Figure 5a Carlson at Fig. 5a 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.

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	Carlson at [0058]  Figure 4 Carlson at Fig. 4 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]

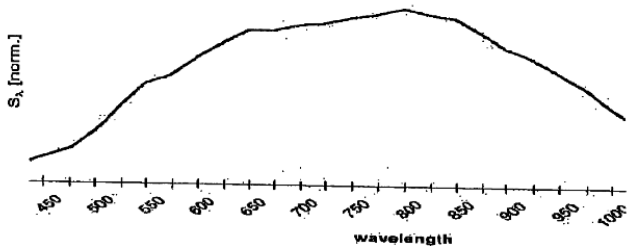
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	 Carlson at Fig. 6c Again, it is of course possible to combine the light source modulation as described with reference to FIGS. 8 and 9 with any of the prior means such as the sensor architecture, as shown with respect to FIGS. 5 and 6 and with beam shaping optics, as described in FIG. 4. Carlson at [0071]  Figure 8 Carlson at Fig. 8

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	 Figure 9 Carlson at Fig. 9 2. Configuration according to claim 1 and at least one beam shaping optical element to direct the emitted light into a human or animal tissue and the light receiver. 3. Configuration according to claim 2, characterised in that the beam shaping element is a diffractive or refractive beam shaping element. 4. Configuration according to one of the claims 1 to 3, characterised in that at least two light emitting sources, such as LEDs, are arranged and that two beam shaping elements are arranged to direct the emitted light into the same area within the human or animal tissue and that the light receiving element is a photo detecting element. Carlson at claim 2-4 9. 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, etc., characterised by at least one measuring sensor for the acquisition of the medical data, such as the state of the cardiovascular and pulmonary 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, at least one beam shaping optical element to direct the emitted light into a human or animal tissue and the light receiver, and

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	at least one light trap such as geometrical baffles and/or an optical wavelength filter, such as a double band pass filter. Carlson at claim 9 14. Configuration according to one of the claims 1 to 13, comprising mechanical fixing means for arranging the configuration at a human or animal tissue as e.g. at an earlobe of an ear, the means guaranteeing that the beam path between the light emitter and the light receiver is always co-linear with the optical axis of the light emitter and the light receiver. 15. Configuration according to claim 14, wherein the means for fixing include a rigid frame with two U- or V-like arranged arms, where in the area of the one arm end the photo detector is arranged, and at the area of the other arm end a clamping mechanism within the LED is arranged screwably connected to the clamping mechanism, so that the distance between the light receiver and the light transmitter can be varied in such a way that the beam path between the light emitter and light receiver always is co-linear with the optical axis of the light emitter and light receiver. Carlson at claim 14-15 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 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]. the wearable device further comprising a detection system 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 the wearable device further comprising a detection system 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. 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:

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	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] 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 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] FIG. 5 b a diagram showing the spectrum sensitivity of a photo detecting element; Carlson at [0037]  Figure 5b Carlson at Fig. 5b

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	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 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] 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. Preferably, the two means, as described with reference to FIGS. 5 b and c, are combined as wavelength filters might be also light permeable in lower wavelengths areas and higher wavelengths areas which, by using a selective light detecting element, can be eliminated. 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. A further possibility for the better performance of a pulsoximetric sensor, is to arrange geometric means as e.g. so-called geometrical baffles (light trap). In FIG. 6 a, a part of a pulsoximetric sensor is shown, which means the part of the sensor after the transmitted light has passed, e.g. the earlobe of a human or

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	animal individual. Within the mentioned sensor part 31, after e.g. a double pass filter 33, circumferential extending baffles 37 are arranged to avoid stray light to reach the photo detecting element. Carlson at [0056]-[0059] 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. 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. 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. 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. 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

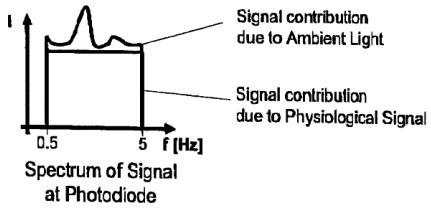
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	substantial, and therefore the deviations of the measured values compared to the real values can be dramatic. Besides the high influence of ambient light, also sunlight can have a dramatic influence, e.g. if a person is walking through streets with 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. 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 [0062]-[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

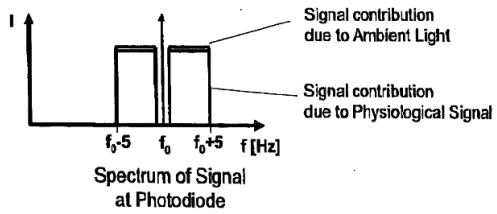
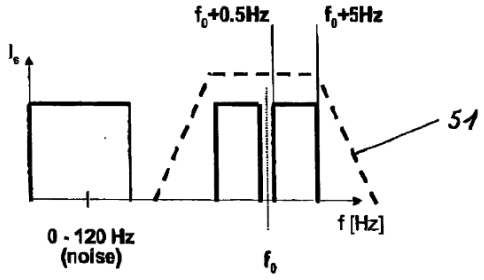
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	of the human or animal individual or due to swelling or contracting of the human or animal tissue during the measurement with the pulsoximetric sensor. In other words, if e.g. an earlobe of an ear 2, as shown in FIG. 2, would swell, than the distance 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] 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]

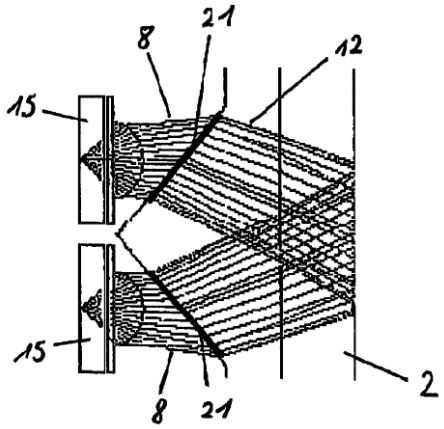
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. wherein the detection system is to be synchronized to the light source;	Carlson discloses or renders obvious the detection system is to be synchronized to the light source. 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]-[0020] 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:

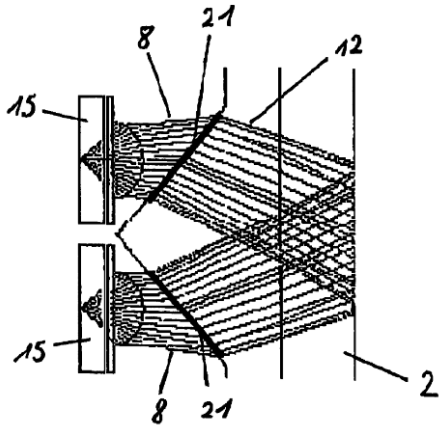
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	direct the emitted light or optical radiation, respectively, by using a beam shaping element, such as e.g. a diffractive or refractive lens to the human or animal tissue; receiving and detecting the emitted and shaped light with at least one light receiving element for determining the light transmitted through the tissue portion of the person or the animal. Carlson at [0022] 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 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] FIG. 7 c a diagram showing power spectrum of physiological signals and ambient light without phase shifting or modulation of the light source of a sensor, FIG. 8 a diagram showing power spectrum of physiological signals and ambient light with phase shifting or modulation of the light source of a sensor; FIG. 9 a principal of using band pass filtering means at a sensor with applied phase shifting or modulation of the light source at a sensor, and Carlson at [0044]-[0046]  Figure 7c Carlson at Fig. 7c

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	 Figure 8 Carlson at Fig. 8  Figure 9 Carlson at Fig. 9 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. 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]

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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. 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 [0069]-[0071]

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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 identified in Defendants’ Invalidity 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

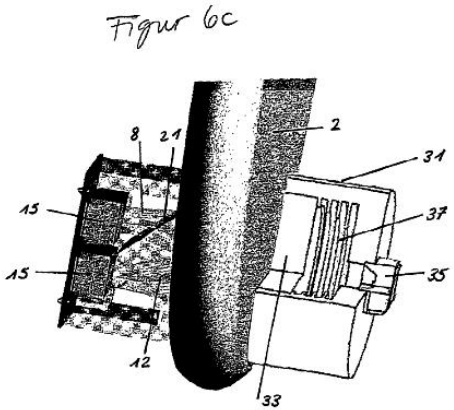
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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Carlson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system comprises 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 spatially separated 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 spatially separated 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. Carlson at [0005]-[0007] 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] FIG. 4 schematically two light emitting sources for an oximetric sensor including beam shaping optics; Carlson at [0035]

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	 Figure 4 Carlson at Fig. 4 FIG. 6 c an oximetric sensor in perspective view, containing optical lenses, filters and geometrical baffles; Carlson at [0041] 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

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	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 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]

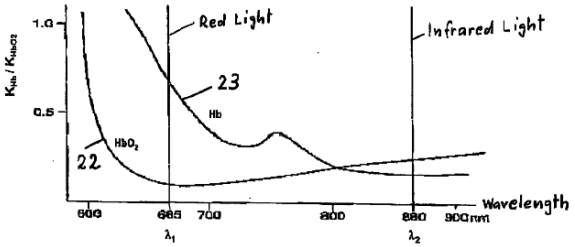
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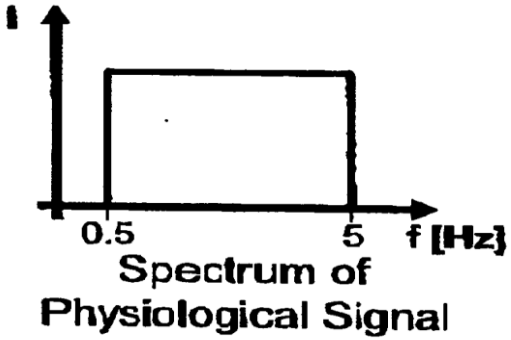
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	 Carlson at Fig. 6c One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet to receive and process at least a portion of the output signal, wherein the smart phone or tablet is to store and display the	Carlson discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet to receive and process at least a portion of the output signal, wherein the smart phone or tablet is to store and display the processed output signal, and wherein at least a portion of the processed output signal is to be transmitted over a wireless transmission link. 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]

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processed output signal, and wherein at least a portion of the processed output signal is to be transmitted over a wireless transmission link;	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.
1[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Carlson discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. The present invention refers to a configuration for the acquisition and/or monitoring of medical data according to the introduction of claim 1 and a method for the acquisition and/or monitoring of the state of health or of medical data of a person or an animal. Carlson at [0001] 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]

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	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] 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] 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

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	be in the range within approximately 500 nm to approximately 1000 nm. In addition, in FIG. 5 a the two wavelengths λ_1 and λ_2 are indicated at which the pulsoximetric sensor is operated. Carlson at [0055]  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]

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	 Figure 7a Carlson at Fig. 7a 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

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	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[i]. the wearable device to increase the signal-to-noise ratio by increasing light intensity of at least one of the semiconductor sources from an initial light intensity;	Carlson discloses or renders obvious the wearable device to increase the signal-to-noise ratio by increasing light intensity of at least one of the semiconductor sources from an initial light intensity. 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:

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	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]-[0020] 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] 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. 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. 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. 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. 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. 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

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	passing a tree, sunlight is attenuated and between the trees sunlight is influencing the measurement of the pulsoximetric sensor. 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 [0062]-[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

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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 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 semiconductor sources are off,	Carlson discloses or renders obvious the detection system further configured to generate a first signal responsive to light received while the semiconductor sources are off. 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

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	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]-[0020] 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. 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. 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

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	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. 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. 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. 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. 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

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	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 [0062]-[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 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

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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 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 semiconductor sources is on; and	Carlson discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the semiconductor sources is on. 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 to

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	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]-[0020] 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. 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. 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.

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	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. 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. 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. 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

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	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 [0062]-[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 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

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	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 the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. 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 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,

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	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]-[0020] 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] 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. 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.

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	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. 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. 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. 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. 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

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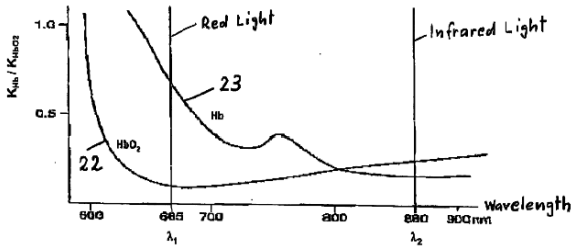
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	contribution which is shown at the top of the signal contribution due to physiological signal and which is due to ambient light, is very small and as a consequence is approximately neglectable. Any noise or sunlight within the range of 0 to 120 Hz, 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 [0062]-[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 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.

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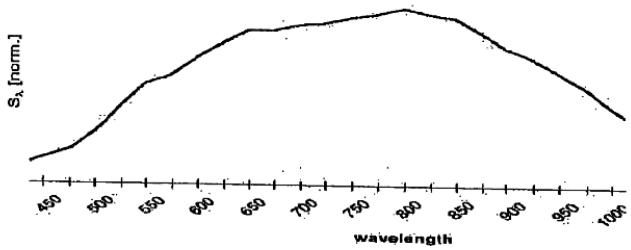
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	Carlson at [0073] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time 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 plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Carlson discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible 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]-[0013]

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	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. 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. Further specific designs of the configurations are described within the dependent claims. 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:

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	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 [0015]-[0025] 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 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 λ_1 and λ_2 are indicated at which the pulsoximetric sensor is operated. 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

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	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. Preferably, the two means, as described with reference to FIGS. 5 b and c, are combined as wavelength filters might be also light permeable in lower wavelengths areas and higher wavelengths areas which, by using a selective light detecting element, can be eliminated. 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 [0055]-[0058]  Figure 5a Carlson at Fig. 5a 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

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	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. Carlson at [0005] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 1 above. Carlson discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. 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 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]

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	FIG. 5 b a diagram showing the spectrum sensitivity of a photo detecting element; Carlson at [0037]  Figure 5b Carlson at Fig. 5b 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 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

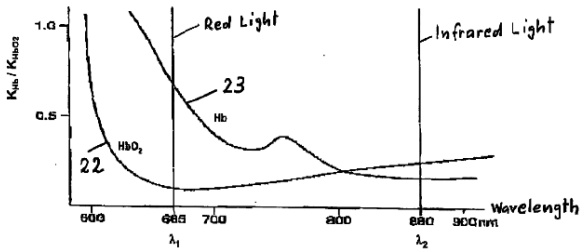
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	nm. A corresponding transmission spectrum of such a double band pass filter will be suitably used in a pulsoximetric sensor as shown in FIG. 5 c. Preferably, the two means, as described with reference to FIGS. 5 b and c, are combined as wavelength filters might be also light permeable in lower wavelengths areas and higher wavelengths areas which, by using a selective light detecting element, can be eliminated. 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. A further possibility for the better performance of a pulsoximetric sensor, is to arrange geometric means as e.g. so-called geometrical baffles (light trap). In FIG. 6 a, a part of a pulsoximetric sensor is shown, which means the part of the sensor after the transmitted light has passed, e.g. the earlobe of a human or animal individual. Within the mentioned sensor part 31, after e.g. a double pass filter 33, circumferential extending baffles 37 are arranged to avoid stray light to reach the photo detecting element. Carlson at [0056]-[0059] 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] 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

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	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 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

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	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.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	*See* claim 2 above. Carlson discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. 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

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	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] 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] FIG. 5 a a diagram showing the light absorption curves of with oxygen saturated (HbO2) and unsaturated (Hb) haemoglobin; Carlson at [0036]  Figure 5a Carlson at Fig. 5a 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] 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 λ_1 and λ_2 are indicated at which the pulsoximetric sensor is operated. 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 [0055]-[0056] 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]

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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 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 system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Carlson discoses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 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]. the wearable device adapted to be placed on a wrist or an ear of a user,	Carlson discloses or renders obvious the wearable device adapted to be placed on teeth, a wrist, or an ear of a user. *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes to generate an output optical light having one or more optical wavelengths;	Carlson discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes to generate an output optical light having one or more optical wavelengths. *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the wearable device comprising one or more lenses to receive at least a portion of the output optical light and to deliver a lens output light to tissue;	Carlson discloses or renders obvious the wearable device comprising one or more lenses to receive at least a portion of the output optical light and to deliver a lens output light to tissue. *See* above at claim 1[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 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]. the wearable device further comprising a detection system to receive	Carlson discloses or renders obvious the wearable device further comprising a detection system 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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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,	*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 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[e]. wherein the detection system is to be synchronized to the light source;	Carlson discloses or renders obvious the detection system is to be synchronized to the light source. *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 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]. 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 spatially separated 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet to receive and process at least a portion of the output signal, wherein the smart phone or tablet is to store and display the processed output signal, and wherein at least a portion of the processed output signal is to be transmitted over a wireless transmission link;	Carlson discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet to receive and process at least a portion of the output signal, wherein the smart phone or tablet is to store and display the processed output signal, and wherein at least a portion of the processed output signal is to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Carlson discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[i]. the wearable device to increase the signal-to-noise ratio by increasing light	Carlson discloses or renders obvious the wearable device to increase the signal-to-noise ratio by increasing light intensity of at least one of the semiconductor sources from an initial light intensity.

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intensity of at least one of the plurality of semiconductor sources from an initial light intensity; and	*See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[j]. the detection system further 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. *See* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[k]. generate a second signal responsive to light received while at least one of the light emitting diode is on; and	Carlson discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diode is on. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Carlson discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Carlson discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. *See* above 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 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 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 8 above. Carlson discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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

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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 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 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	*See* claim 9 above. Carlson discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. *See* above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Carlson discoses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 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.
15[a]. The wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Carlson discloses or renders obvious the wearable device adapted to be placed on teeth, a wrist, or an ear of a user. *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes to generate an output optical light having one or more optical wavelengths;	Carlson discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources to generate an output optical light having a plurality of optical wavelengths. *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[c]. the wearable device comprising one or more lenses to receive at least a portion of the output optical	Carlson discloses or renders obvious the wearable device comprising one or more lenses to receive at least a portion of the output optical light and to deliver a lens output light to tissue. *See* above at claim 1[c].

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light and to deliver a lens output light to tissue;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[d]. the wearable device further comprising a detection system 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 the wearable device further comprising a detection system 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, wherein the detection system is to be synchronized to the light source. *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 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.
15[e]. wherein the detection system is to be synchronized to the light source;	Carlson discloses or renders obvious the detection system is to be synchronized to the light source. *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 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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15[f]. 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 spatially separated 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet to receive and process at least a portion of the output signal, wherein the smart phone or tablet is to store and display the processed output signal, and wherein at least a portion of the processed output signal is to be transmitted over a wireless transmission link.	Carlson discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet to receive and process at least a portion of the output signal, wherein the smart phone or tablet is to store and display the processed output signal, and wherein at least a portion of the processed output signal is to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[h]. wherein the output signal is indicative of one or	Carlson discloses or renders obvious the output signal is indicative of one or more of the physiological parameters.

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more of the physiological parameters;	*See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[i]. the wearable device 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; and	Carlson discloses or renders obvious the wearable device to increase the signal-to-noise ratio by increasing light intensity of at least one of the semiconductor sources from an initial light intensity. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[j]. the detection system further 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. *See* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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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15[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 the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15 [l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Carlson discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Carlson discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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

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’455 Patent	Carlson
	identified in Defendants’ Invalidity 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.
15[n]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Carlson discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. *See* above at claim 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 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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EXHIBIT E3

U.S. Pat. No. 11,160,455 in view of US 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 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 B2 (the "'455 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 E1-E2 and E4-E18, 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 '455 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 '455 Patent.

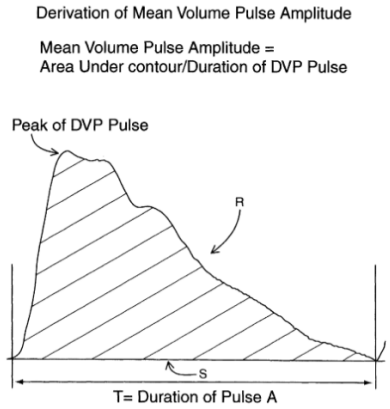
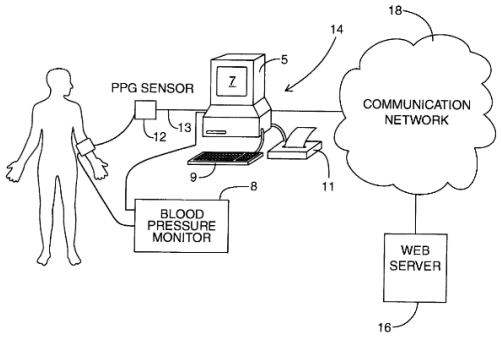
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that 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.

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EXHIBIT E3

’455 Patent	Goodman
Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Goodman discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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

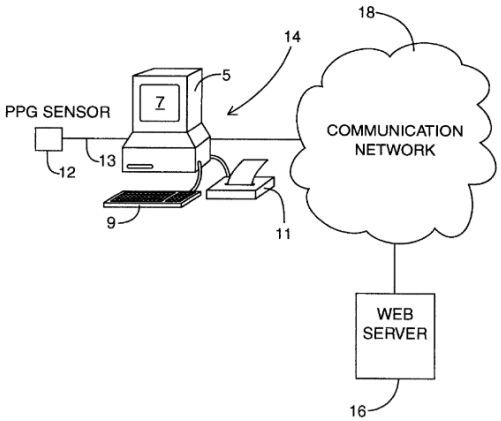
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’455 Patent	Goodman
	 FIG. 15A  FIG. 15B Goodman at Fig. 15 As shown in FIG. 15B, a continuous noninvasive blood pressure monitor 8, such as the Colin model 7000 blood pressure monitor (available from Colin Medical Instruments Corp. of Texas) could be used alongside PPG sensor 12 of system 10 for calibration purposes. The unit is a wrist worn device that

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’455 Patent	Goodman
	initially calibrates itself against a reading from an integral cuff blood pressure device. Thereafter, 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 This invention relates to a physiological Signal monitor ing System and more particularly to a System which allows a user to determine various types of physiological informa tion and which allows a user to electronical Goodman at 1:05-10 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

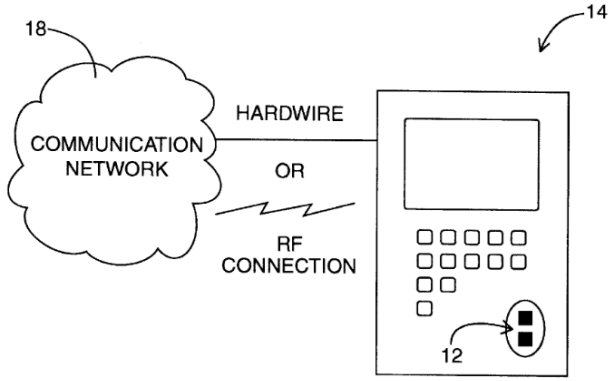
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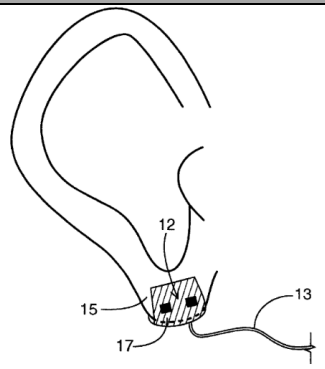
’455 Patent	Goodman
	 FIG. 1 Goodman at Fig. 1 PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse 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 8:60-8:05

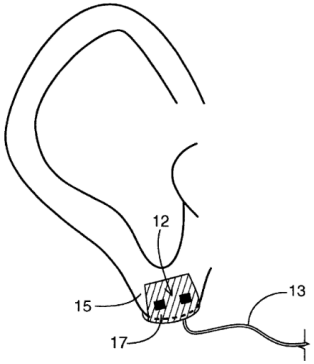
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’455 Patent	Goodman
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time 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]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Goodman discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. 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

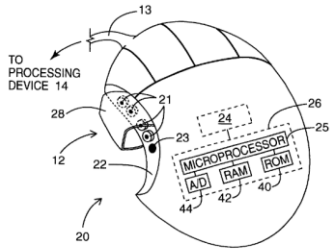
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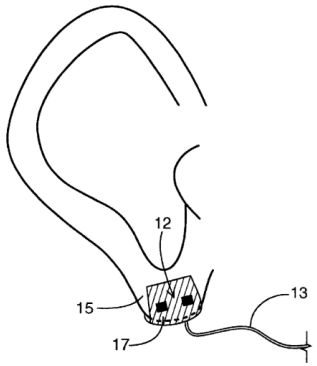
’455 Patent	Goodman
	 FIG. 5 Goodman at Fig. 5 FIG. 6 shows how PPG sensor 12 could be associated with the user's earlobe 15 instead of the user's finger. As discussed, it is well known that the reflective wave originating in the aorta has a significant presence in the volume pulse contour obtained from 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

’455 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[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	Goodman discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of 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

’455 Patent	Goodman
	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. 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 12:23-35

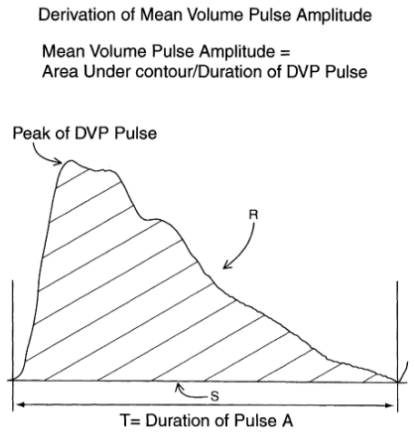
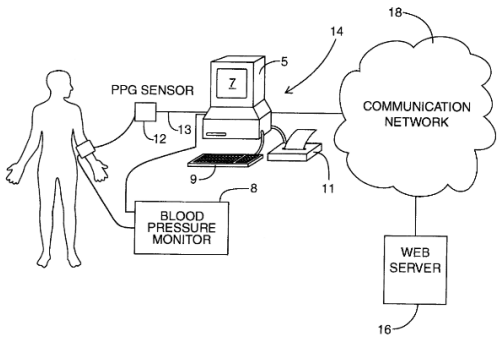
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’455 Patent	Goodman
	 FIG. 2 Goodman at Fig. 2 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the 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 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]. the 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;	Goodman discloses or renders obvious the 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 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

’455 Patent	Goodman
	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 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

’455 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[d]. the wearable device further comprising 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 the wearable device further comprising 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 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

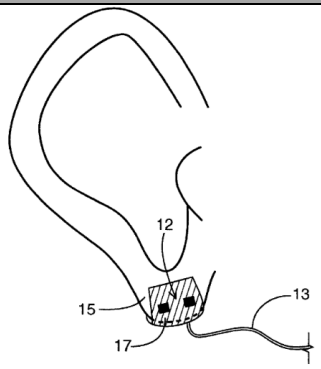
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	 FIG. 15A  FIG. 15B Goodman at Fig. 15

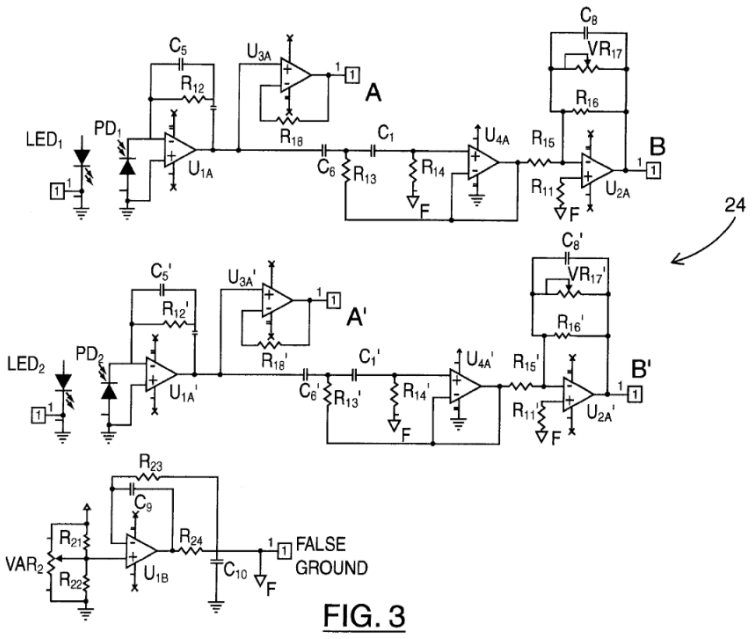
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’455 Patent	Goodman
	As shown in FIG. 15B, a continuous noninvasive blood pressure monitor 8, such as the Colin model 7000 blood pressure monitor (available from Colin Medical Instruments Corp. of Texas) could be used alongside PPG sensor 12 of system 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, 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 Since PPG sensors operate non-invasively, efforts have been made to utilize them to determine estimates of mean, systolic and diastolic blood pressure. These devices either estimate mean blood pressure from the mean value of the blood volume pulse, a measure of pulse wave velocity or changes in the volume pulse contour using formulae and calibrated constants. However, these devices have not achieved widespread use due to a lack of accuracy and difficulty of use. Goodman at 01:50-58 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

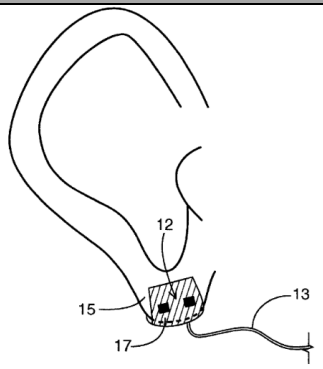
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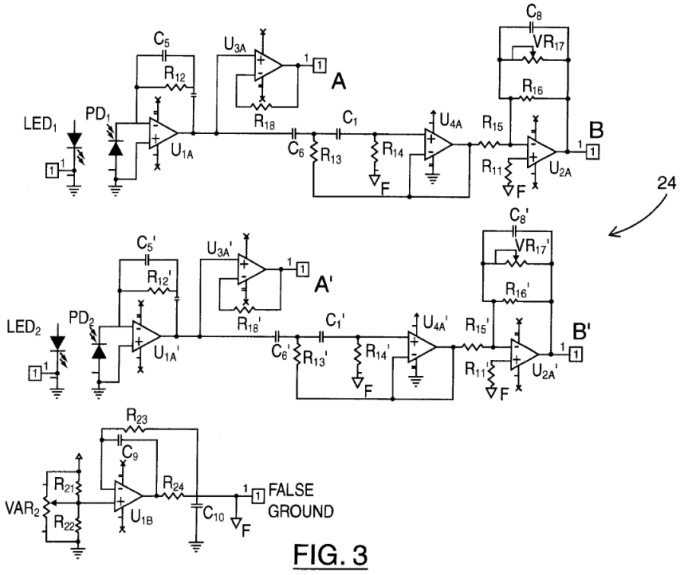
’455 Patent	Goodman
	 FIG. 6 Goodman at Fig. 6 PPG sensor 12 has a relatively small footprint (e.g. few square centimeters) and is implemented using a red LED1 and an infrared LED2, each associated with a photodiode PD1 and PD2 (FIG. 3) in a known configuration for reflective mode operation (i.e. light 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 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

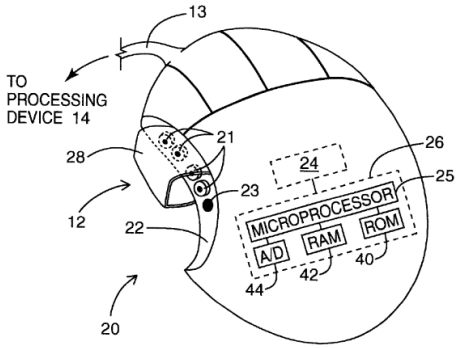
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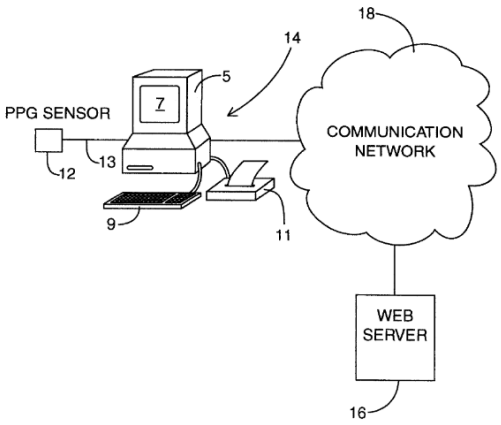
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	are identified with the same reference numbers as for the circuit for photodiode PD1, but with the part numbers primed. Goodman at 10:65 -11:08  FIG. 3 Goodman at Fig. 3 Each circuit includes operational quad amplifiers U1A and U2A fabricated on a 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

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	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 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[e]. 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. Goodman at 09:57-10:07

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	 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 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 spatially separated detectors;	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 spatially separated 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

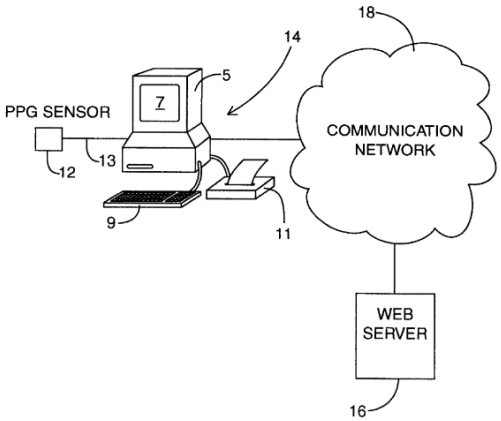
’455 Patent	Goodman
	contour signal. The detector is positioned on the same side as the radiating LED in order to detect the reflected light. Goodman at 09:57-10:07  FIG. 3 Goodman at Fig. 3 Also, as shown in FIG. 2, PPG sensor 12 utilizes cylindrical baffles 21 to house LED1 and LED2 and photodiodes PD1 and PD2 to prevent direct coupling of light from the LED's to the photodiodes. When 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 10:8-18

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	 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

’455 Patent	Goodman
	 FIG. 1 Goodman at Fig. 1 The difference in shape occurs because of the diffusion of light in the finger as it travels from the light Source, through tissue to arterial elements and back to the photodetector. This diffusion smooths the shape of the DVP signal relative to the pressure pulse contour. Goodman at 26:55-66 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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 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]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Goodman discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link 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

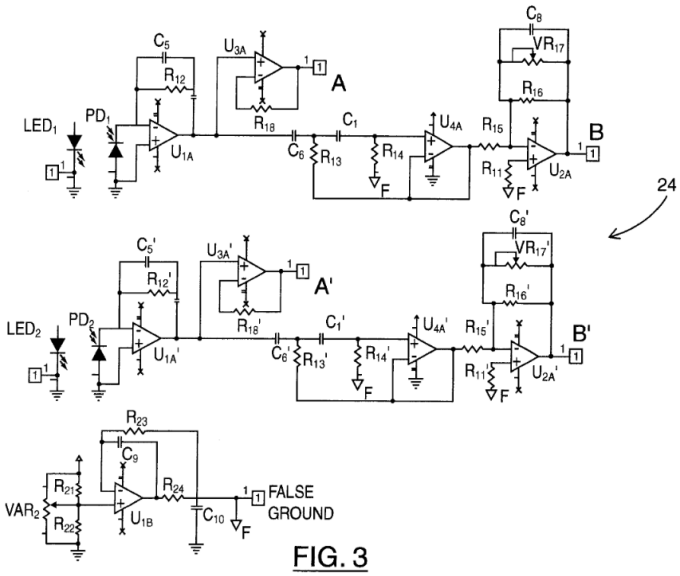
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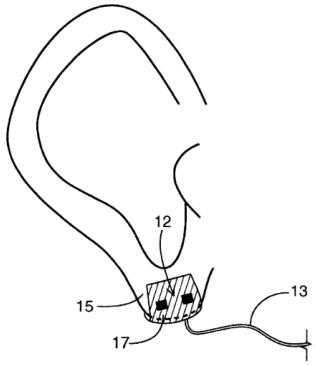
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	Processing device 14 is preferably a conventional personal computer having a central processing unit (CPU) 5, display 7, keyboard 9 and printer 11. Processing device 14 also preferably has a standard Universal Serial Bus (USB), sufficient memory and 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 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

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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 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 one or more of the physiological parameters;	Goodman discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. 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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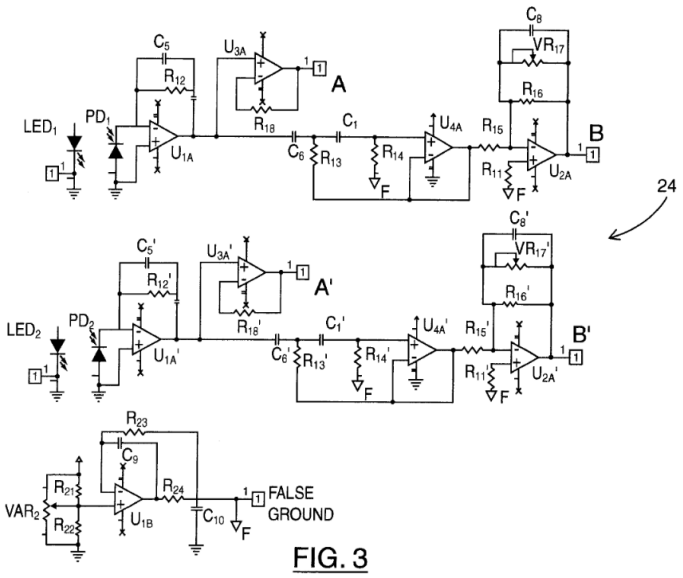
’455 Patent	Goodman
	 FIG. 3 Goodman at Fig. 3 PPGs are well-known instruments which use light for determining and registering variations in a patient's blood volume. They can instantaneously track arterial blood volume changes during the cardiac cycle. PPG sensor 12 is installed within a computer mouse 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 8:60-8:05 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of 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 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 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;	Goodman discloses or renders obvious 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. 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

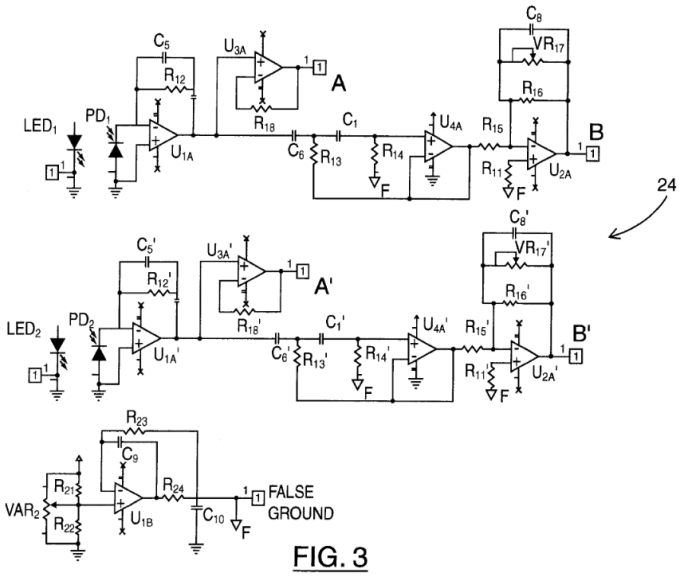
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	FIG. 8 is a plot of a typical conditioned PPG pulse contour signal received by processing device 14 from the user input device 20. As illustrated, the PPG pulse contour consists of three peaks, namely a peak representing the systolic maximum (A), 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 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 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 semiconductor sources are off,	Goodman discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources 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

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	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 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	Goodman discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the semiconductor sources is on; and.

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received while at least one of the semiconductor sources is on; and	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 09:57-10:05 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

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	 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 first signal and the second signal; and	Goodman discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. 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

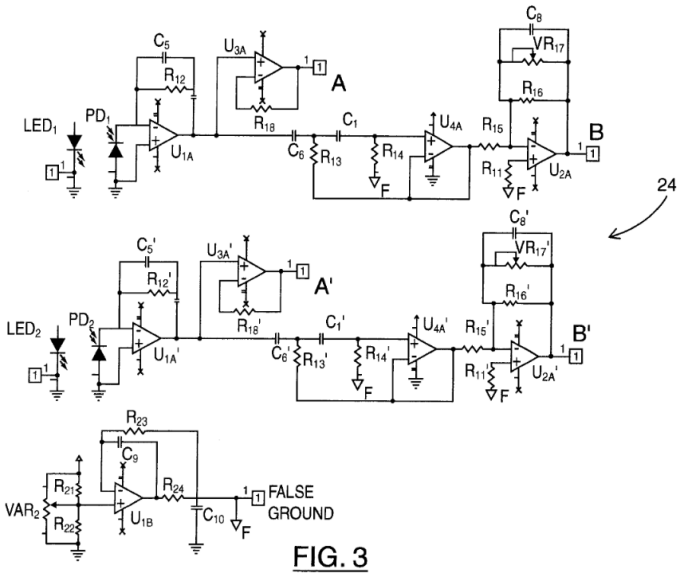
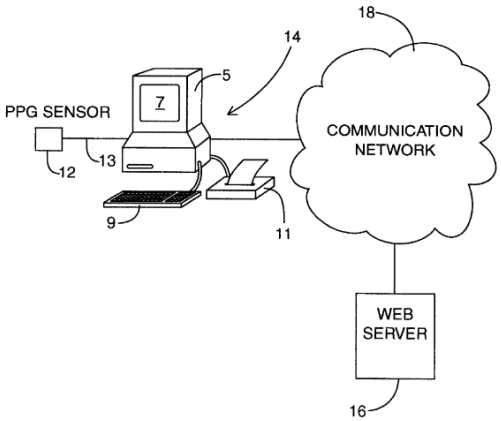
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	LED2 is off. Finally, the presence or absence of a finger on PPG sensor 12 can be determined by turning on an LED for a brief period at a regular time interval and determining whether the associated photodiode detects any reflected light. This polling 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 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.

EXHIBIT E3

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1[m]. wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Goodman discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible 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

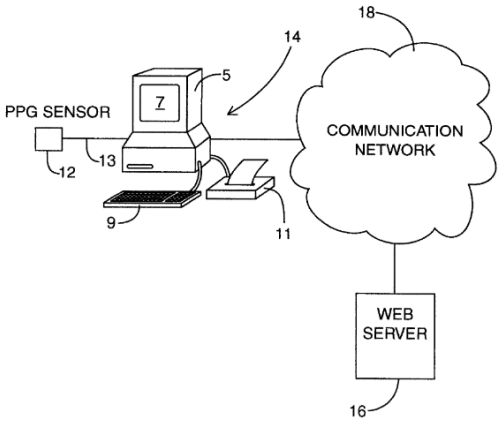
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	 FIG. 1 Goodman at Fig. 1 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at 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.
Claim 2	
2. The system of claim 1, wherein the plurality of	See claim 1 above.

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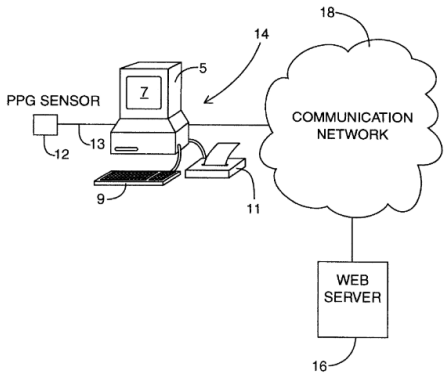
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semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	Goodman discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. 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 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 3	
3. The system of claim 2, wherein the output optical	See claim 2 above.

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light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Goodman discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. 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

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	 FIG. 1 Goodman at Fig. 1 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

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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 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 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Goodman discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 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 wearable device adapted to be placed on a wrist or an ear of a user,	Goodman discloses or renders obvious a wearable device adapted to be placed on a wrist or an ear of a user. See above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
8[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Goodman discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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]. the 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;	Goodman discloses or renders obvious the 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. See above at claim 1[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 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[d]. the wearable device further comprising a detection system configured	Goodman discloses or renders obvious the wearable device further comprising 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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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,	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 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]. wherein the detection system is configured to be synchronized to the light source;	Goodman discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. 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 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[f]. 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	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 spatially separated detectors. See above at claim 1[f].

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coupled to at least one of the spatially separated detectors;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Goodman discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; See above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Goodman discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h].

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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 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[i]. 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; and	Goodman discloses or renders obvious 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. See above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[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. See above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
8[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 the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diodes is on. See above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Goodman discloses or renders the detection system further configured to obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Goodman discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. See above 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 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 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 8 above. Goodman discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 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 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths	See claim 9 above. Goodman discloses or renders obvious the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. See above at claim 1[m].

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comprise near infrared and visible wavelengths.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Goodman discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 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.
15[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Goodman discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, See above at claim 1[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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 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.
15[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Goodman discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths, See above at claim 1[b] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[c]. the 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;	Goodman discloses or renders obvious the 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. See above at claim 1[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 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.
15[d]. the wearable device further comprising a detection system configured to receive at least a portion	Goodman discloses or renders obvious the wearable device further comprising 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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of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	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 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.
15[e]. wherein the detection system is configured to be synchronized to the light source;	Goodman discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. 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 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.
15[f]. 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 spatially separated detectors;	Goodman discloses 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 spatially separated detectors. See above at claim 1[f] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal; wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link	Goodman discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link See above at claim 1[g] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Goodman discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[i]. 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; and	Goodman discloses or renders obvious 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. See above at claim 1[i] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[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. See above at claim 1[j] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[k]. generate a second signal responsive to light received while at least one of	Goodman discloses or renders obvious the detection system further configured to: generate a second signal responsive to light received while at least one of the semiconductor sources is on;and See above at claim 1[k]

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the light emitting diodes is on, and	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal;	Goodman discloses or renders obvious the detection system further configured to: increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes,	Goodman discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, See above 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

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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 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.
15[n]. and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Goodman discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 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.
15[o]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Goodman discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. See above at claim 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.

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EXHIBIT E4

U.S. Pat. No. 11,160,455 in view of US Patent No. 6,519,037 to Wayne D. Jung ("Jung")

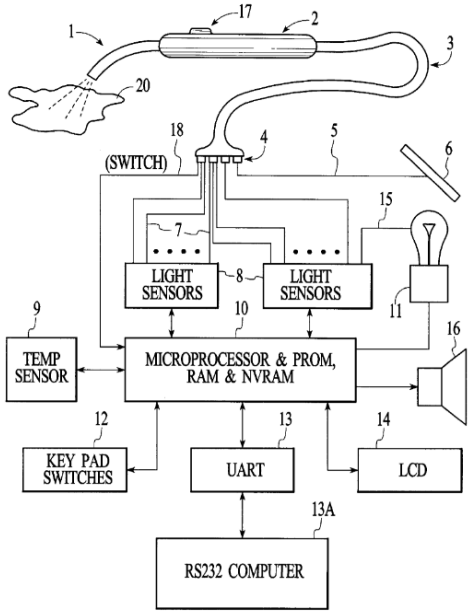
As described in detail below, Jung (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 Patent") under 35 U.S.C. §102 and/or §103, either alone in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits E1-E3 and E5-E18, 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 '455 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 Jung. The cited portions of Jung are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Jung. 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 Jung "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Jung 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 Jung (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 Jung anticipates and/or renders obvious the Asserted Claims of the '455 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.

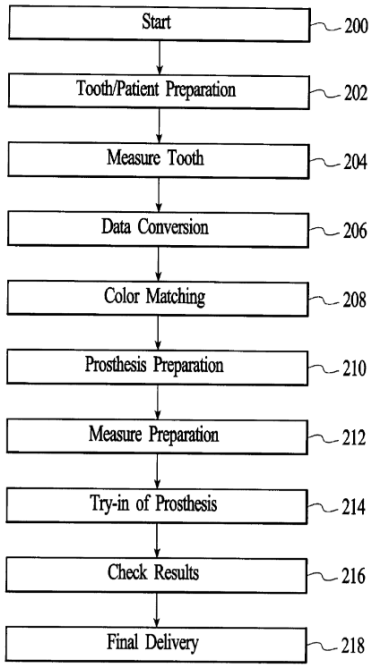
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Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Jung discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. In accordance with the present invention, devices and methods are provided for measuring the color and other optical characteristics of objects such as teeth, reliably and with minimal problems of height and angular dependence and which may be applied to detecting or preventing counterfeiting or the like. A handheld probe is utilized in the present invention, with the handheld probe containing a number of fiber optics in certain preferred embodiments. Light is directed from one (or more) light source(s) towards the object/tooth to be measured, which in certain preferred embodiments is a central light source fiber optic (other light sources and light source arrangements also may be utilized).Light reflected from the object is detected by a number of light receivers. Included in the light receivers (which may be light receiver fiber optics) are a plurality of perimeter and/or broadband or other receivers (which may be light receiver fiber optics, etc.). In certain preferred embodiments, a number of groups of perimeter fiber optics are utilized in order to take measurements at a desired, and predetermined height and angle, thereby minimizing height and angular dependency problems found in conventional methods, and to quantify other optical characteristics such as gloss. In certain embodiments, the present invention also may measure gloss, translucence and fluorescence characteristics of the object/tooth being measured, as well as surface texture and/or other optical or surface characteristics. In certain embodiments, the present invention may distinguish the surface spectral reflectance response and also a bulk spectral response. Jung at 4:2-29. With reference to FIG. 1, an exemplary preferred embodiment of a color/optical characteristic measuring system and method in accordance with the present invention will be described. It should be noted that, at various places herein, such a color measuring system is sometimes referred to as an intraoral reflectometer, etc. Probe tip 1 encloses a plurality of fiber optics, each of which may constitute one or more fiber optic fibers. In a preferred embodiment, the fiber optics contained within probe tip 1 includes a single light source fiber optic and a number of groups of light receiver fiber optics. The use of such fiber optics to

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	measure the color or other optical characteristics of an object will be described later herein. Probe tip 1 is attached to probe body 2, on which is fixed switch 17. Jung at 8:41-55  FIG. 1 Jung at Fig. 1 Microprocessor 10 also communicates with UART 13, which enables microprocessor 10 to be coupled to an external device such as computer 13A. In such embodiments, data provided by microprocessor 10 may be processed as desired for the particular application, such as for averaging, format conversion or for various display or print options, etc. In the preferred embodiment, UART 13 is configured so as to provide what is known as a RS232 interface, such as is commonly found in personal computers.

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	Jung at 10:18-26. In general, under control of microprocessor 10, which may be in response to operator activation (through, for example, key pad switches 12 or switch 17), light is directed from light source 11, and reflected from cold mirror 6 through source fiber optic 5 (and through fiber optic cable 3, probe body 2 and probe tip 1) or through some other suitable light source element and is directed onto object 20. Light reflected from object 20 passes through the receiver fiber optics/elements in probe tip 1 to light sensors 8 (through probe body 2, fiber optic cable 3 and fibers 7). Based on the information produced by light sensors 8, microprocessor 10 produces a color/optical measurement result or other information to the operator. Color measurement or other data produced by microprocessor 10 may be displayed on display 14, passed through UART 13 to computer 13A, or used to generate audio information that is presented to speaker 16. Other operational aspects of the preferred embodiment illustrated in FIG. 1 will be explained hereinafter. Jung at 11:4-21 It is known that certain objects such as human teeth may fluoresce, and such optical characteristics also may be measured in accordance with the present invention. Jung at 15:33-35. FIG. 16A is a flow chart illustrating a general dental application process flow for use of the color/optical measuring systems and methods in accordance with the present invention. At step 200, the color/optical measuring system may be powered-up and stabilized, with any required initialization or other setup routines performed. At step 200, an indication of the system status may be provided to the operator, such as through LCD 14 or speaker 16 of FIG. 1. Also at step 200, the probe tip may be shielded or a clean probe tip may be inserted in order to reduce the likelihood of contamination (see, e.g., FIGS. 7A to 8B and related description). In other embodiments, a plastic or other shield may also be used (which may be disposable, cleanable/reusable, etc., as previously described), so long as it is constructed and/or positioned so as to not adversely affect the measurement process. Jung at 28:19- 34

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	 FIG. 16A Jung at Fig. 16A At step 202, the patient and the tooth to be measured are prepared. Any required cleaning or other tooth preparation would be performed at step 202. Any required patient consultation about the type of prosthesis or area of a tooth to be matched would be performed at (or before) step 202. In certain embodiments, a positioning device is prepared at step 202, such as is illustrated in FIGS. 17A and 17B. In such embodiments, for example, a black or other suitably-colored material 282, which may adhere to tooth 280 (such as with a suitable adhesive), is formed to have opening 281 larger than the diameter of the measuring probe, with opening 281 centered on the area of tooth 280 to be measured. The material of positioning device 282 is formed in a manner to fit on/over tooth 280 (such as over the incisal edge of

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	tooth 280 and/or over one or more adjacent teeth) so that it may be placed on/over tooth 280 in a repeatable manner. Such a positioning device may serve to ensure that the desired area of tooth 280 is measured, and also allows for repeat measurements of the same area for purposes of confirmation, fluorescence measurement, or other optical measurement, or the like. Any other pre-measurement activities may be performed at (or before) step 202. Jung at 28:35-56 With the spectral/color information produced by the present invention, data may be converted to such formats through conventional math, for example. Such math may be performed by microprocessor 10 or computer 13A of FIG. 1, or in some other manner. Jung at 29:16-21 At step 207, a first amount of material to be removed is calculated or estimated (such as by microprocessor 10, computer 13A or other suitable computing device). Jung at 30:62-65. In another particular aspect of the present invention, for example, data processing such as illustrated in FIG. 18 may be taken in conjunction with the processes of FIGS. 16A and/or 16B. At step 286, client database software is run on a computing device, such as computer 13A of FIG. 1. Such software may include data records for each patient, including fields storing the history of dental services performed on the patient, information regarding the status or condition of the patient's teeth, billing, address and other information. Such software may enter a mode by which it is in condition to accept color or other data taken in accordance with the present invention. At step 288, for example, the dentist or other dental professional may select parameters for a particular tooth of the patient to be measured. Depending on the size and condition of the tooth (such as color gradient or the like), the dentist may sector the tooth into one or more regions, such as a grid. Thus, for example, in the case of tooth for which it is decided to take four measurements, the tooth may be sectored into four regions. Such parameters, which may include a pictorial representation on the computer of the tooth sectored into four regions (such as by grid lines), along with tooth identification and patient information may be entered into the computer at this time.

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	At step 290, one or more measurements of the tooth may be taken, such as with a system and method as described in connection with FIGS. 1, SA, SB and/or 6. The number of such measurements preferably is associated with the parameters entered at step 288. Thereafter, at step 292, the data collected from the measurement(s) may be sent to the computer for subsequent processing. As an illustrative example, four color/optical measurements may be taken (for the four regions of the tooth in the above example) and sent to the computer, with the data for the four color/optical measurements (such as RGB or other values) associated with the four regions in accordance with the entered parameters. Jung at 31:30-66. Color/optical characteristics of the object may be determined from the plurality of color sensor measurements, which may include three such sensors in the case of a tristimulus instrument, or 8, 12, 15 or more color sensors for a more full bandwidth system (the precise number may be determined by the desired color resolution, etc.). Jung at 33:9-15. As with previously described embodiments, the reflectivity measurements may then be used to determine optical characteristics of the object being measured, etc. Jung at 35:5-9. The color sensors are utilized to determine the color or other optical characteristics of the object, and the perimeter sensors are utilized to determine if the probe is perpendicular to the surface and/or are utilized to compensate for non-perpendicularangles within certain angular ranges. Jung at 35:40-45. Intraoral reflectometer 380, which may be constructed as described above, includes probe 381. **Data output from reflectometer 380 is coupled to computer 384 over bus 390 (which may be a standard serial or parallel bus, etc.). Computer 384 includes a video freeze frame capability and preferably**

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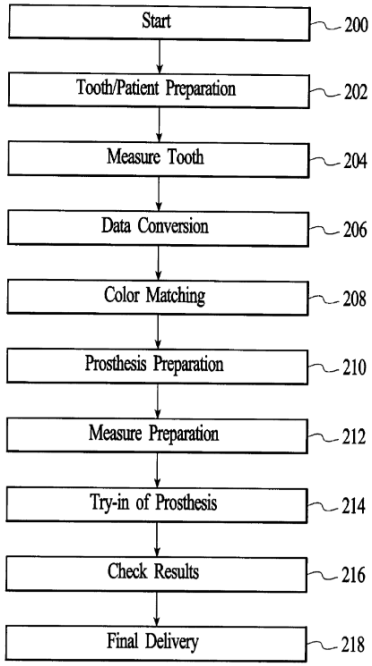
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	a modem. Intraoral camera 382 includes handpiece 383 and couples video data to computer 384 over bus 392. Computer 384 is coupled to remote computer 386 over telecommunication channel 388, which may be a standard telephone line, ISDN line, a LAN or WAN connection, etc. With such an embodiment, video measurements may be taken of one or more teeth by intraoral camera 382, along with optical measurements taken by intraoral reflectometer 380. Computer 384 may store still picture images taken from the output of intraoral camera 382. Jung at 36:29-43 FIG. 38 illustrates an abridged visible light range spectrometer in accordance with another embodiment of the present invention. This embodiment utilizes TSL230 sensors 616, a light source or lamp 604, preferably a hot mirror that reflects IR light with wavelengths above 700 nanometers (not expressly shown in FIG. 38), fiber optic cable assembly consisting of one or more sources (illustrated by light path 608) providing light to object 606, and one or more receivers (illustrated by light path 618) receiving light from object 606, gate array 602 such as an Altera FLEX 10K30™ (believed to be a trademark of Altera Corporation), which is coupled to computer 600 and receives signal inputs from sensors 616 over bus 620. In one preferred embodiment up to fifteen or more TSL230 sensors are utilized. Each TSL230 sensor 616 has an interference filter 614 positioned above the sensor, with each filter preferably having a nominal bandwidth of 20 nanometers (or other bandwidth suitable for the particular application). Sensors 616 also preferably receive a small and controlled amount of light (light path 610) directly from light source 604, preferably after IR filtering. The light source input to sensors 616 serves to bias sensors 616 to produce an output of at least 200 Hz when no light is input to sensors 616 from filters 614. Thus, sensors 616 will always produce an output signal frequency greater than or equal to the sampling frequency of the system. When input light intensities are small, the frequency change is small, and when the light input is large, the frequency change will be large. The scale and sensitivity of sensors 616 are set (by gate array 602 over control bus 612, which may be under control of computer 600) to detect the entire range of light input values. In most cases, particularly in object color determination, the maximum amount of light input into any one of sensors 616 is determined by light source 604 and filters 614 and can be appropriately controlled. Jung at 50:12-45. Such a further embodiment of the present invention is illustrated in FIG. 39. In accordance with this embodiment, light source 638 provides light coupled through a light path (preferably light source fiber

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	636) to probe 630 through optical cable 632. Light received by the probe (i.e., returned 65 from the object or material being evaluated) is coupled to spectrometer/light sensors 640 through a suitable light path (preferably one or more light receiver fibers from optical cable 632). Computer 642 is coupled to spectrometer/light sensors 640 by way of control/data bus 648. Computer 642 also is coupled to light source 638 by way of control line(s) 646, which preferably control the on/off condition of light source 638, and optionally may provide other control information, analog or digital signal levels, etc., to light source 638 as may be desired to optimally control the particular light chosen for light source 638, and its particular characteristics, and for the particular application. Light from light source 638 optionally may be coupled to spectrometer/ light sensors 640 by light path 644, such as for purposes of providing light bias (if required or desired for the particular spectrometer chosen), or for monitoring the characteristics of light source 638 (such as drift, temperature effects and the like). Computer 642 may be a conventional computer such as a PC or microcontroller or other processing device, and preferably is coupled to a user interface (e.g., display, control switches, keyboard, etc.), which is generically illustrated in FIG. 39 by interface 652. Optionally, computer 642 is coupled to other computing devices, such as may be used for data processing, manipulation, storage or further display, through interface 650. Computer 642 preferably includes the typical components such as (but not limited to) a CPU, random access or other memory, non-volatile memory/storage for storing program code, and may include interfaces for the user such as display, audio generators, keyboard or keypad or touch screen or mouse or other user input device (which may be through interface 652), and optionally interfaces to other computers such as parallel or serial interfaces (which may be through interface 650). Computer 642 interfaces to spectrometer/light sensors 640 for control of the spectrometer and overall system and to receive light intensity and light spectrum data from spectrometer/light sensors 640. In a preferred embodiment, control/data bus 648 for interfacing to spectrometer/light sensors 640 is a standard 25 pin bi-directional parallel port. In certain embodiments, computer 642 may be separate, standalone and/or detachable from spectrometer/light sensors 640 and may be a conventional laptop, notebook or other portable or handheld-type personal computer. In other embodiments, computer 642 may be an integral part of the system contained in one or more enclosure(s), and may be an embedded personal computer or other type of integrated computer. Purposes of computer 642 preferably include controlling light source 638 and spectrometer/light sensors 640, receiving light intensity and spectral or other data output from spectrometer/light sensors 640, analyzing received or other data and determining the optical properties

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	of the object or material, and displaying or outputting data to a user or other computing device or data gathering system. Jung at 51:61-52:52. Input/output may be made to processor 981 by input/output circuitry 982, which may include (such as described elsewhere herein), components of a computer, display, keyboard or switches or other input, etc. Such components optimally may be installed on a small printed circuit board 983 or other appropriate substrate, etc. Jung at 90:18-24. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Jung discloses or renders obvious including a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. **FIG. 16A is a flow chart illustrating a general dental application process flow for use of the color/optical measuring systems** and methods in accordance with the present invention. At step 200, the color/optical measuring system may be powered-up and stabilized, with any required initialization or other setup routines performed. At step 200, an indication of the system status may be provided to the operator, such as through LCD 14 or speaker 16 of FIG. 1. Also at step 200, the probe tip may be shielded or a clean probe tip may be inserted in order to reduce the likelihood of contamination (see, e.g., FIGS. 7A to 8B and related description). In other embodiments, a plastic or other shield may also be used (which may be disposable, cleanable/reusable, etc., as previously described), so long as it is constructed and/or positioned so as to not adversely affect the measurement process. Jung at 28:19- 34

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	 FIG. 16A Jung at Fig. 16A At step 202, the patient and the tooth to be measured are prepared. Any required cleaning or other tooth preparation would be performed at step 202. Any required patient consultation about the type of prosthesis or area of a tooth to be matched would be performed at (or before) step 202. In certain embodiments, a positioning device is prepared at step 202, such as is illustrated in FIGS. 17A and 17B. In such embodiments, for example, a black or other suitably-colored material 282, which may adhere to tooth 280 (such as with a suitable adhesive), is formed to have opening 281 larger than the diameter of the measuring probe, with opening 281 centered on the area of tooth 280 to be measured. **The material of positioning device 282 is formed in a manner to fit on/over tooth 280 (such as over the incisal edge of tooth 280 and/or over one or more adjacent teeth) so that it may be placed on/over tooth**

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	280 in a repeatable manner. Such a positioning device may serve to ensure that the desired area of tooth 280 is measured, and also allows for repeat measurements of the same area for purposes of confirmation, fluorescence measurement, or other optical measurement, or the like. Any other pre-measurement activities may be performed at (or before) step 202. Jung at 28:35-56 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 Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	Jung discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. One method for eliminating the height and angular dependency of the light source and receiver is to provide a fixed mounting arrangement where the light source and receiver are stationary and the object is always positioned and measured at a preset height and angle. The fixed mounting arrangement greatly limits the applicability of such a method. Another method is to add mounting feet to the light source and receiver probe and to touch the object with the probe to maintain a constant height and angle. The feet in such an apparatus must be wide enough apart to insure that a constant angle (usually perpendicular) is maintained relative to the object. Such an apparatus tends to be very difficult to utilize on small objects or on objects that are hard to reach, and in general does not work satisfactorily in measuring objects with curved surfaces. Such devices are particularly difficult to implement in the field of dentistry. Jung at 2:55-3:3. Probe tip 1 encloses a plurality of fiber optics, each of which may constitute one or more fiber optic fibers. In a preferred embodiment, the fiber optics contained within probe tip 1 includes a single light source fiber optic and a number of groups of light receiver fiber optics. The use of such fiber optics to

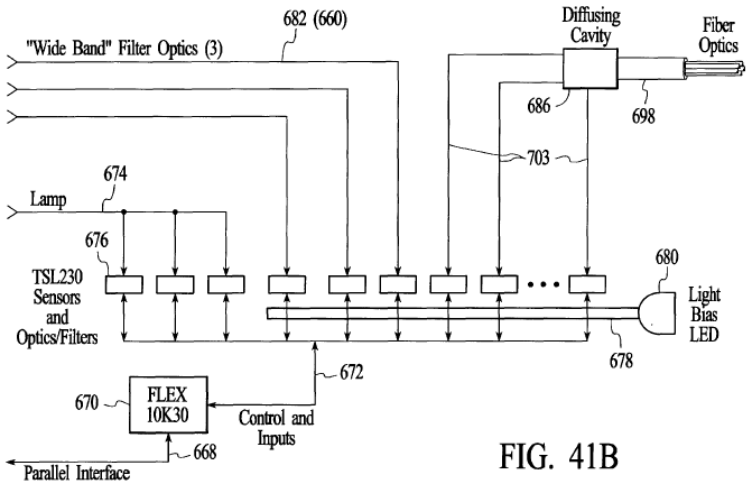
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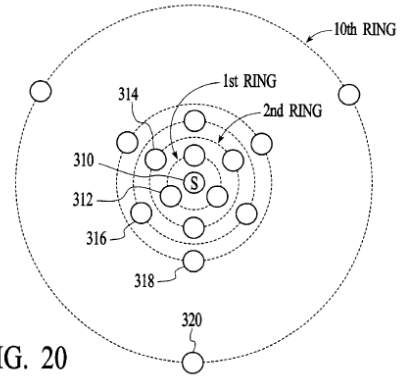
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	measure the color or other optical characteristics of an object will be described later herein. Probe tip 1 is attached to probe body 2, on which is fixed switch 17. Switch 17 communicates with microprocessor 10 through wire 18 and provides, for example, a mechanism by which an operator may activate the device in order to make a color/optical measurement. Fiber optics within probe tip 1 terminate at the forward end thereof (i.e., the end away from probe body 2). The forward end of probe tip 1 is directed towards the surface of the object to be measured as described more fully below. The fiber optics within probe tip 1 optically extend through probe body 2 and through fiber optic cable 3 to light sensors 8, which are coupled to microprocessor 10. Jung at 8:47-65. It is known that certain objects such as human teeth may fluoresce, and such optical characteristics also may be measured in accordance with the present invention. A light source with an ultraviolet component may be used to produce more accurate color/optical data with respect to such objects. Such data may be utilized to adjust the amounts and or proportions or types of dental fluorescing materials in dental restorations or prosthesis. In certain embodiments, a tungsten/halogen source (such as used in a preferred embodiment) may be combined with a UV light source (such as a mercury vapor, xenon or other fluorescent light source, etc.) to produce a light output capable of causing the object to fluoresce. **Alternately, a separate UV light source, combined with a visible-light-blocking filter, may be used to illuminate the object. Such a UV light source may be combined with light from a red LED (for example) in order to provide a visual indication of when the UV light is on and also to serve as an aid for the directional positioning of the probe operating with such a light source**. A second measurement may be taken using the UV light source in a manner analogous to that described earlier, with the band of the red LED or other supplemental light source being ignored. The second measurement may thus be used to produce an indication of the fluorescence of the tooth or other object being measured. With such a UV light source, a silica fiber optic (or other suitable material) typically would be required to transmit the light to the object (standard fiber optic materials such as glass and plastic in general do not propagate UV light in a desired manner, etc.). Jung at 15:33-61 In accordance with the present invention, devices and methods are provided for measuring the color and other optical characteristics of objects such as teeth, reliably and with minimal problems of height and angular dependence and which may be applied to detecting or preventing counterfeiting or the like. A

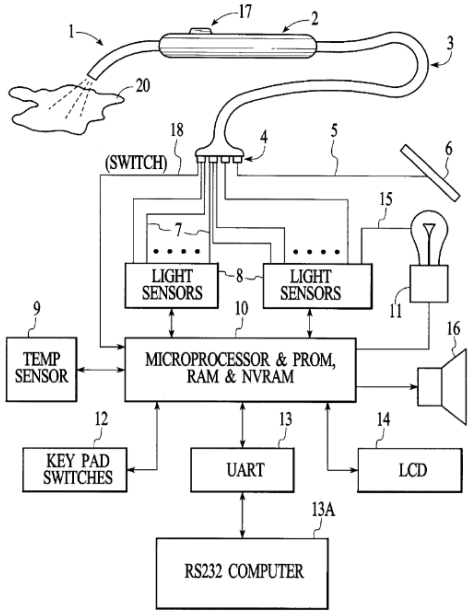
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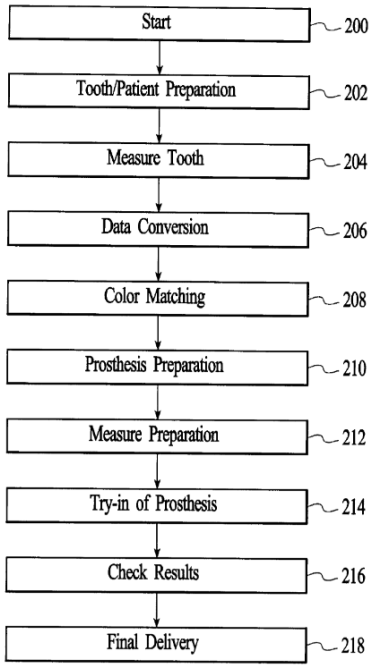
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	handheld probe is utilized in the present invention, with the handheld probe containing a number of fiber optics in certain preferred embodiments. **Light is directed from one (or more) light source(s) towards the object/tooth to be measured, which in certain preferred embodiments is a central light source fiber optic (other light sources and light source arrangements also may be utilized). Light reflected from the object is detected by a number of light receivers. Included in the light receivers (which may be light receiver fiber optics) are a plurality of perimeter and/or broadband or other receivers (which may be light receiver fiber optics, etc.).** In certain preferred embodiments, a number of groups of perimeter fiber optics are utilized in order to take measurements at a desired, and predetermined height and angle, thereby minimizing height and angular dependency problems found in conventional methods, and to quantify other optical characteristics such as gloss. In certain embodiments, the present invention also may measure gloss, translucence and fluorescence characteristics of the object/tooth being measured, as well as surface texture and/or other optical or surface characteristics. In certain embodiments, the present invention may distinguish the surface spectral reflectance response and also a bulk spectral response. Jung at 04:02- 29 **In certain situations, a long time may be required for the light source and for the light bias source to stabilize.** In other situations, the light source and bias source may drift. In preferred embodiments, the light source is a 18 W, 3300 K halogen stabilized tungsten filament lamp manufactured by Welch Allyn, Inc. **The light bias preferably is provided by a high intensity LED and a fiber optic light guide or conduit (see LED 680 and light conduit 678 of FIG. 41A) that passes to each biased sensor of sensors 676. The intensity of LED 680 preferably is controlled and varied with high frequency pulse width modulation, or by analog constant current controllers.** By controlling the intensity of bias LED 680, the bias light level can be varied to best match the sensor sampling rate. Jung at 56:33-46

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	 FIG. 41B Jung at Fig. 41B FIG. 20 illustrates such a further embodiment. The probe of this embodiment includes a plurality of perimeter sensors and a plurality of color sensors coupled to receivers 312-320. The color sensors and related components, etc., may be constructed to operate in a manner analogous to previously described embodiments. **For example, fiber optic cables or the like may couple light from source 310 that is received by receivers 312-320 to sharp cut-off filters or to notch filters, with the received light measured over precisely defined wavelengths (see, e.g., FIGS. 1, 3 and 11-14 and related description).** Color/optical characteristics of the object may be determined from the plurality of color sensor measurements, which may include three such sensors in the case of a tristimulus instrument, or 8, 12, 15 or more color sensors for a more full bandwidth system (the precise number may be determined by the desired color resolution, etc.). Jung at 32:33-46

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	 FIG. 20 Jung 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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. the 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;	Jung discloses or renders obvious the 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 **With reference to FIG. 1, an exemplary preferred embodiment of a color/optical characteristic measuring system** and method in accordance with the present invention will be described. It should be noted that, at various places herein, such a color measuring system is sometimes referred to as an intraoral reflectometer, etc Jung at 8:41- 46

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	 FIG. 1 Jung at Fig. 1 **FIG. 16A is a flow chart illustrating a general dental application process flow for use of the color/optical measuring systems** and methods in accordance with the present invention. At step 200, the color/optical measuring system may be powered-up and stabilized, with any required initialization or other setup routines performed. At step 200, an indication of the system status may be provided to the operator, such as through LCD 14 or speaker 16 of FIG. 1. Also at step 200, the probe tip may be shielded or a clean probe tip may be inserted in order to reduce the likelihood of contamination (see, e.g., FIGS. 7A to 8B and related description). In other embodiments, a plastic or other shield may also be used (which may be disposable, cleanable/reusable, etc., as previously described), so long as it is constructed and/or positioned so as to not adversely affect the measurement process. Jung at 28:19- 34

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	 FIG. 16A Jung at Fig. 16A At step 202, the patient and the tooth to be measured are prepared. Any required cleaning or other tooth preparation would be performed at step 202. Any required patient consultation about the type of prosthesis or area of a tooth to be matched would be performed at (or before) step 202. In certain embodiments, a positioning device is prepared at step 202, such as is illustrated in FIGS. 17A and 17B. In such embodiments, for example, a black or other suitably-colored material 282, which may adhere to tooth 280 (such as with a suitable adhesive), is formed to have opening 281 larger than the diameter of the measuring probe, with opening 281 centered on the area of tooth 280 to be measured. **The material of positioning device 282 is formed in a manner to fit on/over tooth 280 (such as over the incisal edge of tooth 280 and/or over one or more adjacent teeth) so that it may be placed on/over tooth 280 in a repeatable manner.** Such a positioning device may serve to ensure that the desired area of

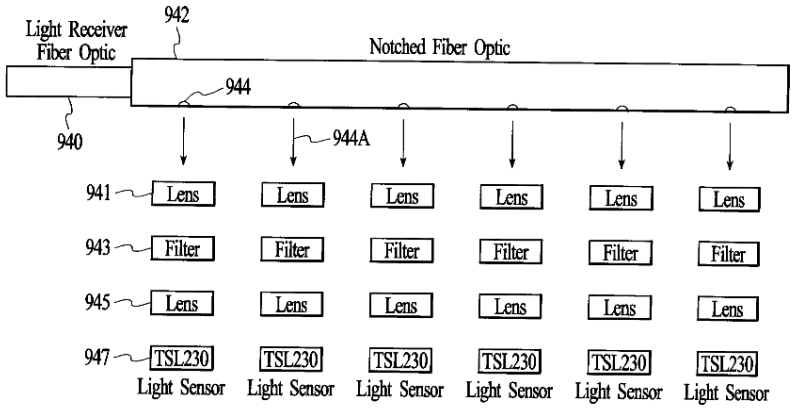
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	tooth 280 is measured, and also allows for repeat measurements of the same area for purposes of confirmation, fluorescence measurement, or other optical measurement, or the like. Any other pre-measurement activities may be performed at (or before) step 202. Jung at 28:35-56 Additionally, and to emphasize the wide utility and variability of various of the inventive concepts and techniques disclosed herein, it should be apparent to those skilled in the art in view of the disclosures herein that the apparatus and methodology may be utilized to measure the optical properties of objects/teeth using other optical focusing and gathering elements, in addition to the fiber optics employed in preferred embodiments herein. For example, lenses or mirrors or other optical elements may also be utilized to construct both the light source element and the light receiver element. A flashlight or other commonly available light source, as particular examples, may be utilized as the light source element, and a common telescope with a photoreceiver may be utilized as the receiver element in a large scale embodiment of the invention. Such refinements utilizing teachings provided herein are expressly within the scope of the present invention. Jung at 46:3-19. Additionally, and to emphasize the wide utility and variability of various of the inventive concepts and techniques disclosed herein, it should be apparent to those skilled in the art in view of the disclosures herein that the apparatus and methodology may be utilized to measure the optical properties of objects using other optical focusing and gathering elements, in addition to the fiber optics employed in preferred embodiments herein. For example, lenses or mirrors or other optical elements may also be utilized to construct both the light source element and the light receiver element. Jung at 48:35-45. As illustrated in FIG. 44, the cone of light produced by exemplary fiber optic 704 (illustrated by lines 712A) preferably is collimated with first aspheric lens (or fresnel lens) 706A (illustrated by lines 712B) prior to entering interference filter 708. Light emitted from filter 708 (illustrated by lines 712C) is "gathered" by second aspheric lens (or fresnel lens) 706B to concentrate (illustrated by lines 712D) as much light as possible on light sensor 710. In accordance with such embodiments, filters, particularly

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	interference-type filters, may more optimally be utilized in a manner to reduce such bandwidth spreading or other undesirable effects. Jung at 55:26-37. FIG. 45 illustrates a preferred embodiment of a light source used in preferred embodiments of the present invention. Such a light source preferably consists of halogen tungsten filament lamp 724, with a lens molded into the envelope of the lamp that produces a concentrated light pattern on an axis parallel to the body of lamp 724. The use of such a lens in lamp 724 is to concentrate the light output and to reduce the shadowing of the lamp filament that may result from lamps with reflectors. Jung at 57:26-34 As illustrated in FIG. 63, light exiting from notches/ports 944 may be coupled to light sensors 947. In the illustrated preferred embodiment, **the light is coupled to sensors 947 through lens 941, filter 943 and lens 945.** Filters 943 can be cut-off, interference or other filters as described elsewhere herein (e.g., to cover a desired spectral band or bands, and may include neutral density filters, etc.). Lens 941 and 945 preferably constitute GRIN lens and/or other lens of a type to assist in collimating or otherwise directing light from notches/ports 944 to sensors 947. As will be understood from description elsewhere herein, certain sensors may receive light without filters or through separate receivers (e.g., sensors for determining height or angle, etc.). Jung at 80:12-24

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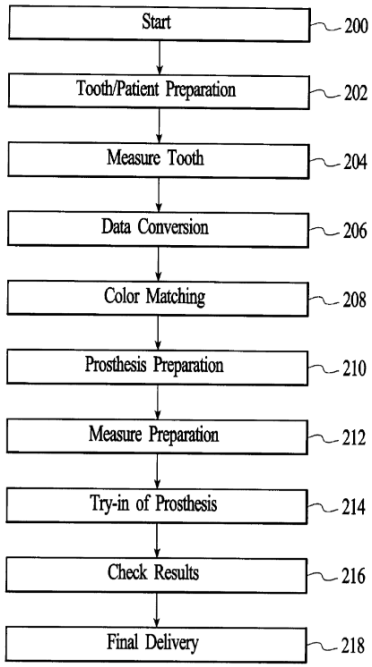
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	 FIG. 63 Jung at Fig. 63 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. the wearable device further comprising 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,	Jung discloses or renders obvious the wearable device further comprising 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. One method for eliminating the height and angular dependency of the light source and receiver is to provide a fixed mounting arrangement where the light source and receiver are stationary and the object is always positioned and measured at a preset height and angle. The fixed mounting arrangement greatly limits the applicability of such a method. Another method is to add mounting feet to the light source and receiver probe and to touch the object with the probe to maintain a constant height and

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	angle. The feet in such an apparatus must be wide enough apart to insure that a constant angle (usually perpendicular) is maintained relative to the object. Such an apparatus tends to be very difficult to utilize on small objects or on objects that are hard to reach, and in general does not work satisfactorily in measuring objects with curved surfaces. Such devices are particularly difficult to implement in the field of dentistry. Jung at 2:55-3:3. In accordance with the present invention, devices and methods are provided for measuring the color and other optical characteristics of objects such as teeth, reliably and with minimal problems of height and angular dependence and which may be applied to detecting or preventing counterfeiting or the like. A handheld probe is utilized in the present invention, with the handheld probe containing a number of fiber optics in certain preferred embodiments. **Light is directed from one (or more) light source(s) towards the object/tooth to be measured, which in certain preferred embodiments is a central light source fiber optic (other light sources and light source arrangements also may be utilized). Light reflected from the object is detected by a number of light receivers. Included in the light receivers (which may be light receiver fiber optics) are a plurality of perimeter and/or broadband or other receivers (which may be light receiver fiber optics, etc.).** In certain preferred embodiments, a number of groups of perimeter fiber optics are utilized in order to take measurements at a desired, and predetermined height and angle, thereby minimizing height and angular dependency problems found in conventional methods, and to quantify other optical characteristics such as gloss. In certain embodiments, the present invention also may measure gloss, translucence and fluorescence characteristics of the object/tooth being measured, as well as surface texture and/or other optical or surface characteristics. In certain embodiments, the present invention may distinguish the surface spectral reflectance response and also a bulk spectral response. Jung at 04:2-29 Probe tip 1 encloses a plurality of fiber optics, each of which may constitute one or more fiber optic fibers. In a preferred embodiment, the fiber optics contained within probe tip 1 includes a single light source fiber optic and a number of groups of light receiver fiber optics. The use of such fiber optics to measure the color or other optical characteristics of an object will be described later herein. Probe tip 1 is attached to probe body 2, on which is fixed switch 17. Switch 17 communicates with microprocessor

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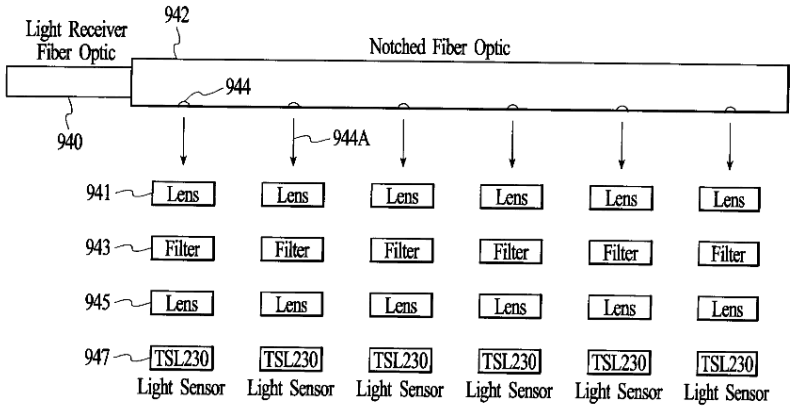
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	10 through wire 18 and provides, for example, a mechanism by which an operator may activate the device in order to make a color/optical measurement. Fiber optics within probe tip 1 terminate at the forward end thereof (i.e., the end away from probe body 2). The forward end of probe tip 1 is directed towards the surface of the object to be measured as described more fully below. The fiber optics within probe tip 1 optically extend through probe body 2 and through fiber optic cable 3 to light sensors 8, which are coupled to microprocessor 10. Jung at 8:47-65. In the embodiment of FIG. 1, the fiber optics from fiber optic cable 3 end at splicing connector 4. From splicing connector 4, each or some of the receiver fiber optics used in this embodiment is/are spliced into a number of smaller fiber optics (generally denoted as fibers 7), which in this embodiment are fibers of equal diameter, but which in other preferred embodiments may be of unequal diameter and/or numeric aperture (NA) (including, for example, larger or smaller "height/angle" or perimeter fibers, as more fully described herein). One of the fibers of each group of fibers may pass to light sensors 8 through a neutral density filter (as more fully described with reference to FIG. 3), and collectively such neutrally filtered fibers may be utilized for purposes of height/angle determination, translucency determination and gloss determination (and also may be utilized to measure other surface characteristics, as more fully described herein). Remaining fibers of each group of fibers may pass to light sensors 8 through color filters and may be used to make color/optical measurements. In still other embodiments, splicing connector 4 is not used, and fiber bundles of, for example, five or more fibers each extend from light sensors 8 to the forward end of probe tip 1. In certain embodiments, unused fibers or other materials may be included as part of a bundle of fibers for purposes of, for example, easing the manufacturing process for the fiber bundle. What should be noted is that, for purposes of the present invention, a plurality of light receiver fiber optics or elements (such as fibers 7) are presented to light sensors 8, with the light from the light receiver fiber optics/elements presenting light reflected from object 20. Jung at 9:10-39. **FIG. 16A is a flow chart illustrating a general dental application process flow for use of the color/optical measuring systems** and methods in accordance with the present invention. At step 200, the color/optical measuring system may be powered-up and stabilized, with any required initialization

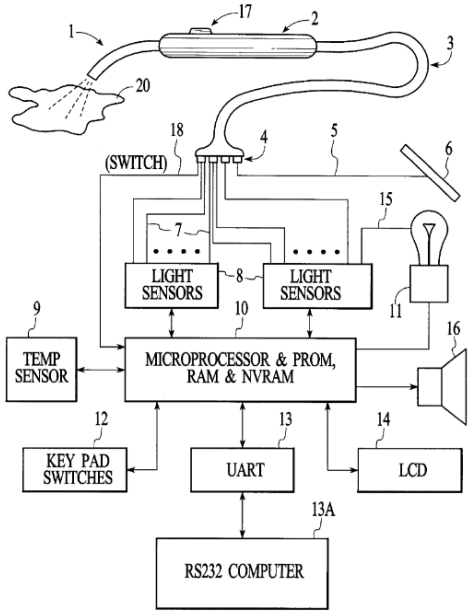
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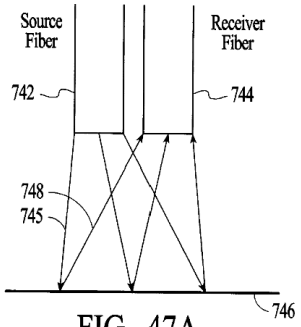
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	or other setup routines performed. At step 200, an indication of the system status may be provided to the operator, such as through LCD 14 or speaker 16 of FIG. 1. Also at step 200, the probe tip may be shielded or a clean probe tip may be inserted in order to reduce the likelihood of contamination (see, e.g., FIGS. 7A to 8B and related description). In other embodiments, a plastic or other shield may also be used (which may be disposable, cleanable/reusable, etc., as previously described), so long as it is constructed and/or positioned so as to not adversely affect the measurement process. Jung at 28:19- 34  FIG. 16A Jung at Fig. 16A At step 202, the patient and the tooth to be measured are prepared. Any required cleaning or other tooth preparation would be performed at step 202. Any required patient consultation about the type of prosthesis or area of a tooth to be matched would be performed at (or before) step 202. In certain

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	embodiments, a positioning device is prepared at step 202, such as is illustrated in FIGS. 17A and 17B. In such embodiments, for example, a black or other suitably-colored material 282, which may adhere to tooth 280 (such as with a suitable adhesive), is formed to have opening 281 larger than the diameter of the measuring probe, with opening 281 centered on the area of tooth 280 to be measured. **The material of positioning device 282 is formed in a manner to fit on/over tooth 280 (such as over the incisal edge of tooth 280 and/or over one or more adjacent teeth) so that it may be placed on/over tooth 280 in a repeatable manner.** Such a positioning device may serve to ensure that the desired area of tooth 280 is measured, and also allows for repeat measurements of the same area for purposes of confirmation, fluorescence measurement, or other optical measurement, or the like. Any other pre-measurement activities may be performed at (or before) step 202. Jung at 28:35-56 As illustrated in FIG. 63, light exiting from notches/ports 944 may be coupled to light sensors 947. In the illustrated preferred embodiment, **the light is coupled to sensors 947 through lens 941, filter 943 and lens 945.** Filters 943 can be cut-off, interference or other filters as described elsewhere herein (e.g., to cover a desired spectral band or bands, and may include neutral density filters, etc.). Lens 941 and 945 preferably constitute GRIN lens and/or other lens of a type to assist in collimating or otherwise directing light from notches/ports 944 to sensors 947. As will be understood from description elsewhere herein, certain sensors may receive light without filters or through separate receivers (e.g., sensors for determining height or angle, etc.). Jung at 80:12-24

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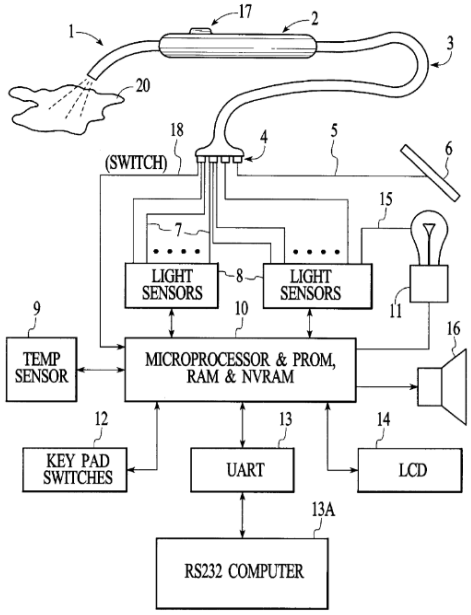
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	 FIG. 63 Jung at Fig. 63 **With reference to FIG. 1, an exemplary preferred embodiment of a color/optical characteristic measuring system** and method in accordance with the present invention will be described. It should be noted that, at various places herein, such a color measuring system is sometimes referred to as an intraoral reflectometer, etc Jung at 8:41- 46

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	 FIG. 1 Jung at Fig. 1 FIG. 47A illustrates the fiber pair at the peaking height, while FIG. 47B illustrates the fiber pair at the critical height. At the critical height, **the only light reflecting from the surface that can be received by receiver fiber 744 is the source ray 745 and the reflected ray 748 with angle of incidence equal to angle of reflection, or it can only detect “spectrally” reflected light.** When the probe is at the peaking height, however, the reflected light rays that can be received by the receiver fiber vary over both a wider angle of incidence range and wider angle of reflection range. Thus, at the peaking height, the receiver is detecting a broad range of incident angle light rays and reflected angle light rays. By adjusting the spectrum for height shifts as described above and by detecting the angle of the probe relative to the surface of the material or object, the reflected or returned spectrum can be measured over a wide incident angular range and reflected angular range. Jung at 60:33- 49

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	 FIG. 47A Jung at Fig 47A Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. **In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise.** Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The 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. **The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations.** Jung at 68:13-32 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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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1[e]. wherein the detection system is configured to be synchronized to the light source;	Jung discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. **In general, under control of microprocessor 10,** which may be in response to operator activation (through, for example, key pad switches 12 or switch 17), **light is directed from light source 11, and reflected from cold mirror 6 through source fiber optic 5 (and through fiber optic cable 3, probe body 2 and probe tip 1) or through some other suitable light source element and is directed onto object 20. Light reflected from object 20 passes through the receiver fiber optics/elements in probe tip 1 to light sensors 8 (through probe body 2, fiber optic cable 3 and fibers 7). Based on the information produced by light sensors 8, microprocessor 10 produces a color/optical measurement result or other information to the operator. Color measurement or other data produced by microprocessor 10 may be displayed on display** 14, passed through UART 13 to computer 13A, or used to generate audio information that is presented to speaker 16. Other operational aspects of the preferred embodiment illustrated in FIG. 1 will be explained hereinafter. Jung at 11:04-21

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	 FIG. 1 Jung at Fig. 1 In an alternate embodiment, iris 718 is replaced by disk 730, which preferably includes a pattern of holes positioned near its perimeter as illustrated in FIGS. 46A and 46B. Preferably, disk 730 is driven with stepping motor 738 through gear 736 and gear teeth 730A so that disk 730 may be rapidly moved to a desired position and held it in a stable position in order to make a light measurement. Stepping motor 738 is controlled by a computer (such as described elsewhere herein; see, e.g., FIGS. 38 and 39), which controls disk 730 to rotate about axis 732 and stop in a desired and controllable position. **Thus, such a computer in effect can vary the NA of the light source synchronously to each measurement. The procedure preferably progresses as follows.** Jung at 58:16-29

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	In one alternate embodiment, the three monochrome sources are not filtered and are supplied light with the same spectral properties as the inner and outer rings (the three sources in such embodiments may not be monochrome, but may be broad-band). With such an alternate embodiment, the light sources may be alternately turned on and off in a manner synchronous with the measurement of spectral data. As an exemplary operation of such an alternative, as the probe approaches a material or object, the inner ring source may be turned on and a measurement is made. The inner ring may then be turned off and the outer ring turned on and a measurement is made. Both inner and outer rings may then be turned off and the three monochrome (or broadband) sources are each in turn turned on and off as a measurement made. The plurality of spectrums or measurements are utilized to determine the optical properties of the material and to measure and/or adjust for height and angular changes in accordance with previously described principles. Jung at 67:48-65. The 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. The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations. Jung at 68:27-32. 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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one	Jung 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 spatially separated detectors.

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analog to digital converter is coupled to at least one of the spatially separated detectors;	It is known that certain objects such as human teeth may fluoresce, and such optical characteristics also may be measured in accordance with the present invention. A light source with an ultraviolet component may be used to produce more accurate color/optical data with respect to such objects. Such data may be utilized to adjust the amounts and or proportions or types of dental fluorescing materials in dental restorations or prosthesis. In certain embodiments, a tungsten/halogen source (such as used in a preferred embodiment) may be combined with a UV light source (such as a mercury vapor, xenon or other fluorescent light source, etc.) to produce a light output capable of causing the object to fluoresce. Alternately, a separate UV light source, combined with a visible-light-blocking filter, may be used to illuminate the object. Such a UV light source may be combined with light from a red LED (for example) in order to provide a visual indication of when the UV light is on and also to serve as an aid for the directional positioning of the probe operating with such a light source. A second measurement may be taken using the UV light source in a manner analogous to that described earlier, with the band of the red LED or other supplemental light source being ignored. The second measurement may thus be used to produce an indication of the fluorescence of the tooth or other object being measured. With such a UV light source, a silica fiber optic (or other suitable material) typically would be required to transmit the light to the object (standard fiber optic materials such as glass and plastic in general do not propagate UV light in a desired manner, etc.). As described earlier, in certain preferred embodiments the present invention utilizes a plurality of perimeter receiver fiber optics spaced apart from and around a central source fiber optic to measure color and determine information regarding the height and angle of the probe with respect to the surface of the object being measured, which may include other surface characteristic information, etc. Without being bound by theory, certain principles underlying certain aspects of the present invention will now be described with reference to FIGS. 4A to 4C. FIG. 4A illustrates a typical step index fiber optic consisting of a core and a cladding. For this discussion, it is assumed that the core has an index of refraction of n0 and the cladding has an index of refraction of n1 . Although the following discussion is directed to "step index" fibers, it will be appreciated by those of skill in the art that such discussion generally is applicable for gradient index fibers as well. Jung at 15:33-16:11

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	The operator may initiate a color/optical measurement by activation of a switch (such as switch 17 of FIG. 1) at step 150. Thereafter, if the system is ready (set-up, initialized, calibrated, etc.), a lower-the-probe tone is emitted (such as through speaker 16 of FIG. 1) at step 152. **The system attempts to detect peak intensity P1 at step 154. If a peak is detected, at step 156 a determination is made whether the measured peak P1 meets the applicable criteria (such as discussed above in connection with FIGS. 5A, 5B and 6). If the measured peak P1 is accepted, a first peak acceptance tone is generated at step 160. If the measured peak P1 is not accepted, an unsuccessful tone is generated at step 158, and the system may await the operator to initiate a further color/optical measurement.** Assuming that the first peak was accepted, the system attempts to detect peak intensity P2 at step 162. If a second peak is detected, at step 164 a determination is made whether the measured peak P2 meets the applicable criteria. If the measured peak P2 is accepted the process proceeds to color calculation step 166 (in other embodiments, a second peak acceptance tone also is generated at step 166). If the measured peak P2 is not accepted, an unsuccessful tone is generated at step 158, and the system may await the operator to initiate a further color/optical measurement. Assuming that the second peak was accepted, a color/optical calculation is made at step 166 (such as, for example, microprocessor 10 of FIG. 1 processing the data output from light sensors 8, etc.). At step 168, a determination is made whether the color calculation meets the applicable criteria. If the color calculation is accepted, a successful tone is generated at step 170. If the color calculation is not accepted, an unsuccessful tone is generated at step 158, and the system may await the operator to initiate a further color/optical measurement. Jung at 27:35-67 **As described elsewhere herein, in accordance with preferred embodiments of the present invention devices and methods for measuring the color and other optical properties of teeth and other materials may be provided. In at least certain of such embodiments, a probe preferably consisting of a bundle of fiber optics may be utilized to illuminate the object or material being measured and to detect light reflected or otherwise returned from the object or material.** The fibers were either source fibers (those providing light to the object or material) or receiver fibers (those used to detect light returned from the object or material). Generally, and as described elsewhere herein, receiver fibers were utilized in a plurality of ways. Some of the fibers served as angle or height detectors and provided light to broad band optical sensors. Other fibers served as spectrometric detectors and provided light to a spectrometer for spectral or color analysis. Jung at 27:35-67

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	One or more of receiver(s) B 454 (in certain embodiments one receiver B may be utilized, while in other embodiments a plurality of receivers B are utilized, which may be circularly arranged around source A, such as 6 or 8 such receivers B) pass to a spectrometer (see, e.g., FIGS. 1, 3, 11, 12, configured as appropriate for such preferred embodiments). Jung at 39:51-56. In accordance with other alternative embodiments of the present invention, improved spectrometer-type systems may be produced. FIG. 59 is a block diagram of one such alternative embodiment. As illustrated, linear (or array) optical sensor 900, which preferably includes an optical manifold that receives and directs light of a given wavelength to appropriate sensing elements provided in linear optical sensor 900. Optical manifolds that direct light of a given wavelength are known in the art and may be constructed, for example, of diffraction gratings or optical filters (such as the optical manifolds and implements of the type described elsewhere herein). **The output of linear optical sensor 900 passes through variable gain amplifier 906, to sample and hold amplifier 908 and to analog-to-digital converter (ADC) 910. Such variable gain amplifiers, sample and hold amplifiers and ADCs are known in the art and are sometimes available as a single unit.** It is desired that the ADC have the desired precision and that the overall system provide for the speed required for the particular application. Jung at 75:44-63 Referring now to FIG. 52, an embodiment of the present invention utilizing probe 800 (illustrated in cross section) including central receiver 802 (preferably a fiber optic) surrounded by two rings 806 and 810 of light sources (also preferably fiber optics). Rings 806 and/or 810 in preferred embodiments are constructed of strands and/or a ring of fiber optics. In alternate embodiments rings 806 and 810 are constructed of cylindrical light guides. FIG. 53 illustrates an embodiment of the present invention utilizing probe 812 (illustrated in cross section) including central receiver 814 (also preferably a fiber optic) surrounded by two rings of sources (preferably fiber optics) where the inner ring includes a plurality of sources or fiber optics 816 and 818, preferably six evenly spaced apart, and the outer ring includes a plurality sources or fiber optics 820, preferably twelve evenly spaced apart. As will be described in greater detail later, the use of two rings of light sources in such embodiments may be in used in accordance with the present invention to provide a method for measuring the opalescence or other optical characteristics of materials or objects.

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	Jung at 65:55-66:7. Thus, if the spectrometer system is constructed with a linear or matrix array where the light receivers intensity is output serially to an analog to digital converter (ADC), then the range of the ADC and the precision of the ADC must be large enough to accommodate the high red light sensitivity (or else the system will saturate rendering the measurement invalid) and it must also be precise enough to permit the low sensitivity elements to have sufficient gain to make quality measurements. Jung at 75:14-23. 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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the	Jung discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. Microprocessor 10 also communicates with UART 13, which enables microprocessor 10 to be coupled to an external device such as computer 13A. In such embodiments, data provided by microprocessor 10 may be processed as desired for the particular application, such as for averaging, format conversion or for various display or print options, etc. In the preferred embodiment, UART 13 is configured so as to provide what is known as a RS232 interface, such as is commonly found in personal computers. Jung at 10:18-26.

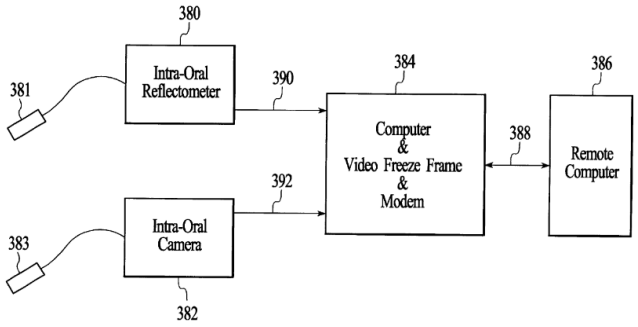
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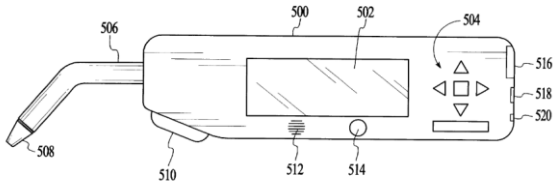
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processed output signal is configured to be transmitted over a wireless transmission link;	In general, under control of microprocessor 10, which may be in response to operator activation (through, for example, key pad switches 12 or switch 17), light is directed from light source 11, and reflected from cold mirror 6 through source fiber optic 5 (and through fiber optic cable 3, probe body 2 and probe tip 1) or through some other suitable light source element and is directed onto object 20. Light reflected from object 20 passes through the receiver fiber optics/elements in probe tip 1 to light sensors 8 (through probe body 2, fiber optic cable 3 and fibers 7). Based on the information produced by light sensors 8, microprocessor 10 produces a color/optical measurement result or other information to the operator. Color measurement or other data produced by microprocessor 10 may be displayed on display 14, passed through UART 13 to computer 13A, or used to generate audio information that is presented to speaker 16. Other operational aspects of the preferred embodiment illustrated in FIG. 1 will be explained hereinafter. Jung at 11:4-21 With the spectral/color information produced by the present invention, data may be converted to such formats through conventional math, for example. Such math may be performed by microprocessor 10 or computer 13A of FIG. 1, or in some other manner. Jung at 29:16-21 At step 207, a first amount of material to be removed is calculated or estimated (such as by microprocessor 10, computer 13A or other suitable computing device). Jung at 30:62-65. In another particular aspect of the present invention, for example, data processing such as illustrated in FIG. 18 may be taken in conjunction with the processes of FIGS. 16A and/or 16B. At step 286, client database software is run on a computing device, such as computer 13A of FIG. 1. Such software may include data records for each patient, including fields storing the history of dental services performed on the patient, information regarding the status or condition of the patient's teeth, billing, address and other information. Such software may enter a mode by which it is in condition to accept color or other data taken in accordance with the present invention.

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	At step 288, for example, the dentist or other dental professional may select parameters for a particular tooth of the patient to be measured. Depending on the size and condition of the tooth (such as color gradient or the like), the dentist may sector the tooth into one or more regions, such as a grid. Thus, for example, in the case of tooth for which it is decided to take four measurements, the tooth may be sectored into four regions. Such parameters, which may include a pictorial representation on the computer of the tooth sectored into four regions (such as by grid lines), along with tooth identification and patient information may be entered into the computer at this time. At step 290, one or more measurements of the tooth may be taken, such as with a system and method as described in connection with FIGS. 1, SA, SB and/or 6. The number of such measurements preferably is associated with the parameters entered at step 288. Thereafter, at step 292, the data collected from the measurement(s) may be sent to the computer for subsequent processing. As an illustrative example, four color/optical measurements may be taken (for the four regions of the tooth in the above example) and sent to the computer, with the data for the four color/optical measurements (such as RGB or other values) associated with the four regions in accordance with the entered parameters. Jung at 31:30-66. Intraoral reflectometer 380, which may be constructed as described above, includes probe 381. **Data output from reflectometer 380 is coupled to computer 384 over bus 390 (which may be a standard serial or parallel bus, etc.). Computer 384 includes a video freeze frame capability and preferably a modem. Intraoral camera 382 includes handpiece 383 and couples video data to computer 384 over bus 392. Computer 384 is coupled to remote computer 386 over telecommunication channel 388, which may be a standard telephone line, ISDN line, a LAN or WAN connection, etc. With such an embodiment, video measurements may be taken of one or more teeth by intraoral camera 382, along with optical measurements taken by intraoral reflectometer 380. Computer 384 may store still picture images taken from the output of intraoral camera 382.** Jung at 36:29-43

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	 FIG. 24 Jung at Fig. 24 The system battery may be charged in charging stand 526 in a conventional manner. A charging indicator (such as lamps 528) may be used to provide an indication of the state of the internal battery. Unit 500 may be removed from the stand, and an optical measurement may be made by the dentist. If the dentist chooses, the optical measurement may be read from display 502, and a prescription may be handwritten or otherwise prepared by the dentist. **Alternately, the color/optical characteristics data may be transmitted by wireless IR transceiver 514 (or other cordless system such as RF) to a wireless transceiver, such as transceiver 530** of charging stand 526. The prescription may then be electronically created based upon the color/optical characteristics data. The electronic prescription may be sent from serial port 524 to a computer or modem or other communications channel to the dental laboratory. Jung at 44:50-65

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	 FIG. 35 Jung at Fig. 35 FIG. 38 illustrates an abridged visible light range spectrometer in accordance with another embodiment of the present invention. This embodiment utilizes TSL230 sensors 616, a light source or lamp 604, preferably a hot mirror that reflects IR light with wavelengths above 700 nanometers (not expressly shown in FIG. 38), fiber optic cable assembly consisting of one or more sources (illustrated by light path 608) providing light to object 606, and one or more receivers (illustrated by light path 618) receiving light from object 606, gate array 602 such as an Altera FLEX 10K30™ (believed to be a trademark of Altera Corporation), which is coupled to computer 600 and receives signal inputs from sensors 616 over bus 620. In one preferred embodiment up to fifteen or more TSL230 sensors are utilized. Each TSL230 sensor 616 has an interference filter 614 positioned above the sensor, with each filter preferably having a nominal bandwidth of 20 nanometers (or other bandwidth suitable for the particular application). Sensors 616 also preferably receive a small and controlled amount of light (light path 610) directly from light source 604, preferably after IR filtering. The light source input to sensors 616 serves to bias sensors 616 to produce an output of at least 200 Hz when no light is input to sensors 616 from filters 614. Thus, sensors 616 will always produce an output signal frequency greater than or equal to the sampling frequency of the system. When input light intensities are small, the frequency change is small, and when the light input is large, the frequency change will be large. The scale and sensitivity of sensors 616 are set (by gate array 602 over control bus 612, which may be under control of computer 600) to detect the entire range of light input values. In most cases, particularly in object color determination, the maximum amount of light input into any one of sensors 616 is determined by light source 604 and filters 614 and can be appropriately controlled. Jung at 50:12-45.

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	Such a further embodiment of the present invention is illustrated in FIG. 39. In accordance with this embodiment, light source 638 provides light coupled through a light path (preferably light source fiber 636) to probe 630 through optical cable 632. Light received by the probe (i.e., returned 65 from the object or material being evaluated) is coupled to spectrometer/light sensors 640 through a suitable light path (preferably one or more light receiver fibers from optical cable 632). Computer 642 is coupled to spectrometer/light sensors 640 by way of control/data bus 648. Computer 642 also is coupled to light source 638 by way of control line(s) 646, which preferably control the on/off condition of light source 638, and optionally may provide other control information, analog or digital signal levels, etc., to light source 638 as may be desired to optimally control the particular light chosen for light source 638, and its particular characteristics, and for the particular application. Light from light source 638 optionally may be coupled to spectrometer/ light sensors 640 by light path 644, such as for purposes of providing light bias (if required or desired for the particular spectrometer chosen), or for monitoring the characteristics of light source 638 (such as drift, temperature effects and the like). Computer 642 may be a conventional computer such as a PC or microcontroller or other processing device, and preferably is coupled to a user interface (e.g., display, control switches, keyboard, etc.), which is generically illustrated in FIG. 39 by interface 652. Optionally, computer 642 is coupled to other computing devices, such as may be used for data processing, manipulation, storage or further display, through interface 650. Computer 642 preferably includes the typical components such as (but not limited to) a CPU, random access or other memory, non-volatile memory/storage for storing program code, and may include interfaces for the user such as display, audio generators, keyboard or keypad or touch screen or mouse or other user input device (which may be through interface 652), and optionally interfaces to other computers such as parallel or serial interfaces (which may be through interface 650). Computer 642 interfaces to spectrometer/light sensors 640 for control of the spectrometer and overall system and to receive light intensity and light spectrum data from spectrometer/light sensors 640. In a preferred embodiment, control/data bus 648 for interfacing to spectrometer/light sensors 640 is a standard 25 pin bi-directional parallel port. In certain embodiments, computer 642 may be separate, standalone and/or detachable from spectrometer/light sensors 640 and may be a conventional laptop, notebook or other portable or handheld-type personal computer. In other embodiments, computer 642 may be an integral part of the system contained in one or more enclosure(s), and may be an embedded personal computer or other type of integrated computer. Purposes of computer 642 preferably include controlling light source 638 and

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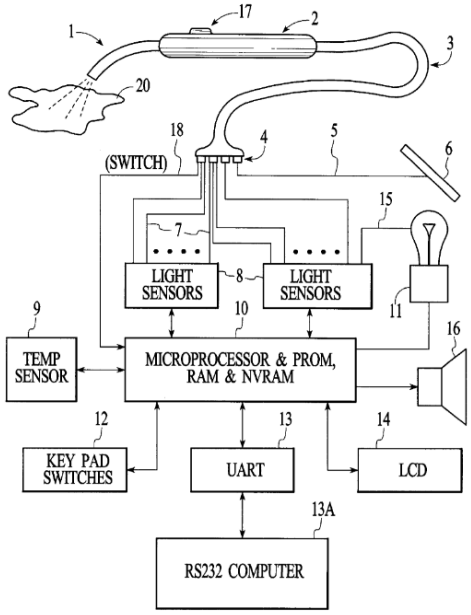
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	spectrometer/light sensors 640, receiving light intensity and spectral or other data output from spectrometer/light sensors 640, analyzing received or other data and determining the optical properties of the object or material, and displaying or outputting data to a user or other computing device or data gathering system. Jung at 51:61-52:52. Input/output may be made to processor 981 by input/output circuitry 982, which may include (such as described elsewhere herein), components of a computer, display, keyboard or switches or other input, etc. Such components optimally may be installed on a small printed circuit board 983 or other appropriate substrate, etc. Jung at 90:18-24. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, 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 one or more of the physiological parameters;	Jung discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. In accordance with the present invention, devices and methods are provided for measuring the color and other optical characteristics of objects such as teeth, reliably and with minimal problems of height and angular dependence and which may be applied to detecting or preventing counterfeiting or the like. A handheld probe is utilized in the present invention, with the handheld probe containing a number of fiber optics in certain preferred embodiments. **Light is directed from one (or more) light source(s) towards the object/tooth to be measured, which in certain preferred embodiments is a central light source fiber optic (other light sources and light source arrangements also may be utilized). Light reflected from the object is detected by a number of light receivers. Included in the light receivers (which**

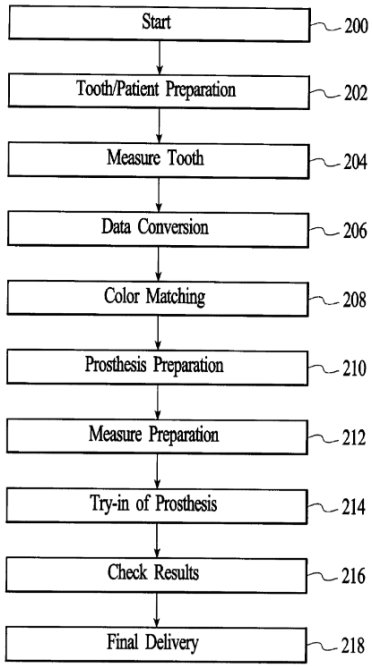
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	may be light receiver fiber optics) are a plurality of perimeter and/or broadband or other receivers (which may be light receiver fiber optics, etc.). In certain preferred embodiments, a number of groups of perimeter fiber optics are utilized in order to take measurements at a desired, and predetermined height and angle, thereby minimizing height and angular dependency problems found in conventional methods, and to quantify other optical characteristics such as gloss. In certain embodiments, the present invention also may measure gloss, translucence and fluorescence characteristics of the object/tooth being measured, as well as surface texture and/or other optical or surface characteristics. In certain embodiments, the present invention may distinguish the surface spectral reflectance response and also a bulk spectral response. Jung at 4:2-29 Probe tip 1 encloses a plurality of fiber optics, each of which may constitute one or more fiber optic fibers. In a preferred embodiment, the fiber optics contained within probe tip 1 includes a single light source fiber optic and a number of groups of light receiver fiber optics. The use of such fiber optics to measure the color or other optical characteristics of an object will be described later herein. Probe tip 1 is attached to probe body 2, on which is fixed switch 17. Switch 17 communicates with microprocessor 10 through wire 18 and provides, for example, a mechanism by which an operator may activate the device in order to make a color/optical measurement. Fiber optics within probe tip 1 terminate at the forward end thereof (i.e., the end away from probe body 2). The forward end of probe tip 1 is directed towards the surface of the object to be measured as described more fully below. The fiber optics within probe tip 1 optically extend through probe body 2 and through fiber optic cable 3 to light sensors 8, which are coupled to microprocessor 10. Jung at 8:47-65. **With reference to FIG. 1, an exemplary preferred embodiment of a color/optical characteristic measuring system** and method in accordance with the present invention will be described. It should be noted that, at various places herein, such a color measuring system is sometimes referred to as an intraoral reflectometer, etc Jung at 8:41- 46

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	It is known that certain objects such as human teeth may fluoresce, and such optical characteristics also may be measured in accordance with the present invention. A light source with an ultraviolet component may be used to produce more accurate color/optical data with respect to such objects. Such data may be utilized to adjust the amounts and or proportions or types of dental fluorescing materials in dental restorations or prosthesis. In certain embodiments, a tungsten/halogen source (such as used in a preferred embodiment) may be combined with a UV light source (such as a mercury vapor, xenon or other fluorescent light source, etc.) to produce a light output capable of causing the object to fluoresce. **Alternately, a separate UV light source, combined with a visible-light-blocking filter, may be used to illuminate the object. Such a UV light source may be combined with light from a red LED (for example) in order to provide a visual indication of when the UV light is on and also to serve as an aid for the directional positioning of the probe operating with such a light source**. A second measurement may be taken using the UV light source in a manner analogous to that described earlier, with the band of the red LED or other supplemental light source being ignored. The second measurement may thus be used to produce an indication of the fluorescence of the tooth or other object being measured. With such a UV light source, a silica fiber optic (or other suitable material) typically would be required to transmit the light to the object (standard fiber optic materials such as glass and plastic in general do not propagate UV light in a desired manner, etc.). Jung at 15:33-61

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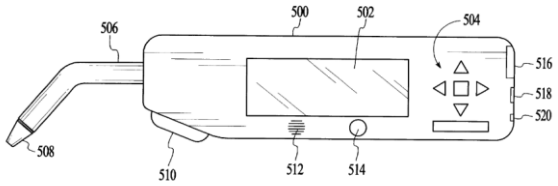
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	 FIG. 1 Jung at Fig. 1 **FIG. 16A is a flow chart illustrating a general dental application process flow for use of the color/optical measuring systems** and methods in accordance with the present invention. At step 200, the color/optical measuring system may be powered-up and stabilized, with any required initialization or other setup routines performed. At step 200, an indication of the system status may be provided to the operator, such as through LCD 14 or speaker 16 of FIG. 1. Also at step 200, the probe tip may be shielded or a clean probe tip may be inserted in order to reduce the likelihood of contamination (see, e.g., FIGS. 7A to 8B and related description). In other embodiments, a plastic or other shield may also be used (which may be disposable, cleanable/reusable, etc., as previously described), so long as it is constructed and/or positioned so as to not adversely affect the measurement process. Jung at 28:19- 34

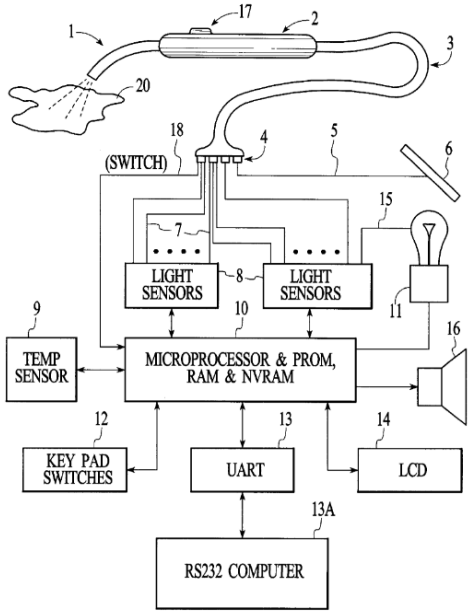
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	 FIG. 16A Jung at Fig. 16A At step 202, the patient and the tooth to be measured are prepared. Any required cleaning or other tooth preparation would be performed at step 202. Any required patient consultation about the type of prosthesis or area of a tooth to be matched would be performed at (or before) step 202. In certain embodiments, a positioning device is prepared at step 202, such as is illustrated in FIGS. 17A and 17B. In such embodiments, for example, a black or other suitably-colored material 282, which may adhere to tooth 280 (such as with a suitable adhesive), is formed to have opening 281 larger than the diameter of the measuring probe, with opening 281 centered on the area of tooth 280 to be measured. **The material of positioning device 282 is formed in a manner to fit on/over tooth 280 (such as over the incisal edge of tooth 280 and/or over one or more adjacent teeth) so that it may be placed on/over tooth 280 in a repeatable manner.** Such a positioning device may serve to ensure that the desired area of

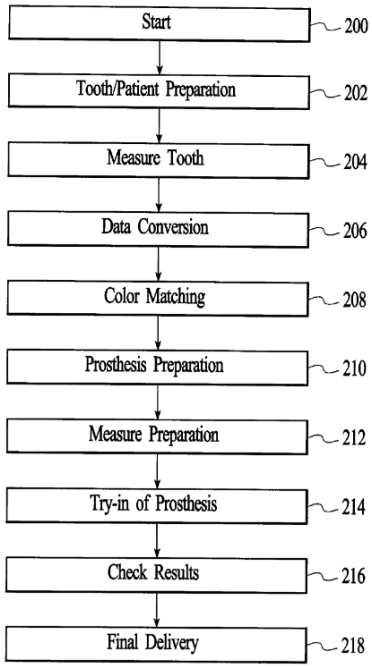
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	tooth 280 is measured, and also allows for repeat measurements of the same area for purposes of confirmation, fluorescence measurement, or other optical measurement, or the like. Any other pre-measurement activities may be performed at (or before) step 202. Jung at 28:35-56 Color/optical characteristics of the object may be determined from the plurality of color sensor measurements, which may include three such sensors in the case of a tristimulus instrument, or 8, 12, 15 or more color sensors for a more full bandwidth system (the precise number may be determined by the desired color resolution, etc.). Jung at 33:9-15. As with previously described embodiments, the reflectivity measurements may then be used to determine optical characteristics of the object being measured, etc. Jung at 35:5-9. The color sensors are utilized to determine the color or other optical characteristics of the object, and the perimeter sensors are utilized to determine if the probe is perpendicular to the surface and/or are utilized to compensate for non-perpendicularangles within certain angular ranges. Jung at 35:40-45. Intraoral reflectometer 380, which may be constructed as described above, includes probe 381. **Data output from reflectometer 380 is coupled to computer 384 over bus 390 (which may be a standard serial or parallel bus, etc.). Computer 384 includes a video freeze frame capability and preferably a modem. Intraoral camera 382 includes handpiece 383 and couples video data to computer 384 over bus 392. Computer 384 is coupled to remote computer 386 over telecommunication channel 388, which may be a standard telephone line, ISDN line, a LAN or WAN connection, etc. With such an embodiment, video measurements may be taken of one or more teeth by intraoral camera 382, along with optical measurements taken by intraoral reflectometer 380. Computer 384 may store still picture images taken from the output of intraoral camera 382.** Jung at 36:29-43

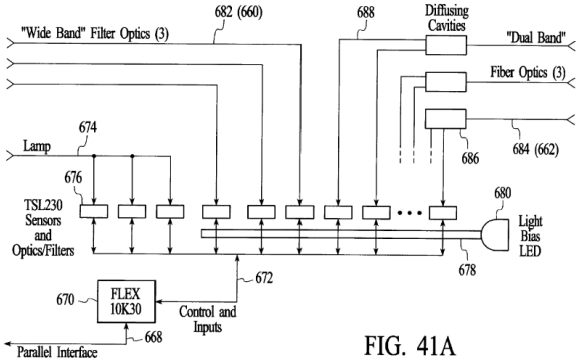
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	 FIG. 35 Jung at Fig. 35 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. 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;	Jung discloses or renders obvious 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. **With reference to FIG. 1, an exemplary preferred embodiment of a color/optical characteristic measuring system** and method in accordance with the present invention will be described. It should be noted that, at various places herein, such a color measuring system is sometimes referred to as an intraoral reflectometer, etc Jung at 8:41- 46

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	 FIG. 1 Jung at Fig. 1 **FIG. 16A is a flow chart illustrating a general dental application process flow for use of the color/optical measuring systems** and methods in accordance with the present invention. At step 200, the color/optical measuring system may be powered-up and stabilized, with any required initialization or other setup routines performed. At step 200, an indication of the system status may be provided to the operator, such as through LCD 14 or speaker 16 of FIG. 1. Also at step 200, the probe tip may be shielded or a clean probe tip may be inserted in order to reduce the likelihood of contamination (see, e.g., FIGS. 7A to 8B and related description). In other embodiments, a plastic or other shield may also be used (which may be disposable, cleanable/reusable, etc., as previously described), so long as it is constructed and/or positioned so as to not adversely affect the measurement process. Jung at 28:19- 34

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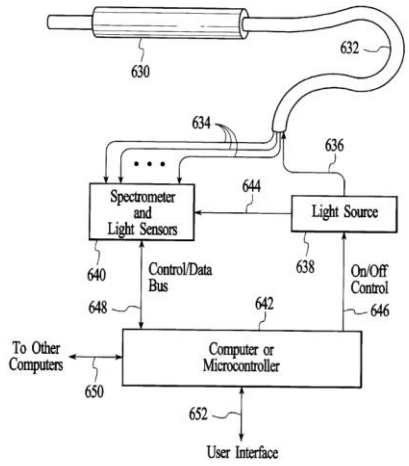
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	confirmation, fluorescence measurement, or other optical measurement, or the like. Any other pre-measurement activities may be performed at (or before) step 202. Jung at 28:35-56 Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. **In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise.** Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The 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. **The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations.** Jung at 68:13-32 FIGS. 14A and 14B illustrate exemplary intensity measurements using a cut-off filter arrangement such as illustrated in FIG. 13B, first in the case of a white surface being measured (FIG. 14A), and also in the case of a blue surface being measured (FIG. 14B). As illustrated in FIG. 14A, in the case of a white surface, the neutrally filtered perimeter fiber optics, **which are used to detect height and angle, etc., generally will produce the highest intensity** (although this depends at least in part upon the characteristics of the neutral density filters). **As a result of the stepped cut-off filtering provided by filters having the characteristics illustrated in FIG. 13B, the remaining intensities will gradually decrease in value as illustrated in FIG. 14A.** In the case of a blue surface, the intensities will decrease in value generally as illustrated in FIG. 14B. Regardless of the surface, however, the intensities out of the filters will always decrease in value as illustrated, with the greatest intensity value being the output of the filter having the lowest wavelength cut-off value (i.e., passes all visible light up to blue), and the lowest intensity value being the output of the filter having the highest wavelength cut-off (i.e., passes only red visible light). As will be understood from the foregoing description, any color data detected that does not fit the decreasing intensity profiles of FIGS. 14A and 14B may be detected as an abnormality,

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	and in certain embodiments detection of such a condition results in data rejection, generation of an error message or initiation of a diagnostic routine, etc. Jung at 26:64-27:23 In certain situations, a long time may be required for the light source and for the light bias source to stabilize. In other situations, the light source and bias source may drift. In preferred embodiments, the light source is a 18 W, 3300 K halogen stabilized tungsten filament lamp manufactured by Welch Allyn, Inc. **The light bias preferably is provided by a high intensity LED and a fiber optic light guide or conduit (see LED 680 and light conduit 678 of FIG. 41A) that passes to each biased sensor of sensors 676. The intensity of LED 680 preferably is controlled and varied with high frequency pulse width modulation, or by analog constant current controllers.** By controlling the intensity of bias LED 680, the bias light level can be varied to best match the sensor sampling rate. Jung at 56:33-47  FIG. 41A Jung at Fig.41A One approach in certain spectrometer systems, particularly those utilized for reflectance measurements, has been to optically normalize in order to flatten the spectral response. This may be done, for example, by reducing the intensity of the red light input to the spectrometer with filters or mirrors or the like, such as interference filters, to reduce the intensity of red light on the sensors and force the red intensity to be within the range of the blue sensors. The disadvantage of such systems is that it causes the noise level of the red sensors to be increased to the noise level of the blue sensors since the signal

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	from the red sensors is reduced, requiring an increase in overall system gain, hence the system noise is forced to the level of the lowest sensitivity input. Jung at 75:31-43. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, 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 semiconductor sources are off,	Jung discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off. Such a further embodiment of the present invention is illustrated in FIG. 39. In accordance with this embodiment, light source 638 provides light coupled through a light path (preferably light source fiber 636) to probe 630 through optical cable 632. Light received by the probe (i.e., returned from the object or material being evaluated) is coupled to spectrometer/light sensors 640 through a suitable light path (preferably one or more light receiver fibers from optical cable 632). Computer 642 is coupled to spectrometer/light sensors 640 by way of control/data bus 648. Computer 642 also is coupled to light source 638 by way of control line(s) 646, **which preferably control the on/off condition of light source 638, and optionally may provide other control information, analog or digital signal levels, etc., to light source 638 as may be desired to optimally control the particular light chosen for light source 638, and its particular characteristics, and for the particular application. Light from light source 638 optionally may be coupled to spectrometer/light sensors 640 by light path 644, such as for purposes of providing light bias (if required or desired for the particular spectrometer chosen), or for monitoring the characteristics of light source 638 (such as drift, temperature effects and the like).** Jung at 51:61-52:16

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	 FIG. 39 Jung at Fig. 39 In one alternate embodiment, the three monochrome sources are not filtered and are supplied light with the same spectral properties as the inner and outer rings (the three sources in such embodiments may not be monochrome, but may be broad-band). **With such an alternate embodiment, the light sources may be alternately turned on and off in a manner synchronous with the measurement of spectral data**. **As an exemplary operation of such an alternative, as the probe approaches a material or object, the inner ring source may be turned on and a measurement is made. The inner ring may then be turned off and the outer ring turned on and a measurement is made.** Both inner and outer rings may then be turned off and the three monochrome (or broadband) sources are each in turn turned on and off as a measurement is made. The plurality of spectrums or measurements are utilized to determine the optical properties of the material and to measure and/or adjust for height and angular changes in accordance with previously described principles. Jung at 67:47-65

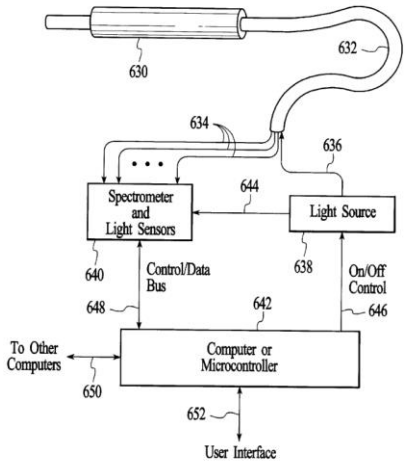
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	Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise. Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. **The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The 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. The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations. Jung at 68:13-32 **The intensity measured with light biasing is thus:** **$I_t = I_b + I_i$** **where:** **I_t =Total measured intensity** **I_b =Bias light intensity** **I_i =Input light intensity** In such embodiments, the spectrometer generally must be normalized. In certain cases it may be desirable to linearize the spectrometer as well, although linearization would be a one time setup while normalization would be performed regularly. The normalization process is a two step process. **Firstly the input light source is removed (either with an aperture or by turning it off) and the bias intensity (Ib) is measured.** Secondly a known light input is applied and the intensity is measured a second time (in color reflectance utilization the spectrometer system preferably may first measure a black material such as a black absorption cavity and makes a second measurement on a material with a known reflectance spectrum; the intensity and thus the gain of each sensor can be calculated). The normalized intensity of a sensor is thus $I=G(I_t - I_b)$ where G=Gain of the sensor (unique for each sensor).

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	Jung at 95:20-45 **Generally, light biasing causes the system to loose resolution. If the light bias is much greater than the light input,** then one is subtracting two large numbers to create a small number (very undesirable). However, if the light bias is on the order of the "white" level or maximum intensity of the system the resolution is reduced by a factor of 2. On the other hand if the bias level is 10% or less of the "white" level intensity the resolution is largely unaffected. he resultant resolution after subtracting the light bias is $R = R_0 \frac{I_w}{I_w + I_b}$ where R0=System total resolution. Jung at 95:46-60 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 Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, 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 semiconductor sources is on; and	Jung discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on; and. Such a further embodiment of the present invention is illustrated in FIG. 39. In accordance with this embodiment, light source 638 provides light coupled through a light path (preferably light source fiber 636) to probe 630 through optical cable 632. Light received by the probe (i.e., returned from the object or material being evaluated) is coupled to spectrometer/light sensors 640 through a suitable light path (preferably one or more light receiver fibers from optical cable 632). Computer 642 is coupled to spectrometer/light sensors 640 by way of control/data bus 648. Computer 642 also is coupled to light source 638 by way of control line(s) 646, **which preferably control the on/off condition of light source 638, and optionally may provide other control information, analog or digital signal levels, etc., to light source 638 as may be desired to optimally control the particular light chosen for light source**

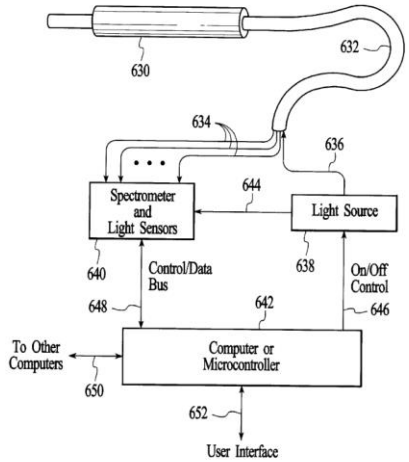
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	638, and its particular characteristics, and for the particular application. Light from light source 638 optionally may be coupled to spectrometer/light sensors 640 by light path 644, such as for purposes of providing light bias (if required or desired for the particular spectrometer chosen), or for monitoring the characteristics of light source 638 (such as drift, temperature effects and the like). Jung at 51:61-52:16  FIG. 39 Jung at Fig. 39 In one alternate embodiment, the three monochrome sources are not filtered and are supplied light with the same spectral properties as the inner and outer rings (the three sources in such embodiments may not be monochrome, but may be broad-band). **With such an alternate embodiment, the light sources may be alternately turned on and off in a manner synchronous with the measurement of spectral data**. **As an exemplary operation of such an alternative, as the probe approaches a material or object, the inner ring source may be turned on and a measurement is made. The inner ring may then be turned off and the outer ring turned on and a measurement is made.** Both inner and outer rings may then be turned off and the three monochrome (or broadband) sources are each in turn turned on and off

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	as a measurement is made. The plurality of spectrums or measurements are utilized to determine the optical properties of the material and to measure and/or adjust for height and angular changes in accordance with previously described principles. Jung at 67:47-65 Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise. Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. **The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The 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. The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations. Jung at 68:13-32 **The intensity measured with light biasing is thus:** **$I_t = I_b + I_i$** **where:** **I_t =Total measured intensity** **I_b =Bias light intensity** **I_i =Input light intensity** In such embodiments, the spectrometer generally must be normalized. In certain cases it may be desirable to linearize the spectrometer as well, although linearization would be a one time setup while normalization would be performed regularly. The normalization process is a two step process. Firstly the input light source is removed (either with an aperture or by turning it off) and the bias intensity (Ib) is measured**. Secondly a known light input is applied and the intensity is measured a second time** (in color reflectance utilization the spectrometer system preferably may first measure a black material such

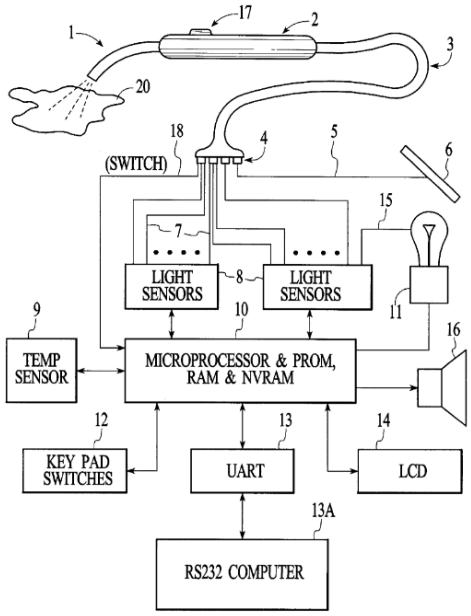
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	as a black absorption cavity and makes a second measurement on a material with a known reflectance spectrum; the intensity and thus the gain of each sensor can be calculated). The normalized intensity of a sensor is thus $I=G(I_t - I_b)$ where G=Gain of the sensor (unique for each sensor). Jung at 95:20-45 **Generally, light biasing causes the system to loose resolution. If the light bias is much greater than the light input,** then one is subtracting two large numbers to create a small number (very undesirable). However, if the light bias is on the order of the "white" level or maximum intensity of the system the resolution is reduced by a factor of 2. On the other hand if the bias level is 10% or less of the "white" level intensity the resolution is largely unaffected. he resultant resolution after subtracting the light bias is $R = R_0 \frac{I_w}{I_w + I_b}$ where R0=System total resolution. Jung at 95:46-60 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 Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, 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	Jung discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal; and. Such a further embodiment of the present invention is illustrated in FIG. 39. In accordance with this embodiment, light source 638 provides light coupled through a light path (preferably light source fiber 636) to probe 630 through optical cable 632. Light received by the probe (i.e., returned from the object

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	or material being evaluated) is coupled to spectrometer/light sensors 640 through a suitable light path (preferably one or more light receiver fibers from optical cable 632). Computer 642 is coupled to spectrometer/light sensors 640 by way of control/data bus 648. Computer 642 also is coupled to light source 638 by way of control line(s) 646, **which preferably control the on/off condition of light source 638, and optionally may provide other control information, analog or digital signal levels, etc., to light source 638 as may be desired to optimally control the particular light chosen for light source 638, and its particular characteristics, and for the particular application. Light from light source 638 optionally may be coupled to spectrometer/light sensors 640 by light path 644, such as for purposes of providing light bias (if required or desired for the particular spectrometer chosen), or for monitoring the characteristics of light source 638 (such as drift, temperature effects and the like).** Jung at 51:61-52:16  FIG. 39 Jung at Fig. 39 In one alternate embodiment, the three monochrome sources are not filtered and are supplied light with the same spectral properties as the inner and outer rings (the three sources in such embodiments may not be monochrome, but may be broad-band). **With such an alternate embodiment, the light sources may**

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	be alternately turned on and off in a manner synchronous with the measurement of spectral data. **As an exemplary operation of such an alternative, as the probe approaches a material or object, the inner ring source may be turned on and a measurement is made. The inner ring may then be turned off and the outer ring turned on and a measurement is made.** Both inner and outer rings may then be turned off and the three monochrome (or broadband) sources are each in turn turned on and off as a measurement is made. The plurality of spectrums or measurements are utilized to determine the optical properties of the material and to measure and/or adjust for height and angular changes in accordance with previously described principles. Jung at 67:47-65 Certain spectrometer systems can collect data at high data rates such as certain spectrometers manufactured by Ocean Optics, Inc., which can have an integration time of 1 millisecond. **In typical data gathering applications, the spectrometer is run at a high rate and the data is signal averaged over many samples to reduce noise.** Such signal averaging techniques are well known to those skilled in the art. In an alternate embodiment of the present invention, the three monochrome sources each have the same out of band wavelength. The inner and outer ring sources provide light filtered or otherwise generated to include only the visible band. **The light provided to the inner and outer rings is gated on and off as discussed above or one or the other rings is left on (but still a plurality of spectral measurements preferably are taken). The 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. The visible band of the spectrum preferably are signal averaged to reduce noise and the out of band sensors preferably are utilized for angle and height determinations. Jung at 68:13-32 **The intensity measured with light biasing is thus:** **$I_t = I_b + I_i$** **where:** **I_t =Total measured intensity** **I_b =Bias light intensity** **I_i =Input light intensity**

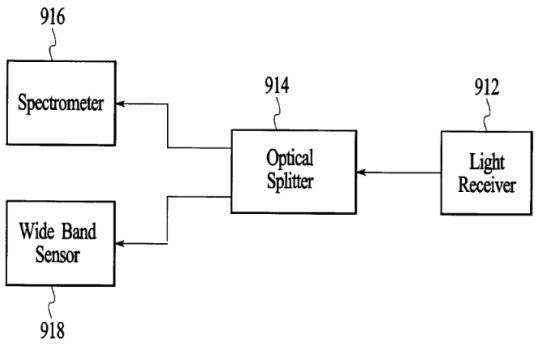
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	In such embodiments, the spectrometer generally must be normalized. In certain cases it may be desirable to linearize the spectrometer as well, although linearization would be a one time setup while normalization would be performed regularly. The normalization process is a two step process. **Firstly the input light source is removed (either with an aperture or by turning it off) and the bias intensity (Ib) is measured. Secondly a known light input is applied and the intensity is measured a second time** (in color reflectance utilization the spectrometer system preferably may first measure a black material such as a black absorption cavity and makes a second measurement on a material with a known reflectance spectrum; the intensity and thus the gain of each sensor can be calculated). The normalized intensity of a sensor is thus $I=G(I_t - I_b)$ where G=Gain of the sensor (unique for each sensor). Jung at 95:20-45 **Generally, light biasing causes the system to loose resolution. If the light bias is much greater than the light input, then one is subtracting two large numbers to create a small number** (very undesirable). However, if the light bias is on the order of the "white" level or maximum intensity of the system the resolution is reduced by a factor of 2. On the other hand if the bias level is 10% or less of the "white" level intensity the resolution is largely unaffected. he resultant resolution after subtracting the light bias is $R = R_0 \frac{I_w}{I_w + I_b}$ where R0=System total resolution. Jung at 95:46-60 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 Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, 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 plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Jung discloses or renders obvious wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. **With reference to FIG. 1, an exemplary preferred embodiment of a color/optical characteristic measuring system** and method in accordance with the present invention will be described. It should be noted that, at various places herein, such a color measuring system is sometimes referred to as an intraoral reflectometer, etc Jung at 8:41- 46  FIG. 1 Jung at Fig. 1

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	In one such preferred embodiment, a broad band white light source supplies light to all light source fibers/light guides. Light supplied to the three monochromatic light sources is filtered with narrow band pass notch filters with center wavelengths greater than 700 nanometers. For example, one center wavelength may be 750 nanometers, while another center wavelength may be 775 nanometers, and a third center wavelength may be 800 nanometers. It should be noted that the exact filter wavelengths are not important; it is only important that such wavelengths be sufficiently different so that they do not overlap and may be separately detected, as described herein. The other two rings of light sources include, for example, a broad-band visible range filter that passes light from 400 to 700 nanometers and rejects light in the range of the three monochrome filters. What is important is the broad-band light sources preferably do not emit light in the frequency range of the monochromatic light sources, or at least do not emit light in such frequency range to a degree that would interfere with the detection of the monochromatic light as described herein. Jung at 66:66-67:17 In one alternate embodiment, the three monochrome sources are not filtered and are supplied light with the same spectral properties as the inner and outer rings (the three sources in such embodiments may not be monochrome, but may be broad-band). With such an alternate embodiment, the light sources may be alternately turned on and off in a manner synchronous with the measurement of spectral data. As an exemplary operation of such an alternative, as the probe approaches a material or object, the inner ring source may be turned on and a measurement is made. The inner ring may then be turned off and the outer ring turned on and a measurement is made. Both inner and outer rings may then be turned off and the three monochrome (or broadband) sources are each in turn turned on and off as a measurement is made. **The plurality of spectrums or measurements are utilized to determine the optical properties of the material and to measure and/or adjust for height and angular changes in accordance with previously described principles.** Jung at 67:47-65 In accordance with other alternative embodiments of the present invention, improved spectrometer-type systems may be produced. FIG. 59 is a block diagram of one such alternative embodiment. As illustrated, linear (or array) optical sensor 900, which preferably includes an optical manifold that receives and directs light of a given wavelength to appropriate sensing elements provided in linear optical sensor 900. Optical manifolds that direct light of a given

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	wavelength are known in the art and may be constructed, for example, of diffraction gratings or optical filters (such as the optical manifolds and implements of the type described elsewhere herein). The output of linear optical sensor 900 passes through variable gain amplifier 906, to sample and hold amplifier 908 and to analog-todigital converter (ADC) 910. Such variable gain amplifiers, sample and hold amplifiers and ADCs are known in the art and are sometimes available as a single unit. It is desired that the ADC have the desired precision and that the overall system provide for the speed required for the particular application. Jung at 75:44-63 FIG. 60 illustrates a preferred exemplary implementation of such an embodiment of the present invention. Such an embodiment preferably includes a reflectance-type probe having at least one light source and at least one light receiver element (examples of such probes and light sources/receivers are described elsewhere herein; FIG. 60 illustrates for discussion purposes only light receiver 912). Light receiver 912 couples received light to optical splitter 914, which couples received light to spectrometer 916 and also to wide band (value) sensor 918. In accordance with such embodiments, **spectrometer 916 (which may be of a design/type described elsewhere herein) preferably measures the spectral properties of the received light as a function of optical wavelength over a band range such as the visible band (400 nm to 700 nm).** Wide band sensor 918 preferably measures the light energy over a wide band, and preferably over the same total band as spectrometer 916. Jung at 77:29-45

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	 FIG. 60 Jung at Fig. 60 The optical band may be spectrally divided by refraction (prisms), diffraction (such as diffraction gratings or slits) or by optical band pass filters such as interference or other bandpass filters. Typical optical sensors are linear sensors such as MOS or CCD detectors or photodiodes or photodiode arrays. Independent of the method of spectrally dividing the light into narrow band spectral components and presenting the narrow bands to optical receivers, the efficiency of each optical receiver in general is wavelength or color dependent. In addition, the efficiency of the optical splitting technique is also color dependent. Thus, the optical sensor measuring blue light from 400 to 410 nm, for example, will have a different efficiency than the optical sensor measuring red light from 660 to 670 nm. Jung at 82:11-24 As previously discussed, in accordance with the present invention, the color and other optical properties of teeth and other materials may be measured with various types of spectrometers. Such spectrometers were disclosed, for example, to consist of filters that separate light into narrow wavelength bands and preferably light to frequency converter optical sensors (or other sensors) that measured the intensity of light in each separated optical band.

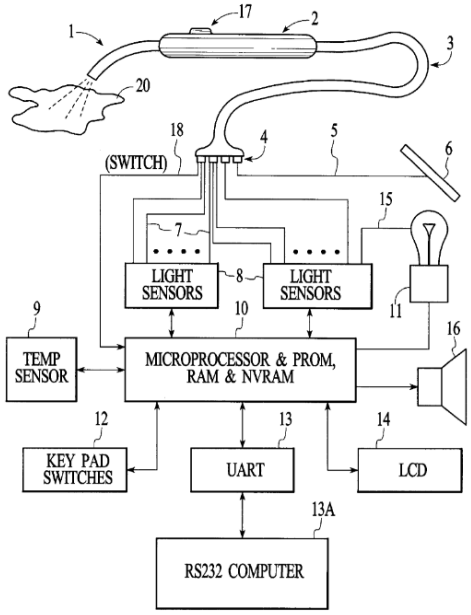
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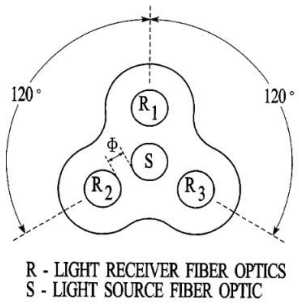
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	Jung at 86:10-17 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 1 above. Jung discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. In accordance with the present invention, devices and methods are provided for measuring the color and other optical characteristics of objects such as teeth, reliably and with minimal problems of height and angular dependence and which may be applied to detecting or preventing counterfeiting or the like. A handheld probe is utilized in the present invention, with the handheld probe containing a number of fiber optics in certain preferred embodiments. Light is directed from one (or more) light source(s) towards the object/tooth to be measured, which in certain preferred embodiments is a central light source fiber optic (other light sources and light source arrangements also may be utilized). **Light reflected from the object is detected by a number of light receivers.** Included in the light receivers (which may be light receiver fiber optics) are a plurality of perimeter and/or broadband or other receivers (which may be light receiver fiber optics, etc.). In certain preferred embodiments, a number of groups of perimeter fiber optics are utilized in order to take measurements at a desired, and predetermined height and angle, thereby minimizing height and angular dependency problems found in conventional methods, and to quantify other optical characteristics such as gloss. In certain embodiments, the present invention also may measure gloss, translucence and fluorescence characteristics of the object/tooth being measured, as well as surface texture and/or other optical or surface characteristics. In certain embodiments, the present invention may distinguish the surface spectral reflectance response and also a bulk spectral response. Jung at 04:02-29

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	In general, under control of microprocessor 10, which may be in response to operator activation (through, for example, key pad switches 12 or switch 17), **light is directed from light source 11, and reflected from cold mirror 6 through source fiber optic 5 (and through fiber optic cable 3, probe body 2 and probe tip 1) or through some other suitable light source element and is directed onto object 20. Light reflected from object 20 passes through the receiver fiber optics/elements in probe tip 1 to light sensors 8 (through probe body 2, fiber optic cable 3 and fibers 7). Based on the information produced by light sensors 8, microprocessor 10 produces a color/optical measurement result or other information to the operator. Color measurement or other data produced by microprocessor 10 may be displayed on display** 14, passed through UART 13 to computer 13A, or used to generate audio information that is presented to speaker 16. Other operational aspects of the preferred embodiment illustrated in FIG. 1 will be explained hereinafter. Jung at 11:4-21

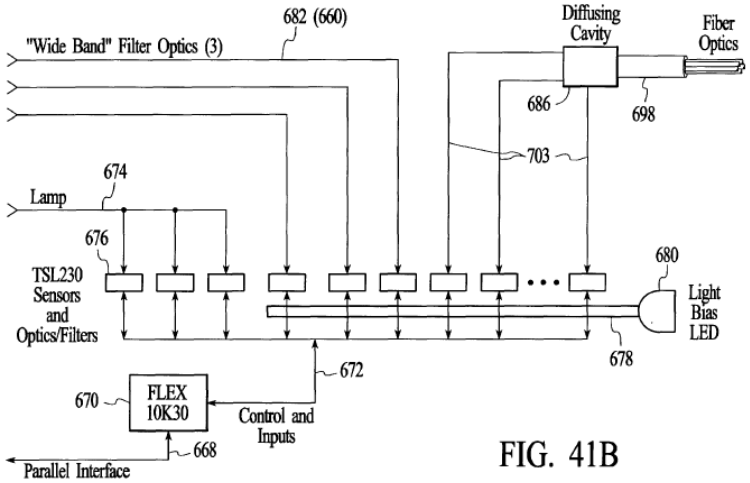
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	 FIG. 1 Jung at Fig. 1 With reference to FIG. 2, an embodiment of a fiber optic arrangement presented at the forward end of probe tip 1 will now be described, which may serve to further the understanding of preferred embodiments of the present invention. As illustrated in FIG. 2, this embodiment utilizes a single central light source fiber optic, denoted as light source fiber optic S, **and a plurality of perimeter light receiver fiber optics, denoted as light receivers R1, R2 and R3.** As is illustrated, this embodiment utilizes three perimeter fiber optics, although in other embodiments two, four or some other number of receiver fiber optics are utilized. As more fully described herein, the perimeter light receiver fiber optics serve not only to provide reflected light for purposes of making the color/optical measurement, but such perimeter fibers also serve to provide information regarding the angle and height of probe tip 1 with respect to the surface of the object that is being measured, and also may provide information regarding the surface characteristics of the object that is being measured.

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	Jung at 11:22- 40  R - LIGHT RECEIVER FIBER OPTICS S - LIGHT SOURCE FIBER OPTIC FIG. 2 Jung at Fig. 2 It is known that certain objects such as human teeth may fluoresce, and such optical characteristics also may be measured in accordance with the present invention. A light source with an ultraviolet component may be used to produce more accurate color/optical data with respect to such objects. Such data may be utilized to adjust the amounts and or proportions or types of dental fluorescing materials in dental restorations or prosthesis. In certain embodiments, a tungsten/halogen source (such as used in a preferred embodiment) may be combined with a UV light source (such as a mercury vapor, xenon or other fluorescent light source, etc.) to produce a light output capable of causing the object to fluoresce. **Alternately, a separate UV light source, combined with a visible-light-blocking filter, may be used to illuminate the object. Such a UV light source may be combined with light from a red LED (for example) in order to provide a visual indication of when the UV light is on and also to serve as an aid for the directional positioning of the probe operating with such a light source**. A second measurement may be taken using the UV light source in a manner analogous to that described earlier, with the band of the red LED or other supplemental light source being ignored. The second measurement may thus be used to produce an indication of the fluorescence of the tooth or other object being measured. With such a UV light source, a silica fiber optic (or other suitable material) typically would be required to transmit the light to the object (standard fiber optic materials such as glass and plastic in general do not propagate UV light in a desired manner, etc.). Jung at 15:33- 61

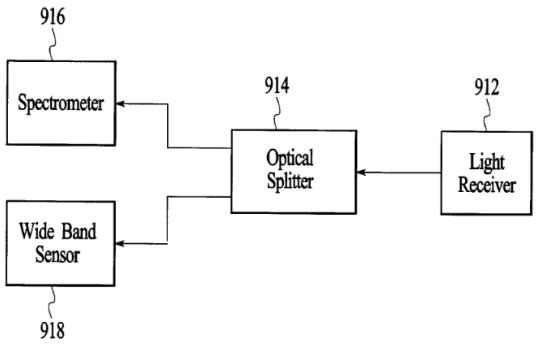
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	In accordance with the present invention, devices and methods are provided for measuring the color and other optical characteristics of objects such as teeth, reliably and with minimal problems of height and angular dependence and which may be applied to detecting or preventing counterfeiting or the like. A handheld probe is utilized in the present invention, with the handheld probe containing a number of fiber optics in certain preferred embodiments. **Light is directed from one (or more) light source(s) towards the object/tooth to be measured, which in certain preferred embodiments is a central light source fiber optic (other light sources and light source arrangements also may be utilized). Light reflected from the object is detected by a number of light receivers. Included in the light receivers (which may be light receiver fiber optics) are a plurality of perimeter and/or broadband or other receivers (which may be light receiver fiber optics, etc.).** In certain preferred embodiments, a number of groups of perimeter fiber optics are utilized in order to take measurements at a desired, and predetermined height and angle, thereby minimizing height and angular dependency problems found in conventional methods, and to quantify other optical characteristics such as gloss. In certain embodiments, the present invention also may measure gloss, translucence and fluorescence characteristics of the object/tooth being measured, as well as surface texture and/or other optical or surface characteristics. In certain embodiments, the present invention may distinguish the surface spectral reflectance response and also a bulk spectral response. Jung at 04:2-29 One or more of receiver(s) B 454 (in certain embodiments one receiver B may be utilized, while in other embodiments a plurality of receivers B are utilized, which may be circularly arranged around source A, such as 6 or 8 such receivers B) pass to a spectrometer (see, e.g., FIGS. 1, 3, 11, 12, configured as appropriate for such preferred embodiments). Jung at 39:51-56. **In certain situations, a long time may be required for the light source and for the light bias source to stabilize.** In other situations, the light source and bias source may drift. In preferred embodiments, the light source is a 18 W, 3300 K halogen stabilized tungsten filament lamp manufactured by Welch Allyn, Inc. **The light bias preferably is provided by a high intensity LED and a fiber optic light guide or conduit (see LED 680 and light conduit 678 of FIG. 41A) that passes to each biased sensor of**

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	sensors 676. The intensity of LED 680 preferably is controlled and varied with high frequency pulse width modulation, or by analog constant current controllers. By controlling the intensity of bias LED 680, the bias light level can be varied to best match the sensor sampling rate. Jung at 56:33-46  FIG. 41B Jung at Fig. 41B Referring now to FIG. 52, an embodiment of the present invention utilizing probe 800 (illustrated in cross section) including central receiver 802 (preferably a fiber optic) surrounded by two rings 806 and 810 of light sources (also preferably fiber optics). Rings 806 and/or 810 in preferred embodiments are constructed of strands and/or a ring of fiber optics. In alternate embodiments rings 806 and 810 are constructed of cylindrical light guides. FIG. 53 illustrates an embodiment of the present invention utilizing probe 812 (illustrated in cross section) including central receiver 814 (also preferably a fiber optic) surrounded by two rings of sources (preferably fiber optics) where the inner ring includes a plurality of sources or fiber optics 816 and 818, preferably six evenly spaced apart, and the outer ring includes a plurality sources or fiber optics 820, preferably twelve evenly spaced apart. As will be described in greater detail later, the use of two rings of light sources in such embodiments may be in

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	used in accordance with the present invention to provide a method for measuring the opalescence or other optical characteristics of materials or objects. Jung at 65:55-66:7. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	See claim 2 above. Jung discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. FIG. 60 illustrates a preferred exemplary implementation of such an embodiment of the present invention. Such an embodiment preferably includes a reflectance-type probe having at least one light source and at least one light receiver element (examples of such probes and light sources/receivers are described elsewhere herein; FIG. 60 illustrates for discussion purposes only light receiver 912). Light receiver 912 couples received light to optical splitter 914, which couples received light to spectrometer 916 and also to wide band (value) sensor 918. In accordance with such embodiments, **spectrometer 916 (which may be of a design/type described elsewhere herein) preferably measures the spectral properties of the received light as a function of optical wavelength over a band range such as the visible band (400 nm to 700 nm).** Wide band sensor 918 preferably measures the light energy over a wide band, and preferably over the same total band as spectrometer 916. Jung at 77:29-45

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	 FIG. 60 Jung at Fig. 60 In accordance with such embodiments, monochrome sources 808 and 816 are supplied with monochromatic or nearly monochromatic light that preferably is out of the band of interest. For color determination, the optical band of interest is typically 400 to 700 nanometers. Most spectrometers, however, such as those described elsewhere herein and/or CCD spectrometers such as those manufactured by Ocean Optics, are sensitive well into the infra-red light band. Thus, many spectrometers are capable of detecting light from 700 nanometers to 800 nanometers or even longer wavelengths. In preferred embodiments utilizing this aspect of the present invention, the three monochromatic light source fibers are each supplied with monochromatic light of different wavelengths. One preferred way to provide such monochromatic light is by utilizing three infra-red LEDs of different wavelengths, for example, or by filtering a white light source with interference notch filters with different center wavelengths. In one such preferred embodiment, a broad band white light source supplies light to all light source fibers/light guides. Light supplied to the three monochromatic light sources is filtered with narrow band pass notch filters with center wavelengths greater than 700 nanometers. For example, one center

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	wavelength may be 750 nanometers, while another center wavelength may be 775 nanometers, and a third center wavelength may be 800 nanometers. It should be noted that the exact filter wavelengths are not important; it is only important that such wavelengths be sufficiently different so that they do not overlap and may be separately detected, as described herein. The other two rings of light sources include, for example, a broad-band visible range filter that passes light from 400 to 700 nanometers and rejects light in the range of the three monochrome filters. What is important is the broad-band light sources preferably do not emit light in the frequency range of the monochromatic light sources, or at least do not emit light in such frequency range to a degree that would interfere with the detection of the monochromatic light as described herein. Jung at 66:47-67:17 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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Jung discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, 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 wearable device adapted to be placed on a wrist or an ear of a user,	Jung discloses or renders obvious a wearable device adapted to be placed on a wrist or an ear of a user. See above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Jung discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. the 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;	Jung discloses or renders obvious the 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. See above at claim 1[c].

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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 Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. the wearable device further comprising 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,	Jung discloses or renders obvious the wearable device further comprising 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. 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 Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. wherein the detection system is configured to be synchronized to the light source;	Jung discloses or renders obvious the, wherein the detection system is configured to be synchronized to the light source. 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 Defendents' 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 Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. 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 spatially separated detectors;	Jung 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 spatially separated detectors. See above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured	Jung discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; See above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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to be transmitted over a wireless transmission link;	
8[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Jung discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[i]. 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; and	Jung discloses or renders obvious 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. See above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Jung 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 above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Jung discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. See above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Jung discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l].

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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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Jung discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. See above 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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 8 above. Jung discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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

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	identified in Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	See claim 9 above. Jung discloses or renders obvious the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. See above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Jung discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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

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	identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Jung discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, See above at claim 1[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Jung discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;, See above at claim 1[b] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[c]. the wearable device comprising one or more	Jung discloses or renders obvious the 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.

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lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue;	See above at claim 1[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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[d]. the wearable device further comprising 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,	Jung discloses or renders obvious the wearable device further comprising 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,. 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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[e]. wherein the detection system is configured to be synchronized to the light source;	Jung discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. 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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[f]. 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 spatially separated detectors;	Jung discloses 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 spatially separated detectors. See above at claim 1[f] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal; wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link	Jung discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link See above at claim 1[g] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Jung discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[i]. 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; and	**Jung** discloses or renders obvious 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. See above at claim 1[i] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[j]. the detection system further configured to: generate a first signal responsive to light received	Jung 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 above at claim 1[j]

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while the light emitting diodes are off,	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Jung discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on;and See above at claim 1[k] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal;	Jung discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendents' 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 Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes,	Jung discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, See above 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 Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[n]. wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Jung discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 Defendents' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[o]. wherein the output optical light comprises wavelengths between 600	**Jung** discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.

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nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	See above at claim 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 Defendents’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not Disclosed by Jung, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Jung, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT E5

U.S. Pat. No. 11,160,455 in view of WO Patent Publication No. 2012/099536 to Md. Ir-wan bin Md. Kassim ("Kassim")

As described in detail below, Kassim (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 B2 (the "'455 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 E1-E4 and E6-E18, 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 '455 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 '455 Patent.

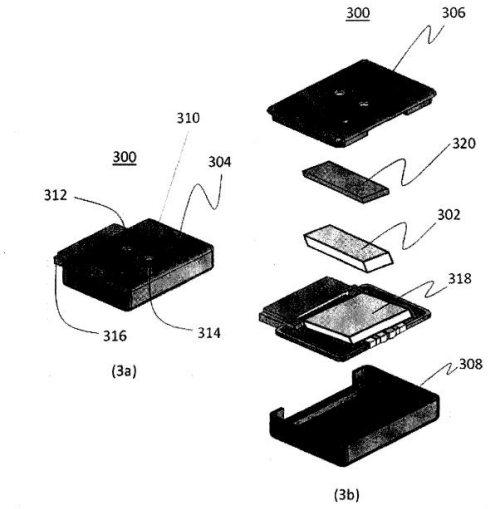
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that 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.

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EXHIBIT E5

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Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kassim discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. Optical monitoring of physiological characteristics utilizes the detection of light transmitted through a location of a user being measured. Photoplethysmography (PPG) is an optical measurement technique used to detect blood volume changes in the microvascular bed of living tissue, typically by detecting light transmitted through the ear lobe or fingertip. As arterial pulsations enter the capillary bed, changes in the volume of the blood vessels or characteristics of the blood itself modify the optical properties of the capillary bed. A PPG signal is used to measure saturation of peripheral oxygen (Sp02), which is an estimation of the level of oxygen saturation in a fluid, such as blood. The PPG signal can also be used to measure blood pressure. 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. Kassim at 01:24-25 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 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

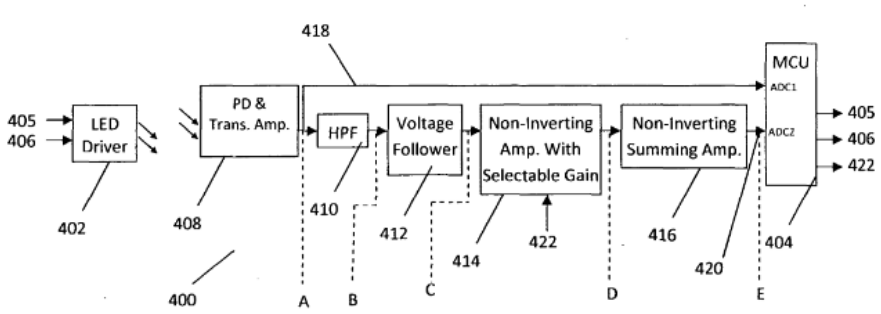
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	limited to visible light only. The term "light" as used herein can include, but is not limited to, X-ray light rays, visible light rays, ultraviolet light rays and infra-red light rays. Kassim at 11:23-28 The optical measurement device 300 further 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 12:05-10  Figure 3 Kassim at Fig. 3 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. Kassim at 12:27-33 During operation, at the output of the detection assembly 408, a raw PPG signal is recorded. This enables the DC component of the signal to be acquired e.g. for LED illumination intensity adjustment and Sp02 calculation. The high-pass filter 410 can introduce a filter with a high-pass cut off of e.g. about 0.12 Hz so as to remove the DC component of the raw PPG signal. This can also produce the AC component of the signal, with the AC component oscillating about ground voltage. The output of the high-pass filter 410 is transmitted to the voltage follower amplifier module 412 to create a high impedance signal. The inventors have recognised that without a high impedance, the signal may be lost at the amplification stage subsequently. Kassim at 14:11-19

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	 Figure 4(a) Kassim at Fig. 4a 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 21:33-22:6 Advantageously, in the example embodiment, a signal reconstruction of true Red and/or IR PPG signals to remove ambient signal interference can be avoided. The inventors have recognised that by identifying and utilising only significant information for Sp02 calculation, an efficient and accurate calculation can be carried out. The inventors have recognized that by using only the maximum and minimum values of the respective red, IR and ambient signal pulses, the calculation of Sp02 can be carried out. For example, 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, i.e. when none of the LEDs is turned on. Kassim at 22:27-23:3 In other words, instead of reconstructing a true Red PPG signal (devoid of ambient signal) and a true IR PPG signal (devoid of ambient signal), advantageously, reconstruction is avoided in example

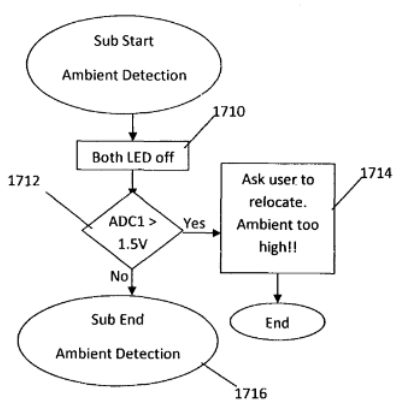
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	embodiments, and only the maximum and minimum values of 3 PPG signals are obtained for analysis to obtain Sp02 value. This can minimise processing and consume less power. Kassim at 23:5-9 With the AC and DC signal portions, the inventors have recognised that significant information can be further extracted for Sp02 calculation. Using the circuit of Figure4(a), it can be seen from Figures 10(a) and (b) that the AC and DC components of the Red and IR PPG signals are larger than those of the ambient PPG signal. Therefore, the contribution of the ambient PPG signal is less significant compared with the contribution of the RED or IR PPG signals. This can provide for a more accurate Sp02 calculation. That is, in example embodiments, the LED illumination intensity can be tuned to a level that provides for detected signals that provide as high a detected voltage as possible, without saturating the signals. The intensity can be controlled by the MCU. The tuning can ensure that both Red and IR signals transmitted to ADC1 can reach an amplitude level significantly higher than Ambient signals transmitted to ADC1. For example, if an Ambient signal at ADC1 is about 0.5V, both Red and IR signals at ADC1 can preferably be set at about 2V or above. This is described and illustrated in more detail below with Figure 18. In addition, there can be steps taken to ensure that detected Ambient light signals are not too high. Exemplary steps are described and illustrated in more detail below with Figure 17. Kassim at 24:14-28 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. Kassim at 28:22-26 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 SpO2 measurement. Kassim at 29:1-2 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. $R= f(AC_{ir},AC_{r},AC_{am}, DC_{ir}, DC_{r}, DC_{am})$ Kassim at 29:5-9

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	The inventors have recognised that, indirectly, deviation 6R reflects the confidence level of the computation result of R. The calculated propagation error may be displayed on a screen of a personal mobile processing device to inform the user of the potential accuracy of the $Sp0_2$ measurement. Kassim at 29:10-13 Alternatively, instead of the calculated propagation error, a representative description of the propagation error may be displayed. For example, for a propagation error of more than e.g. 30% of the mean of the calculated R, the user may be informed that the measured Sp02 is highly inaccurate and may be advised to retake the readings at a more suitable location. As another example, for a deduced propagation error of less than e.g. 10%, the user may be informed that the measured Sp02 is relatively accurate. Kassim at 29:15-20 The equations below illustrate the algorithm for determining the accuracy. $R= f(AC_{ir},AC_r,AC_{am}, DC_{ir}, DC_r, DC_{am})$ $$\sigma_R^2 = \left(\frac{\partial R}{\partial AC_{ir}}\right)\sigma_{AC_{ir}}^2 + \left(\frac{\partial R}{\partial AC_r}\right)\sigma_{AC_r}^2 + \left(\frac{\partial R}{\partial AC_{am}}\right)\sigma_{AC_{am}}^2 + \left(\frac{\partial R}{\partial DC_{ir}}\right)\sigma_{DC_{ir}}^2 + \left(\frac{\partial R}{\partial DC_r}\right)\sigma_{DC_r}^2 + \left(\frac{\partial R}{\partial DC_{am}}\right)\sigma_{DC_{amr}}^2$$ Further, each parameter has individual deviation as follows, $DC,r = AC - -AC_{avg\ ir} + cr_{AClr}$ $= DC_{a»S},r + °DC, AC_r = AC,$ $DC = DC_{avg,am} + ° DC, AC_{,,,,} = ■AC_{avg\ a,,,} + \& AC_m$ Hence, the average value of R $$_{avg} = \sqrt{\left[\frac{AC_{avg,r}{}^2 - AC_{avg,am}{}^2}{DC_{avg,r}{}^2 - DC_{avg,am}{}^2}\right] \times \left[\frac{DC_{avg,ir}{}^2 - DC_{avg,am}{}^2}{AC_{avg,ir}{}^2 - AC_{avg,am}{}^2}\right]}$$

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	$$\sigma_R = R_{avg} \times sqrt\left[\frac{\sigma^2_{AC_{ir}}}{(AC_{avg,ir}-AC_{avg,am})^2}+\frac{\sigma^2_{DC_{ir}}}{(DC_{avg,ir}-DC_{avg,am})^2}+\frac{\sigma^2_{AC_r}}{(AC_{avg,r}-AC_{avg,am})^2}+\frac{\sigma^2_{DC_r}}{(DC_{avg,r}-DC_{avg,am})^2}+\frac{\left[(AC_{avg,ir}-AC_{avg,am})-(AC_{avg,r}-AC_{avg,am})\right]^2\left[\sigma^2_{AC_{am}}\right]}{(AC_{avg,ir}-AC_{avg,am})^2(AC_{avg,r}-AC_{avg,am})^2}+\frac{\left[(DC_{avg,r}-DC_{avg,am})-(DC_{avg,ir}-DC_{avg,am})\right]^2\left[\sigma^2_{DC_{am}}\right]}{(DC_{avg,r}-DC_{avg,am})^2(DC_{avg,ir}-DC_{avg,am})^2}\right]$$ Therefore, it can be derived that $R = R_{Avg} \pm \sigma_R$ Kassim at 29:22-30:19 In another example embodiment, the ratio R can be determined using averages of maximum and minimum values. In the example embodiment, each Red and IR PPG signal are paired on a per cycle basis. A subtraction is carried out using an average ambient signal value. The average ambient signal value can be obtained before or after obtaining the Red and IR PPG signals. Kassim at 30:20-24 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. At step 1710, both the Red and IR LEDs are switched off. At step 1712, it is determined whether ADC1 of the MCU of the measurement device reads a value of e.g. more than about 1.5V. If the reading is more than the exemplary value of 1.5V at step 1712, at step 1714, the personal mobile processing device is configured to alert the user to relocate to another location for the optical measurement as the ambient light interference is determined to be too high. If the reading is less than the exemplary value of 1.5V at step 1712, at step 1716, the ambient light detection process ends. Kassim at 32:27-35

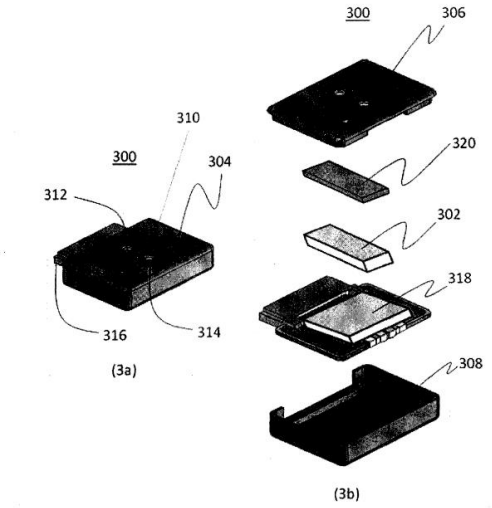
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	 Figure 17 Kassim at Fig. 17 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art 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 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]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Kassim discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, Optical monitoring of physiological characteristics utilizes the detection of light transmitted through a location of a user being measured. Photoplethysmography (PPG) is an optical measurement technique used to detect blood volume changes in the microvascular bed of living tissue, typically by detecting light transmitted through the ear lobe or fingertip. As arterial pulsations enter the capillary bed, changes in the volume of the blood vessels or characteristics of the blood itself modify the optical properties of the capillary bed. A PPG signal is used to measure saturation of peripheral oxygen (Sp02), which is an

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	estimation of the level of oxygen saturation in a fluid, such as blood. The PPG signal can also be used to measure blood pressure. Kassim at 1:14-22 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. The LEDs illuminate the tissue (e.g. skin) of the user and the photodetector measures small variations in light intensity associated with changes in perfusion in a catchment volume. An oximeter in such a configuration is typically called a transmittance-type oximeter. The light from the LEDs passes through the tissue and is detected by the photodiode. One LED is red, with wavelength of approximately 660 nanometers (nm), and the other is infrared, with a wavelength of approximately 905, 910 or 940 nm. Absorption at these wavelengths differs significantly between oxyhemoglobin and its deoxygenated form. Therefore, the ratio of oxyhemoglobin to deoxyhemoglobin can be calculated from the ratio of the absorption of the red and infrared light, i.e. the ratio of red light to infrared light absorption of pulsating components at the measuring site. Kassim at 1:24-2:3 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 2:5-2:6 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 02:8-14 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

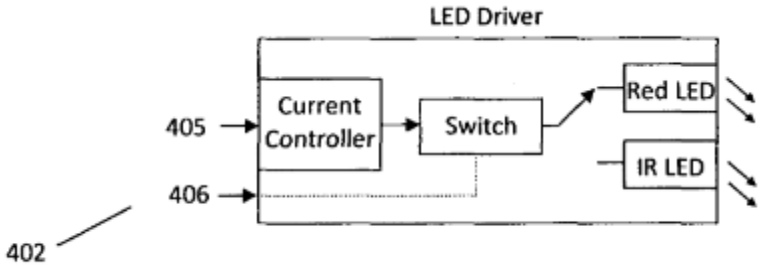
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	portion of the user as a signal; an amplifier module coupled to the detection assembly configured to apply a gain to an alternating- current component of the signal; a microcontroller coupled to the detection assembly configured to assess a direct-current 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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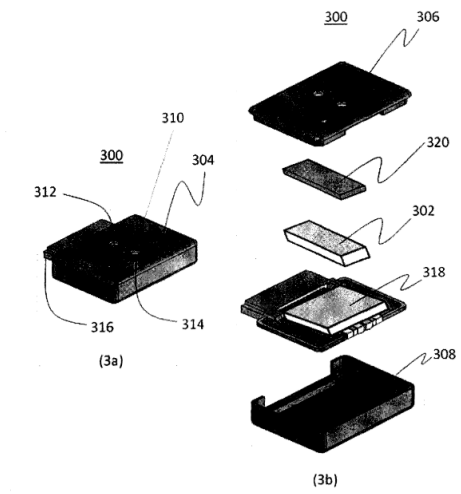
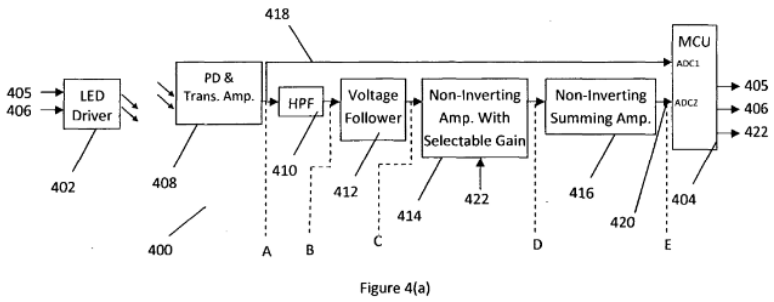
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	 Figure 3 Kassim at Fig. 3. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art 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[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a	Kassim discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths; 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. The LEDs illuminate the tissue

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plurality of optical wavelengths;	(e.g. skin) of the user and the photodetector measures small variations in light intensity associated with changes in perfusion in a catchment volume. An oximeter in such a configuration is typically called a transmittance-type oximeter. The light from the LEDs passes through the tissue and is detected by the photodiode. One LED is red, with wavelength of approximately 660 nanometers (nm), and the other is infrared, with a wavelength of approximately 905, 910 or 940 nm. Absorption at these wavelengths differs significantly between oxyhemoglobin and its deoxygenated form. Therefore, the ratio of oxyhemoglobin to deoxyhemoglobin can be calculated from the ratio of the absorption of the red and infrared light, i.e. the ratio of red light to infrared light absorption of pulsating components at the measuring site. Kassim at 01:24-2:3 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 02:8-14 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 02:34-03:9. The illumination assembly may comprise a red light source and/or an infra-red light source.The light sources may be toggled on/off for the detection assembly to detect the reflected output light as a single signal. Kassim at 03:18-23.

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	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 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 11:23-32. 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 Figure 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.  Figure 4(b) Kassim at Fig. 4b

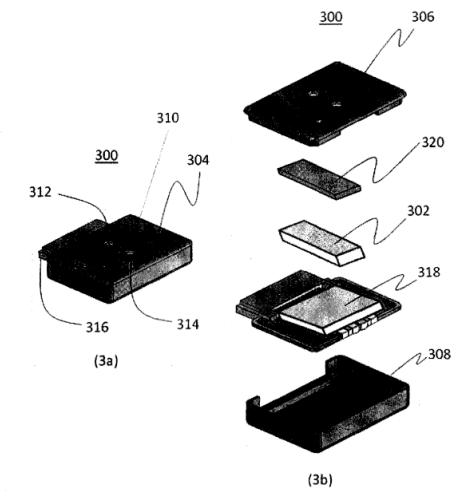
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	In the example embodiment, optionally, a pressure detection assembly 318 may be provided in the optical measurement device 300. The pressure detection assembly 318 can be configured to detect and transmit to a personal mobile processing device (not 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. 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.  Figure 4(a) Kassim at Fig. 4(a). One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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

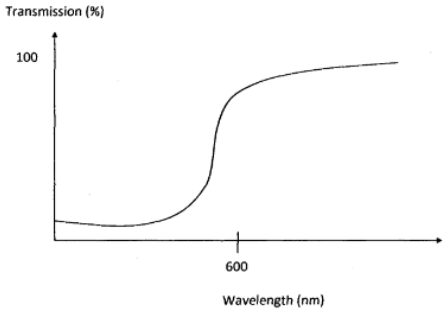
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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. the wearable device comprising one or more lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue;	Kassim discloses or renders obvious the 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. 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. The LEDs illuminate the tissue (e.g. skin) of the user and the photodetector measures small variations in light intensity associated with changes in perfusion in a catchment volume. An oximeter in such a configuration is typically called a transmittance-type oximeter. The light from the LEDs passes through the tissue and is detected by the photodiode. One LED is red, with wavelength of approximately 660 nanometers (nm), and the other is infrared, with a wavelength of approximately 905, 910 or 940 nm. Absorption at these wavelengths differs significantly between oxyhemoglobin and its deoxygenated form. Therefore, the ratio of oxyhemoglobin to deoxyhemoglobin can be calculated from the ratio of the absorption of the red and infrared light, i.e. the ratio of red light to infrared light absorption of pulsating components at the measuring site. 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 01:24-2:6 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 02:8-14 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

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	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, 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. 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.

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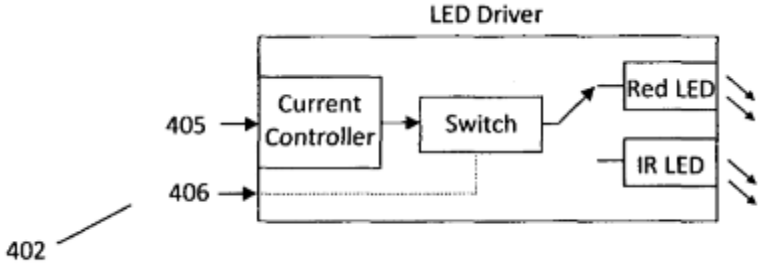
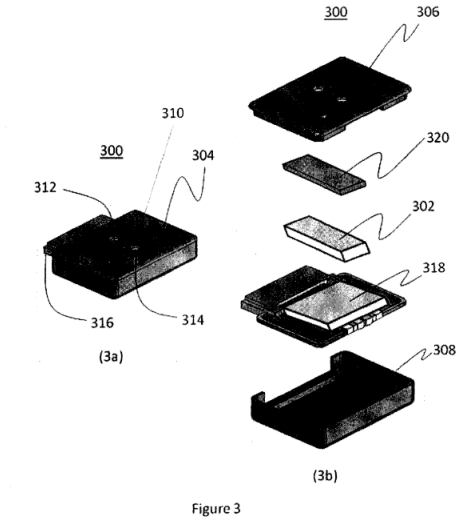
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	 Figure 3 Kassim at Fig. 3. The optical measurement device 300 can additionally be integrated with optical filters e.g. 320 to minimize the disturbance from ambient light. In the example embodiment, an edge filter with optical transmission characteristics can be used. Kassim at 13:1-3. Figure 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 13:5-12.

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	 Figure 3 (c) Kassim at Fig. 3 (c) 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 Kassim at 13:19-23. Therefore, in an example embodiment, an optical measurement device can be provided. The device can comprise an illumination assembly configured to output light to a 15 surface portion of a user for measurement. The illumination assembly can comprise one or more light sources such as one or more LEDs. Kassim at 20:13-16. It will be appreciated by a person skilled in the art that other variations and/or modifications may be made to the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive. Kassim at 34:21-24. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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.
1[d]. the wearable device further comprising 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,	Kassim discloses or renders obvious the wearable device further comprising 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 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. The LEDs illuminate the tissue (e.g. skin) of the user and the photodetector measures small variations in light intensity associated with changes in perfusion in a catchment volume. An oximeter in such a configuration is typically called a transmittance-type oximeter. The light from the LEDs passes through the tissue and is detected by the photodiode. One LED is red, with wavelength of approximately 660 nanometers (nm), and the other is infrared, with a wavelength of approximately 905, 910 or 940 nm. Kassim at 1:24-34. 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

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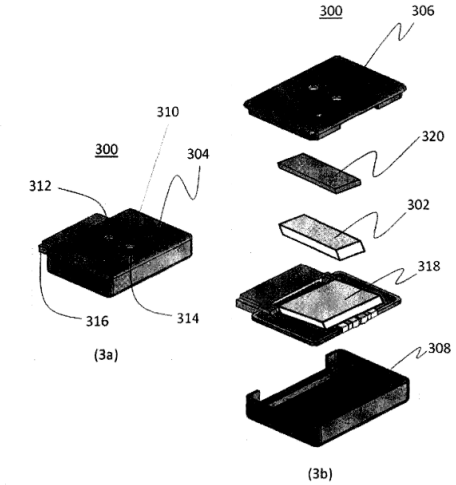
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	300 further comprises a coupling member 316 that can provide coupling between the measurement device 300 to a personal mobile processing device/feedback unit (not shown) in a cableless configuration. The coupling member 316 may be in the form of an 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.  Figure 4(b) Kassim at Fig. 4b  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. 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. Figure 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.

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	Kassim at 13:5-12. Figure 4(a) is a schematic block diagram illustrating an optical measurement device 400 in an example embodiment. Figure 4(b) is a schematic block drawing illustrating an illumination assembly in an example embodiment. Figure 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 Figure 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. 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. Kassim at 20:1-11. Therefore, in an example embodiment, an optical measurement device can be provided. The device can comprise an illumination assembly configured to output light to a surface portion of a user for

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	measurement. The illumination assembly can comprise one or more light sources such as one or more LEDs. That is, the illumination can comprise a red light source and/or an infra-red light source. The device further comprises a detection assembly configured to detect the output light reflected from said surface portion of the user as a signal. The detection assembly can comprise a photodetector. The device can comprise an amplifier module directly or indirectly coupled to the detection assembly, the amplifier module configured to apply a gain to an alternating-current component of the detected signal. The device can further comprise a microcontroller coupled to the detection assembly and configured to assess a direct-current voltage level of the signal. The microcontroller is also configured to control the light output at the illumination assembly based on said assessing the direct-current voltage level This can allow the microcontroller to determine whether there is a low perfusion scenario, and/or whether the illumination intensity of the illumination assembly is to be tuned, e.g. to move the amplitude difference formed based on a red and an IR light illumination to be closer together or e.g. whether the driving current of LEDs are to be reduced. In addition, the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. For example, for a low perfusion scenario, a higher gain is selected. Kassim at 20:13-31. 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. 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

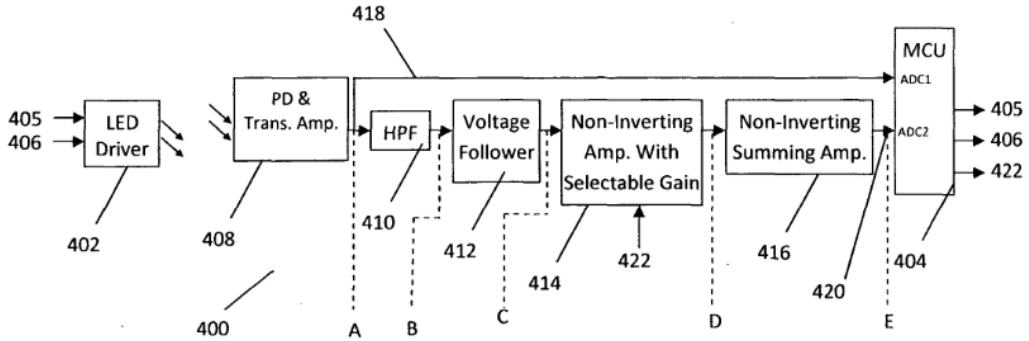
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	module applying the gain. Thus, for a gain of about 20 times in a coldfinger scenario, a difference of about 00mV becomes about 2V, compared to a saturation voltage level of e.g. about 3.3V. It will be appreciated that within each signal, there is 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[e]. wherein the detection system is configured to be synchronized to the light source;	Kassim discloses or renders obvious wherein 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 8:24-28. 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. Figure 8(a) is a schematic graph illustrating output obtained at a light detector (compare 408 of Figure 4) during toggling between a red LED and an IR LED in an example embodiment. The graph is shown with the y-axis representing voltage V values and the x- axis representing milli-seconds ms values. The red LED and IR LED are preferably driven by the microcontroller so that the detected output (compare point A of Figure 4(a)) based on the respective red and IR LEDs is at the same voltage of about 2.5V.

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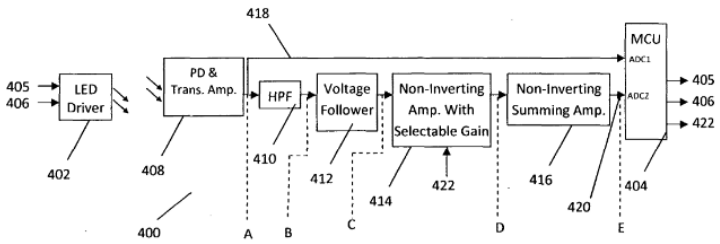
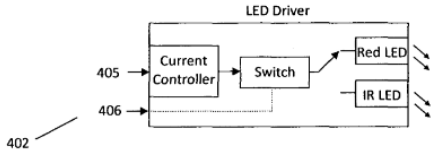
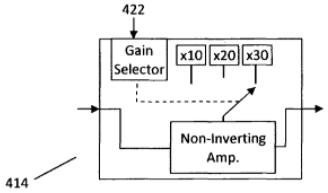
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	However, it is appreciated that this is often difficult and there may be differences in the outputs. Figure 8(a) shows a corresponding amplitude difference of about 100mV. The oscillation period corresponds to the toggling period, e.g. with respect to Figure 7(a). Kassim at 16:17-25. 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[f]. 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 spatially separated 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 spatially separated 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

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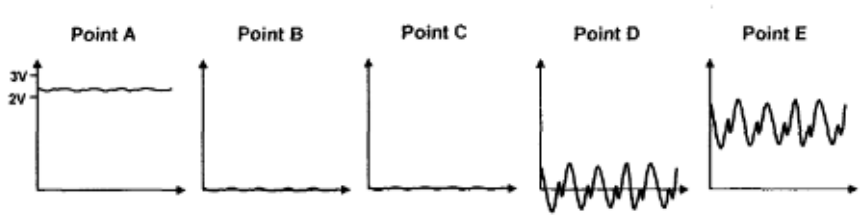
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	a surface portion of a user for measurement. The illumination assembly 402 can comprise one or more light sources e.g. light emitting diodes (LEDs) that can vary in light intensity based on variable resistors and controlled by a microcontroller MCU 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.  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.

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	Kassim at 14:01-02. Figure 5 is a schematic flow graph diagram illustrating signal conditioning for a single detected signal in an example embodiment. Reference is also made to Figure 4. The signal is detected at the detection assembly 408. The signal may be either a Red signal or an IR signal detected from a red LED illumination or a IR LED illumination respectively. The graph at Point A shows the signal with both DC and AC components at the output of the detection assembly 408. It can be seen that the AC component is small from the graph. The graph at Point B shows the signal at the output of the high-pass filter 410 with the DC component of the signal removed and the AC component of the signal being forced to oscillate about ground voltage. The graph at Point C shows the high impedance AC signal at the output of the voltage follower amplifier module 412. The graph at Point D shows the AC signal at the output of the non-inverting amplifier module 414 with a suitable gain provided to the signal. The graph at Point E shows the AC signal at the output of the non-inverting summing amplifier module 416. A DC value of about 1.5V has been added to the AC signal such that the signal is pushed above the ground voltage. This can advantageously allow the signal to be digitized by the analog-to-digital converter of the microcontroller 404. Kassim at 14:30-15:9.

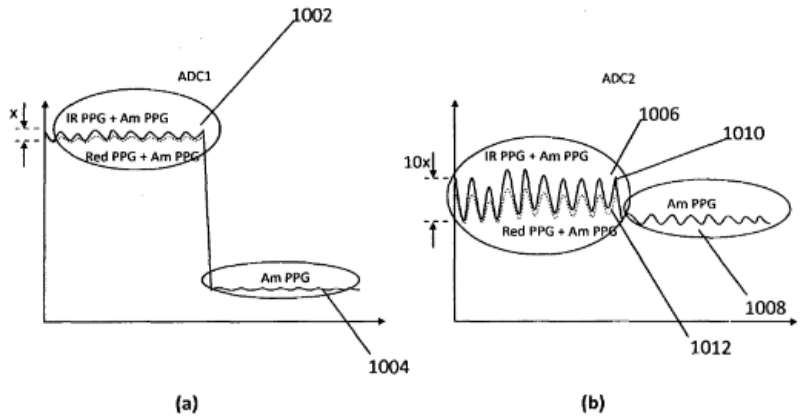
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	 Figure 4(a)  Figure 4(b)  Figure 4(c) Kassim at Fig. 4a,4b,4c & 4d

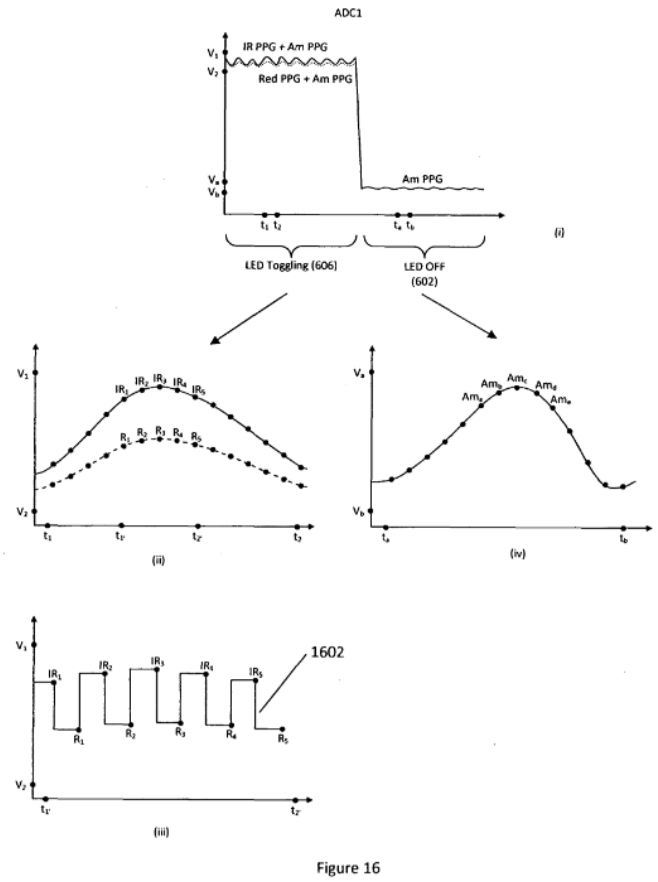
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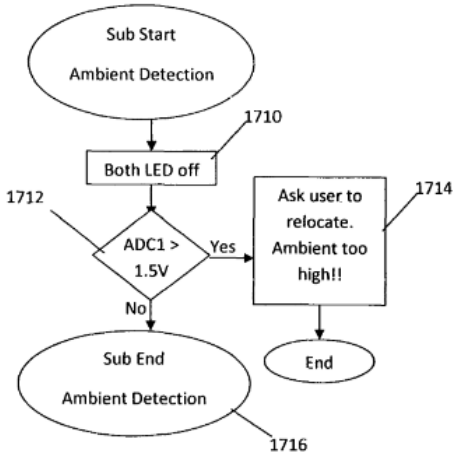
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	 Figure 5 In some example embodiments, the intensity of each IR and Red LED is further tuned such that the output at the detection assembly shows a response of between 2V-2.5V (at ADC1). That is, the inventors have recognized that the effects of ambient 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 16:26-35. 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. Kassim at 20:1-11.

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	Therefore, in an example embodiment, an optical measurement device can be provided. The device can comprise an illumination assembly configured to output light to a surface portion of a user for measurement. The illumination assembly can comprise one or more light sources such as one or more LEDs. That is, the illumination can comprise a red light source and/or an infra-red light source. The device further comprises a detection assembly configured to detect the output light reflected from said surface portion of the user as a signal. The detection assembly can comprise a photodetector. The device can comprise an amplifier module directly or indirectly coupled to the detection assembly, the amplifier module configured to apply a gain to an alternating-current component of the detected signal. The device can further comprise a microcontroller coupled to the detection assembly and configured to assess a direct-current voltage level of the signal. The microcontroller is also configured to control the light output at the illumination assembly based on said assessing the direct-current voltage level This can allow the microcontroller to determine whether there is a low perfusion scenario, and/or whether the illumination intensity of the illumination assembly is to be tuned, e.g. to move the amplitude difference formed based on a red and an IR light illumination to be closer together or e.g. whether the driving current of LEDs are to be reduced. In addition, the microcontroller is configured to select a gain value for said applying the gain based on said assessing the direct-current voltage level. For example, for a low perfusion scenario, a higher gain is selected. Kassim at 20:13-31. Figure 10(a) is a graph illustrating signals acquired at an analog to digital converter (compare ADC1 of Figure 4(a)) in an example embodiment. The y-axis is in terms of mV and the x-axis is in terms of ms. Numeral 002 shows the signals obtained when the Red and IR LEDs are turned on during the toggling sequence 606 (Figure 6(a)). Numeral 1004 shows the signals obtained when the Red and IR LEDs are turned off during the OFF condition 602 (Figure 6(a)). As shown, the amplitude of the signals obtained during the toggling sequence 606 (Figure 6) is notated as x'. Kassim at 23:23-29. Figure 10(b) is a graph illustrating AC signals acquired at an analog to digital converter (compare ADC2 of Figure 4(a)) in an example embodiment. The y-axis is in terms of mV and the x-axis is in terms of ms. Numeral 1006 shows the AC signals when the Red and IR LEDs are turned on during the toggling sequence 606 (Figure 6(a)). Numeral 1008 shows the AC signals when the Red and IR LEDs are turned off during the OFF condition 602 (Figure 6(a)). The IR signals are shown with solid lines at 1010 and the Red signals are shown with dotted lines at 1012. With the amplification provided in Figure 4(a), as

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	shown, the difference between the Red and IR detected AC signals is notated as 10x', i.e. a gain of about 10 times has been provided. Kassim at 23:31-24:4.  Figure 10 Kassim at Fig. 10 With the AC and DC signal portions, the inventors have recognised that significant information can be further extracted for Sp02 calculation. Using the circuit of Figure4(a), it can be seen from Figures 10(a) and (b) that the AC and DC components of the Red and IR PPG signals are larger than those of the ambient PPG signal. Therefore, the contribution of the ambient PPG signal is less significant compared with the contribution of the RED or IR PPG signals. This can provide for a more accurate Sp02 calculation. That is, in example embodiments, the LED illumination intensity can be tuned to a level that provides for detected signals that provide as high a detected voltage as possible, without saturating the signals. The intensity can be controlled by the MCU. The tuning can ensure that both Red and IR signals transmitted to ADC1 can reach an amplitude level significantly higher than Ambient signals transmitted to ADC1. For example, if an Ambient signal at ADC1 is about 0.5V, both Red and IR signals at ADC1 can preferably be set at about 2V or above. This is described and illustrated in more detail below with

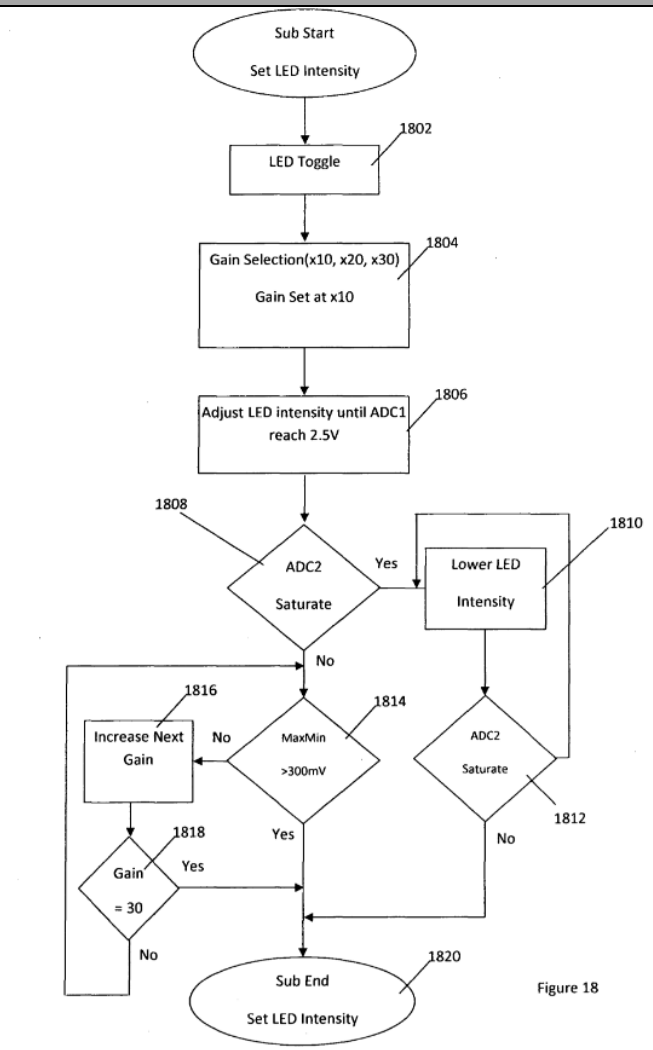
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	Figure 18. In addition, there can be steps taken to ensure that detected Ambient light signals are not too high. Exemplary steps are described and illustrated in more detail below with Figure 17. Kassim at 24:14-28. Based on the LED firing sequence as illustrated in Figure 6, the data obtained at ADC1 and ADC2 can be processed to select the AC and DC components of the IR, Red and Ambient conditions. Kassim at 24:30-32. 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. Figure 16 shows how a signal forms at an analog to digital converter (compare ADC1 422 of Figure 4) when two LEDs toggle and when both LEDs are switched off in an example embodiment. During toggling, the signal detected at a photodetector PD is shown in part (iii) of Figure 16. The square wave 1602 is the detected signal which reflects the sampled points based on the toggling timing sequence. At each sampled point of Red (R1F R2....Rn,) and IR (IR1 t IR2 IRn), analog to digital conversion ADC is executed and the values captured by a microcontroller MCU. Data is separated or de-multiplexed in the MCU and can be presented as individual Red and IR data (or separated Red and IR PPG signals) in dots format, as shown in part (ii) of Figure 16. Over a larger time frame, a PPG signal comprising Red and IR are formed, as shown in part (i) of Figure 16. When both LEDs are switched off, only 1 signal (Ambient) is present and thus the ADC captured values are not separated. This signal at part (i) passes through the signal conditioning and produces a signal substantially similar to Figure 10(b). Kassim at 32:13-25.

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	 Figure 16 Kassim at Fig. 16 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. At step 1710, both the Red and IR LEDs are switched off. At step 1712, it is determined whether ADC1 of the MCU of the measurement device reads a value of e.g. more than about 1.5V. If the reading is more than the exemplary value of 1.5V at step 1712, at step 1714, the personal mobile processing device is configured to alert the user to relocate to another location for the optical measurement as the ambient

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	light interference is determined to be too high. If the reading is less than the exemplary value of 1.5V at step 1712, at step 1716, the ambient light detection process ends. Kassim at 32:27-35.  Figure 17 Kassim at Fig. 17 Figure 18 is a schematic flow diagram illustrating a light intensity setting process in an example embodiment. This process can be used for scenarios for normal measurements. At step 1802, a LED toggle sequence is performed. At step 1804, the light data detected at step 1802 undergoes a gain process. The gain may be selected from, for example, ten times, twenty times or thirty times etc. In the example embodiment, a gain of e.g. ten times is selected. At step 1806, it is determined whether ADC1 of the MCU of the measurement device reads a value of e.g. about 2.5V. The LEDs intensity is adjusted until the reading reaches 2.5V. This can ensure that the contribution of the ambient light is not substantially more than the contribution of the LEDs, when measured by the detector. In this example embodiment, because the ambient light cannot exceed 1.5V, and each LED is adjusted to result in a measurement of about 2.5V, the ambient light does not exceed more than about 60% of the light detected by the detector, when each LED is switched on. At step 1808, it is determined whether ADC2 of the MCU of the

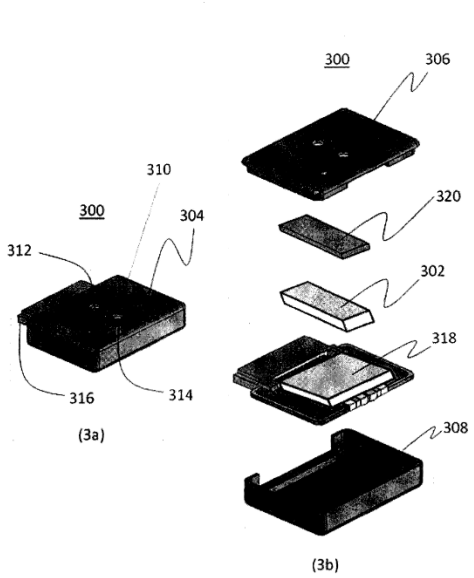
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	measurement device reaches saturation, e.g. at about 3.3V. If ADC2 has reached saturation, at step 1810, the LEDs intensity is lowered until ADC2 is no longer saturated at step 1812. Kassim at 33:1-16. If ADC2 has not reached saturation at step 1808, at step 1814, it is determined whether the maximum and minimum data points have a difference of more than e.g. about 300mV. If the difference at step 1814 is not more than e.g. about 300mV, at step 1816, the gain can be increased. At step 1818, it is determined whether the gain is thirty times. If the gain is thirty times, the LED intensity is set and the setting process is ended at step 1820. If the gain is not yet thirty times at step 1818, the process loops back to step 1814. Kassim at 33:18-23.

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	 Figure 18 Kassim at Fig. 18 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

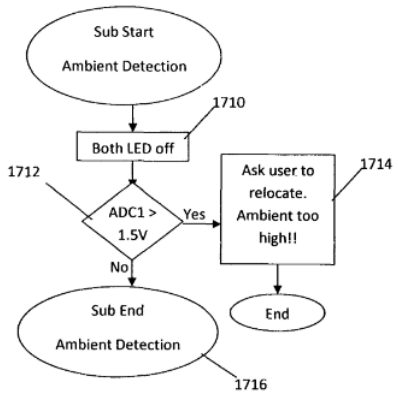
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	identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary 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.
1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Kassim discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;. 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 SpO_2 values determination. Kassim at 8:30-34. 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 Figure 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. 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

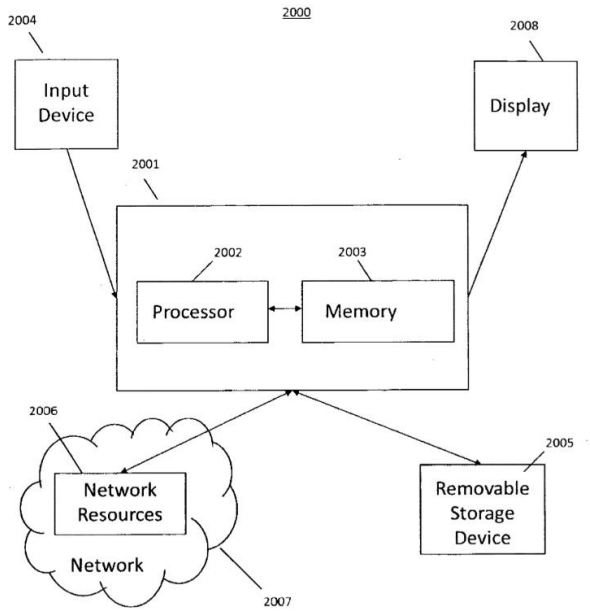
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	through a proprietary connector, such a universal serial bus (USB) port or the 30 pin connection used in the Apple® iPhone® (Apple Computer, Inc., Cupertino, CA). Kassim at 12:12-18.  Figure 3 Kassim at Fig. 3. In the example embodiment, the light 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

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	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. Kassim at 12:27-33. 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 21:33-22:6. 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. Kassim at 28:22-26 The inventors have recognised that, indirectly, deviation бR reflects the confidence level of the computation result of R. The calculated propagation error may be displayed on a screen of a personal mobile processing device to inform the user of the potential accuracy of the $Sp0_2$ measurement. Kassim at 29:10-13 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. At step 1710, both the Red and IR LEDs are switched off. At step 1712, it is determined whether ADC1 of the MCU of the measurement device reads a value of e.g. more than about 1.5V. If the reading is more than the exemplary value of 1.5V at step 1712, at step 1714, the personal mobile processing device is configured to alert the user to relocate to another location for the optical measurement as the ambient

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	light interference is determined to be too high. If the reading is less than the exemplary value of 1.5V at step 1712, at step 1716, the ambient light detection process ends. Kassim at 32:27-35  Figure 17 Kassim at Fig. 17 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

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	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 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

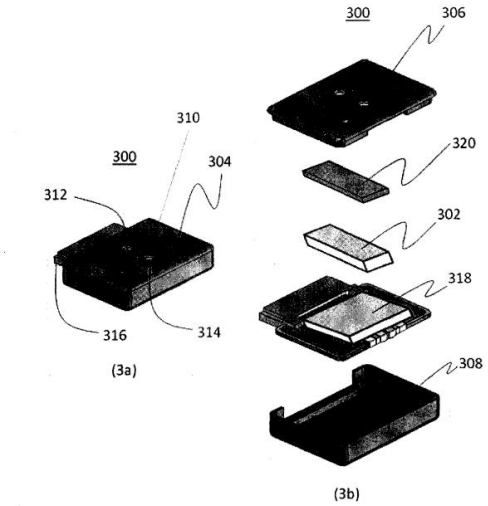
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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Kassim, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kassim, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Kassim discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. Optical monitoring of physiological characteristics utilizes the detection of light transmitted through a location of a user being measured. Photoplethysmography (PPG) is an optical measurement technique used to detect blood volume changes in the microvascular bed of living tissue, typically by detecting light transmitted through the ear lobe or fingertip. As arterial pulsations enter the capillary bed, changes in the volume of the blood vessels or characteristics of the blood itself modify the optical properties of the capillary bed. A PPG signal is used to measure saturation of peripheral oxygen (Sp02), which is an estimation of the level of oxygen saturation in a fluid, such as blood. The PPG signal can also be used to measure blood pressure. Kassim at 1:14-22 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. Kassim at 1:24-25 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 8:24-28. 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.

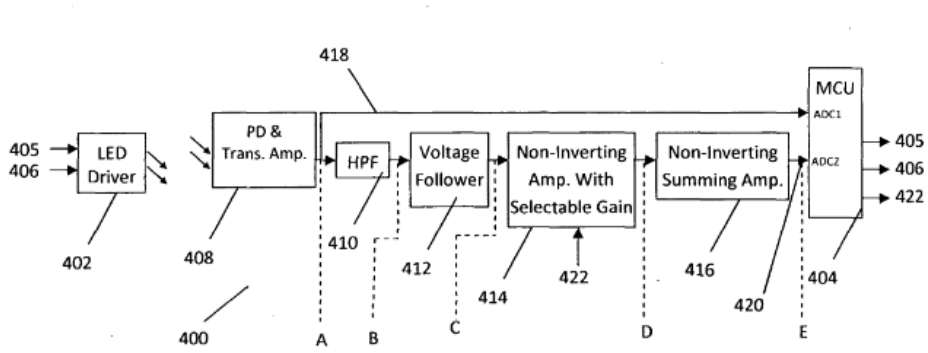
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	Kassim at 8:30-34. In some example embodiments, saturation of peripheral oxygen (SP02) information of a user is derivable from detected output light information from both a red LED and an infra-red LED. Further, in the description herein, the term "light" as used herein is meant to be interpreted in a broad sense and is not 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. Kassim at 11:23-28 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® 10 iPhone® (Apple Computer, Inc., Cupertino, CA) etc. Kassim at 12:5-10 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). 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.

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	 Figure 3 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. Kassim at 12:27-33 During operation, at the output of the detection assembly 408, a raw PPG signal is recorded. This enables the DC component of the signal to be acquired e.g. for LED illumination intensity adjustment and Sp02 calculation. The high-pass filter 410 can introduce a filter with a high-pass cut off of e.g. about 0.12 Hz so as to remove the DC component of the raw PPG signal. This can also produce the AC component of the signal, with the AC component oscillating about ground voltage. The output of the high-pass filter 410 is transmitted to the voltage follower amplifier module 412 to create a high impedance signal. The inventors have recognised that without a high impedance, the signal may be lost at the amplification stage subsequently. Kassim at 14:11-19

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	 Figure 4(a) Kassim at Fig. 4 (a) 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 21:33-22:6 Advantageously, in the example embodiment, a signal reconstruction of true Red and/or IR PPG signals to remove ambient signal interference can be avoided. The inventors have recognised that by identifying and utilising only significant information for Sp02 calculation, an efficient and accurate calculation can be carried out. The inventors have recognized that by using only the maximum and minimum values of the respective red, IR and ambient signal pulses, the calculation of Sp02 can be carried out. For example, 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, i.e. when none of the LEDs is turned on. Kassim at 22:27-23:3

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	In other words, instead of reconstructing a true Red PPG signal (devoid of ambient signal) and a true IR PPG signal (devoid of ambient signal), advantageously, reconstruction is avoided in example embodiments, and only the maximum and minimum values of 3 PPG signals are obtained for analysis to obtain Sp02 value. This can minimise processing and consume less power. Kassim at 23:5-9 With the AC and DC signal portions, the inventors have recognised that significant information can be further extracted for Sp02 calculation. Using the circuit of Figure4(a), it can be seen from Figures 10(a) and (b) that the AC and DC components of the Red and IR PPG signals are larger than those of the ambient PPG signal. Therefore, the contribution of the ambient PPG signal is less significant compared with the contribution of the RED or IR PPG signals. This can provide for a more accurate Sp02 calculation. That is, in example embodiments, the LED illumination intensity can be tuned to a level that provides for detected signals that provide as high a detected voltage as possible, without saturating the signals. The intensity can be controlled by the MCU. The tuning can ensure that both Red and IR signals transmitted to ADC1 can reach an amplitude level significantly higher than Ambient signals transmitted to ADC1. For example, if an Ambient signal at ADC1 is about 0.5V, both Red and IR signals at ADC1 can preferably be set at about 2V or above. This is described and illustrated in more detail below with Figure 18. In addition, there can be steps taken to ensure that detected Ambient light signals are not too high. Exemplary steps are described and illustrated in more detail below with Figure 17. Kassim at 24:14-28. 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. Kassim at 28:22-26 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 SpO2 measurement. Kassim at 29:1-2 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. $R= f(AC_{ir},AC_r,AC_{am}, DC_{ir}, DC_r, DC_{am})$

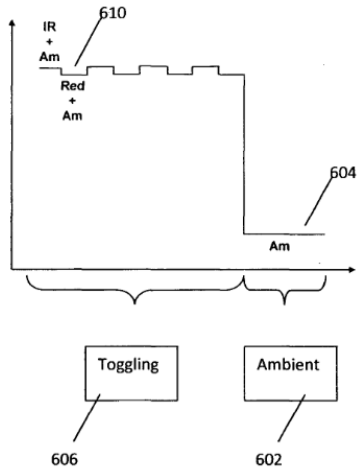
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	Kassim at 29:5-9 The inventors have recognised that, indirectly, deviation ϭR reflects the confidence level of the computation result of R. The calculated propagation error may be displayed on a screen of a personal mobile processing device to inform the user of the potential accuracy of the $Sp0_2$ measurement. Kassim at 29:10-13 Alternatively, instead of the calculated propagation error, a representative description of the propagation error may be displayed. For example, for a propagation error of more than e.g. 30% of the mean of the calculated R, the user may be informed that the measured Sp02 is highly inaccurate and may be advised to retake the readings at a more suitable location. As another example, for a deduced propagation error of less than e.g. 10%, the user may be informed that the measured Sp02 is relatively accurate. Kassim at 29:15-20 The equations below illustrate the algorithm for determining the accuracy. R= f(AC_{ir},AC_r,AC_{am}, DC_{ir}, DC_r, DC_{am}) $$\sigma_R^2 = \left(\frac{\partial R}{\partial AC_{ir}}\right)\sigma_{AC_{ir}}^2 + \left(\frac{\partial R}{\partial AC_r}\right)\sigma_{AC_r}^2 + \left(\frac{\partial R}{\partial AC_{am}}\right)\sigma_{AC_{am}}^2 + \left(\frac{\partial R}{\partial DC_{ir}}\right)\sigma_{DC_{ir}}^2 + \left(\frac{\partial R}{\partial DC_r}\right)\sigma_{DC_r}^2 + \left(\frac{\partial R}{\partial DC_{am}}\right)\sigma_{DC_{amr}}^2$$ Further, each parameter has individual deviation as follows, DC,r = AC - -$AC_{avg\ ir}$ + cr_{AClr} = $DC_{a»S,r}$ + °DC, AC_r = AC, DC = $DC_{avg,am}$ + ° DC, AC,,,, = ■$AC_{avg\ a,,,}$ + & AC_m Hence, the average value of R $$_{avg} = \sqrt{\left[\frac{AC_{avg,r}{}^2 - AC_{avg,am}{}^2}{DC_{avg,r}{}^2 - DC_{avg,am}{}^2}\right] \times \left[\frac{DC_{avg,ir}{}^2 - DC_{avg,am}{}^2}{AC_{avg,ir}{}^2 - AC_{avg,am}{}^2}\right]}$$

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	$$\sigma_R = R_{avg} \times sqrt\left[\frac{\sigma^2_{AC_{ir}}}{(AC_{avg,ir}-AC_{avg,am})^2}+\frac{\sigma^2_{DC_{ir}}}{(DC_{avg,ir}-DC_{avg,am})^2}+\frac{\sigma^2_{AC_r}}{(AC_{avg,r}-AC_{avg,am})^2}+\frac{\sigma^2_{DC_r}}{(DC_{avg,r}-DC_{avg,am})^2}+\frac{\left[(AC_{avg,ir}-AC_{avg,am})-(AC_{avg,r}-AC_{avg,am})\right]^2\left[\sigma^2_{AC_{am}}\right]}{(AC_{avg,ir}-AC_{avg,am})^2(AC_{avg,r}-AC_{avg,am})^2}+\frac{\left[(DC_{avg,r}-DC_{avg,am})-(DC_{avg,ir}-DC_{avg,am})\right]^2\left[\sigma^2_{DC_{am}}\right]}{(DC_{avg,r}-DC_{avg,am})^2(DC_{avg,ir}-DC_{avg,am})^2}\right]$$ Therefore, it can be derived that $R = R_{Avg} \pm \sigma_R$ In another example embodiment, the ratio R can be determined using averages of maximum and minimum values. In the example embodiment, each Red and IR PPG signal are paired on a per cycle basis. A subtraction is carried out using an average ambient signal value. The average ambient signal value can be obtained before or after obtaining the Red and IR PPG signals. Kassim at 29:22-30:24 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. At step 1710, both the Red and IR LEDs are switched off. At step 1712, it is determined whether ADC1 of the MCU of the measurement device reads a value of e.g. more than about 1.5V. If the reading is more than the exemplary value of 1.5V at step 1712, at step 1714, the personal mobile processing device is configured to alert the user to relocate to another location for the optical measurement as the ambient light interference is determined to be too high. If the reading is less than the exemplary value of 1.5V at step 1712, at step 1716, the ambient light detection process ends. Kassim at 32:27-35 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

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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.
1[i]. 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;	Kassim discloses or renders obvious 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. 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. Further to the above, it has been recognized by the inventors that, to provide single path system, control of the illumination intensities of the respective light sources (e.g. the LEDs) and/or selection of gain can be significant in obtaining accurate measurements and avoiding saturation at the output. Kassim at 15:11-14. 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. Hence, even with a fixed gain of e.g. about 10 times, the inventors have recognised that the DC components of both the Red and IR light sources can be set to be as close as possible to each other so as

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	to achieve a conditioned signal. The above may be achieved by tuning the illumination intensities of the light sources. In addition, a high gain can then be imposed without saturating the output signal, for a single path processing circuitry with toggling capabilities that can cater for low perfusion scenarios. Kassim at 18:32-19:2. Thus, there can be provided an optical measurement device that allows a gain to be selected for obtaining AC components of a PPG signal. The optical measurement device can further control illumination intensities of light sources of an illumination assembly of the measurement device. The selectable gain and the control of the illumination intensities are used such that an output signal at the optical measurement device is within a predetermined voltage/amplitude range. The predetermined voltage/amplitude range is selected based on a known saturation level of the device. Kassim at 19:4-10. 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. Kassim at 20:1-11. 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[j]. the detection system further configured to: generate a first signal responsive to light received	Kassim discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off.

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while the semiconductor sources 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.  Figure 6(a) Kassim at Fig. 6(a) . Figure 6(b) shows an example of de-multiplexed signals in an example embodiment. The de-multiplexed signals can be obtained during the toggling phase at the various points in the signal processing path. The IR PPG signals (in bold) e.g. 612 and Red PPG signals (dotted) e.g. 614 can be obtained. Figure 6(c) shows another example of de-multiplexed signals in an example embodiment. Figure 6(c) is similar to Figure 6(b) with the exception that the time scale used for Figure 6(c) is smaller. Compare t1-t2 indicated on Figures 6(b) and (c). The graphs of Figure 6(c) represent the individual sampled points,

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	rather than the complete waveforms formed by the individual points as shown in Figure 6(b). A more detailed illustration is provided below with reference to Figure 16. Kassim at 15:23-30. Figure 7(a) is an exemplary schematic timing wave diagram for toggling on/off of an IR LED and a Red LED. Figure 7(b) is an alternative schematic timing wave diagram for toggling on/off of an IR LED and a Red LED in an example embodiment. Figure 7(b) is a modification of Figure 7(a) to allow an ambient PPG signal to be obtained. Figure 7(b) also illustrates a toggling sequence within sequence 606 of Figure 6. There is a relatively brief period At 702 between each toggling, e.g. about I OOμε, when both the Red and IR LEDs are turned off. Each LED is turned on for about 2.9ms e.g. numeral 704, which makes each toggling cycle to be about 6ms. This can improve the IR and Red PPG signals accuracy. The brief period At 702 allows a time break between switching from a Red and IR signal condition (or vice versa). This may be useful to a single path system whereby detection of the red and IR signals are performed using the same circuitry, i.e. a single path system. The brief period At 702 introduced can ensure that each detected Red and IR light information displays its own behavior. The inventors have recognised that if there is no break e.g. provided by period At 702, the light signal of the previously switched on LED may still be present in the processing path. That is, using the brief period can reduce "crosstalk" issues. Kassim at 16:1-15. Figure 8(a) is a schematic graph illustrating output obtained at a light detector (compare 408 of Figure 4) during toggling between a red LED and an IR LED in an example embodiment. The graph is shown with the y-axis representing voltage V values and the x- axis representing milli-seconds ms values. The red LED and IR LED are preferably driven by the microcontroller so that the detected output (compare point A of Figure 4(a)) based on the respective red and IR LEDs is at the same voltage of about 2.5V. However, it is appreciated that this is often difficult and there may be differences in the outputs. Figure 8(a) shows a corresponding amplitude difference of about 100mV. The oscillation period corresponds to the toggling period, e.g. with respect to Figure 7(a). Kassim at 16:17-25. 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

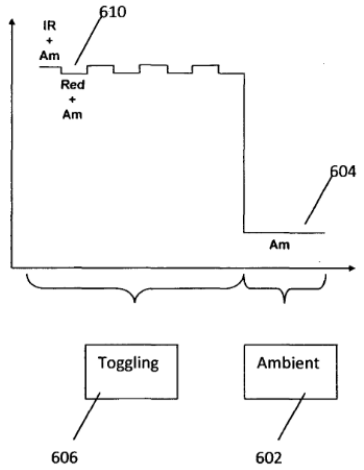
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	provide for a signal amplitude that is as high as possible above the ambient signal, but still provide room for the signal to not be saturated at 3.3V. Kassim at 16:27-35. Thus, the inventors have recognized that ambient light interference can be 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 17:1-5. To determine Sp02 values, for example, a proprietary lookup table is typically provided by manufacturers. A calculated ratio R is used for referring to the lookup table to determine Sp02 values. R is defined as, $$R = \frac{\frac{AC_R}{DC_R}}{\frac{AC_{IR}}{DC_{IR}}}$$ where AC, DC refer to alternating current and direct current values respectively. The conditions IR and R refer to conditions whereby infra-red light and red light are used respectively. It is noted that ambient light noise is usually subtracted or removed in the R calculations. Kassim at 22:8-17. In example embodiments, there can be provided a method and system for noise cancellation, e.g. for Sp02 measurements. In one example embodiment, AC and DC values are respectively obtained for a Red PPG signal measurement, an IR PPG signal measurement and an ambient PPG signal measurement (where both the red and IR LEDs are turned off). The maximum and minimum values of the PPG signal measurements are determined. A Sp02 value based on a ratio R value calculated using the determined maximum and minimum values can then be determined. Kassim at 22:19-25. Advantageously, in the example embodiment, a signal reconstruction of true Red and/or IR PPG signals to remove ambient signal interference can be avoided. The inventors have recognised that by identifying and utilising only significant information for Sp02 calculation, an efficient and accurate calculation can

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	be carried out. The inventors have recognized that by using only the maximum and minimum values of the respective red, IR and ambient signal pulses, the calculation of Sp02 can be carried out. For example, 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, i.e. when none of the LEDs is turned on. Kassim at 22:28-23:3. In other words, instead of reconstructing a true Red PPG signal (devoid of ambient signal) and a true IR PPG signal (devoid of ambient signal), advantageously, reconstruction is avoided in example embodiments, and only the maximum and minimum values of 3 PPG signals are obtained for analysis to obtain Sp02 value. This can minimise processing and consume less power. Kassim at 23:5-9. 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.
1[k]. generate a second signal responsive to light received while at least one of	Kassim discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on; and.

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the semiconductor sources is on; and	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. Figure 6(c) shows another example of de-multiplexed signals in an example embodiment. Figure 6(c) is similar to Figure 6(b) with the exception that the time scale used for Figure 6(c) is smaller. Compare t1-t2 indicated on Figures 6(b) and (c). The graphs of Figure 6(c) represent the individual sampled points, rather than the complete waveforms formed by the individual points as shown in Figure 6(b). A more detailed illustration is provided below with reference to Figure 16. Kassim at 15:23-30. Figure 7(a) is an exemplary schematic timing wave diagram for toggling on/off of an IR LED and a Red LED. Figure 7(b) is an alternative schematic timing wave diagram for toggling on/off of an IR LED and a Red LED in an example embodiment. Figure 7(b) is a modification of Figure 7(a) to allow an ambient PPG signal to be obtained. Figure 7(b) also illustrates a toggling sequence within sequence 606 of Figure 6. There is a relatively brief period At 702 between each toggling, e.g. about I OOμε, when both the Red and IR LEDs are turned off. Each LED is turned on for about 2.9ms e.g. numeral 704, which makes each toggling cycle to be about 6ms. This can improve the IR and Red PPG signals accuracy. The brief period At 702 allows a time break between switching from a Red and IR signal condition (or vice versa). This may be useful to a single path system whereby detection of the red and IR signals are performed using the same circuitry, i.e. a single path system. The brief period At 702 introduced can ensure that each detected Red and IR light information displays its own behavior. The inventors have recognised that if there is no break e.g. provided by period At 702, the light signal of the previously switched on LED may still be present in the processing path. That is, using the brief period can reduce "crosstalk" issues. Kassim at 16:1-15. Figure 8(a) is a schematic graph illustrating output obtained at a light detector (compare 408 of Figure 4) during toggling between a red LED and an IR LED in an example embodiment. The graph is shown with the y-axis representing voltage V values and the x- axis representing milli-seconds ms values. The red LED and IR LED are preferably driven by the microcontroller so that the detected output (compare point A of Figure 4(a)) based on the respective red and IR LEDs is at the same voltage of about 2.5V. However, it is appreciated that this is often difficult and there may be differences in the outputs. Figure

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	8(a) shows a corresponding amplitude difference of about 100mV. The oscillation period corresponds to the toggling period, e.g. with respect to Figure 7(a). Kassim at 16:17-25. 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. Kassim at 16:27-35. 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 17:1-5.

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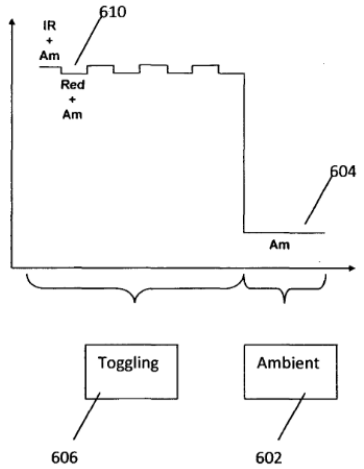
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, 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.
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. Figure 6(c) shows another example of de-multiplexed signals in an example embodiment. Figure 6(c) is similar to Figure 6(b) with the exception that the time scale used for Figure 6(c) is smaller. Compare t1-t2 indicated on Figures 6(b) and (c). The graphs of Figure 6(c) represent the individual sampled points, rather than the complete waveforms formed by the individual points as shown in Figure 6(b). A more detailed illustration is provided below with reference to Figure 16. Kassim at 15:23-30. Figure 7(a) is an exemplary schematic timing wave diagram for toggling on/off of an IR LED and a Red LED. Figure 7(b) is an alternative schematic timing wave diagram for toggling on/off of an IR LED and a Red LED in an example embodiment. Figure 7(b) is a modification of Figure 7(a) to allow an ambient PPG signal to be obtained. Figure 7(b) also illustrates a toggling sequence within sequence 606 of Figure 6. There is a relatively brief period At 702 between each toggling, e.g. about I OOμε, when both the Red and IR LEDs are turned off. Each LED is turned on for about 2.9ms e.g. numeral 704, which makes each toggling cycle to be about 6ms. This can improve the IR and Red PPG signals accuracy. The brief period At 702 allows a time break between switching from a Red and IR signal condition (or vice versa). This may be useful to a single path system whereby detection of the red and IR signals are performed using the same circuitry, i.e. a single path system. The brief period At 702 introduced can ensure that each

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	detected Red and IR light information displays its own behavior. The inventors have recognised that if there is no break e.g. provided by period At 702, the light signal of the previously switched on LED may still be present in the processing path. That is, using the brief period can reduce "crosstalk" issues. Kassim at 16:01-15. Figure 8(a) is a schematic graph illustrating output obtained at a light detector (compare 408 of Figure 4) during toggling between a red LED and an IR LED in an example embodiment. The graph is shown with the y-axis representing voltage V values and the x- axis representing milli-seconds ms values. The red LED and IR LED are preferably driven by the microcontroller so that the detected output (compare point A of Figure 4(a)) based on the respective red and IR LEDs is at the same voltage of about 2.5V. However, it is appreciated that this is often difficult and there may be differences in the outputs. Figure 8(a) shows a corresponding amplitude difference of about 100mV. The oscillation period corresponds to the toggling period, e.g. with respect to Figure 7(a). Kassim at 16:17-25. 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. Kassim at 16:27-35.

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	 Figure 6(a) Kassim at Fig. 6(a). Figure 6(c) shows another example of de-multiplexed signals in an example embodiment. Figure 6(c) is similar to Figure 6(b) with the exception that the time scale used for Figure 6(c) is smaller. Compare t1-t2 indicated on Figures 6(b) and (c). The graphs of Figure 6(c) represent the individual sampled points, rather than the complete waveforms formed by the individual points as shown in Figure 6(b). A more detailed illustration is provided below with reference to Figure 16. Kassim at 15:23-30. Figure 7(a) is an exemplary schematic timing wave diagram for toggling on/off of an IR LED and a Red LED. Figure 7(b) is an alternative schematic timing wave diagram for toggling on/off of an IR LED and a Red LED in an example embodiment. Figure 7(b) is a modification of Figure 7(a) to allow an ambient PPG signal to be obtained. Figure 7(b) also illustrates a toggling sequence within sequence 606 of Figure 6. There is a relatively brief period At 702 between each toggling, e.g. about I OOμε, when both the Red and IR LEDs are turned off. Each LED is turned on for about 2.9ms e.g. numeral 704, which makes each toggling cycle to be about 6ms. This can improve the IR and Red PPG signals accuracy. The brief period At 702 allows a time break between switching from a Red and IR signal condition (or vice versa). This

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	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.
1[m]. wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Kassim discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. 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. The LEDs illuminate the tissue (e.g. skin) of the user and the photodetector measures small variations in light intensity associated with changes in perfusion in a catchment volume. An oximeter in such a configuration is typically called a transmittance-type oximeter. The light from the LEDs passes through the tissue and is detected by the photodiode. One LED is red, with wavelength of approximately 660 nanometers (nm), and the other is infrared, with a wavelength of approximately 905, 910 or 940 nm. Absorption at these wavelengths differs significantly between oxyhemoglobin and its deoxygenated form. Therefore, the ratio of

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	oxyhemoglobin to deoxyhemoglobin can be calculated from the ratio of the absorption of the red and infrared light, i.e. the ratio of red light to infrared light absorption of pulsating components at the measuring site. Kassim at 1:24-2:3 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 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 11:23-3:28. 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. 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.

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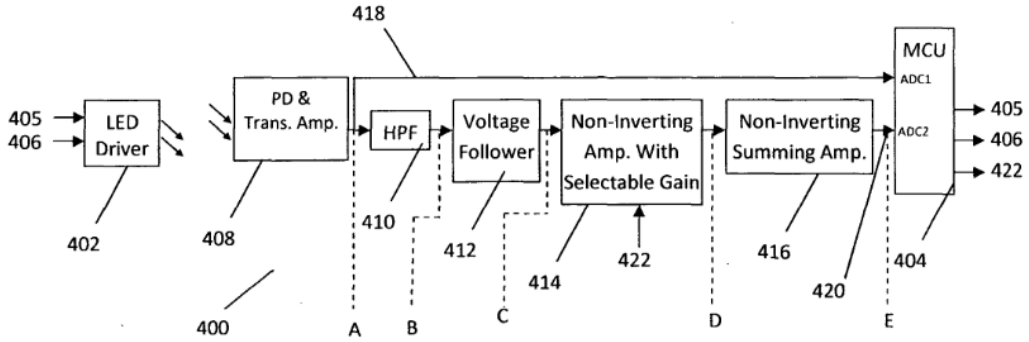
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	Thus, in the above described example embodiment, direct-current (DC) and alternating-current (AC) values of a first (e.g. red), second (e.g. IR) and third (e.g. ambient) signal waveforms can be obtained based on the respective maximum and minimum 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) 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 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting	See claim 1 above.

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diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	Kassim discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. 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. The LEDs illuminate the tissue (e.g. skin) of the user and the photodetector measures small variations in light intensity associated with changes in perfusion in a catchment volume. An oximeter in such a configuration is typically called a transmittance-type oximeter. The light from the LEDs passes through the tissue and is detected by the photodiode. One LED is red, with wavelength of approximately 660 nanometers (nm), and the other is infrared, with a wavelength of approximately 905, 910 or 940 nm. Absorption at these wavelengths differs significantly between oxyhemoglobin and its deoxygenated form. Therefore, the ratio of oxyhemoglobin to deoxyhemoglobin can be calculated from the ratio of the absorption of the red and infrared light, i.e. the ratio of red light to infrared light absorption of pulsating components at the measuring site. 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 01:24-2:3 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 02:8-14 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

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	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) Kassim at Fig. 4 (a) Therefore, in an example embodiment, an optical measurement device can be provided. The device can comprise an illumination assembly configured to output light to a 15 surface portion of a user for measurement. The illumination assembly can comprise one or more light sources such as one or more LEDs. Kassim at 20:13-16. 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.

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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.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	

See claim 2 above.

Kassim discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.

Optical monitoring of physiological characteristics utilizes the detection of light transmitted through a location of a user being measured. Photoplethysmography (PPG) is an optical measurement technique used to detect blood volume changes in the microvascular bed of living tissue, typically by detecting light transmitted through the ear lobe or fingertip. As arterial pulsations enter the capillary bed, changes in the volume of the blood vessels or characteristics of the blood itself modify the optical properties of the capillary bed. 20 A PPG signal is used to measure saturation of peripheral oxygen (SpO2), which is an estimation of the level of oxygen saturation in a fluid, such as blood. The PPG signal can also be used to measure blood pressure.

Kassim at 1:14:23

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 (SpO2) calculations/measurements.

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Kassim at 8:24-28

In some example embodiments, saturation of peripheral oxygen (SPO2) 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 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.

Kassim at 11:23-28.

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 900-1000 nm can be used. Alternatively, a single filter which allow transmission of light from about 600-1000nm 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.
$R= f(AC_{ir},AC_r,AC_{am}, DC_{ir}, DC_r, DC_{am})$
Kassim at 28:22-29:9.

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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.	
Claim 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kassim discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. See above at claim 1[pre]

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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[a]. A wearable device adapted to be placed on a wrist or an ear of a user,	Kassim discloses or renders obvious a wearable device adapted to be placed on a wrist or an ear of a user, See above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Kassim discloses or renders obvious, the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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]. the wearable device comprising one or more lenses configured to receive	Kassim discloses or renders obvious the 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.

at least a portion of the output optical light and to deliver a lens output light to tissue;	See above at claim 1[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.
8[d]. the wearable device further comprising 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,	Kassim discloses or renders obvious the wearable device further comprising 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, 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 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]. wherein the detection system is configured to be synchronized to the light source;	Kassim discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. 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 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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8[f]. 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 spatially separated 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 spatially separated detectors. See above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Kassim discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; See above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[h]. wherein the output signal is indicative of one or	Kassim discloses or renders obvious the output signal is indicative of one or more of the physiological parameters.

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more of the physiological parameters;	See above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[i]. 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; and	Kassim discloses or renders obvious 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. See above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[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. See above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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

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	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[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. See above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[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. See above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Kassim discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. See above 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

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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.
Claim 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 8 above. Kassim discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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.
Claim 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	See claim 9 above Kassim discloses or renders obvious the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. See above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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

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	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 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kassim discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 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.
15[a]. the wearable deviceadapted to be placed on teeth, a wrist, or an ear of a user,	Kassim discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, See above at claim 1[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.
15[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes	Kassim discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b]

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configured to generate an output optical light having one or more optical wavelengths;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.
15[c]. the 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;	Kassim discloses or renders obvious the 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. See above at claim 1[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.
15[d]. the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source;	Kassim discloses or renders obvious the wearable device further comprising 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, 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 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.
15[e]. wherein the detection system is configured to be	Kassim discloses or renders obvious wherein the detection system is configured to be synchronized to the light source.

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synchronized to the light source;	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 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.
15[f]. 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 spatially separated 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 spatially separated detectors. See above at claim 1[f] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal; wherein the smart phone or tablet is configured to store and	Kassim discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link See above at claim 1[g] One of ordinary skill would find this limitation disclosed either expressly 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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display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.
15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Kassim discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.
15[i]. 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; and	Kassim discloses or renders obvious 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. See above at claim 1[i] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.
15[j]. the detection system further configured to:	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.

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generate a first signal responsive to light received while the light emitting diodes are off,	See above at claim 1[j] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.
15[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 semiconductor sources is on; and. See above at claim 1[k] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal;	Kassim discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes,	Kassim discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, See above 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.
15[n]. wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Kassim discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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.
15[o]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure	Kassim discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. See above at claim 3

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a level of oxy-hemoglobin and deoxy-hemoglobin.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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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EXHIBIT E6

U.S. Pat. No. 11,160,455 in view of U.S. Patent Publication No. 2011/0237911 to Marcelo M. Lamego ("Lamego")

As described in detail below, Lamego (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 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 E1-E5 and E7-E18, 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 '455 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 Lamego. The cited portions of Lamego are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Lamego. 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 Lamego "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Lamego 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 Lamego (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 Lamego anticipates and/or renders obvious the Asserted Claims of the '455 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.

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Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lamego discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. A physiological monitor for determining blood oxygen saturation of a medical patient includes a sensor, a signal processor and a display. The sensor includes at least three light emitting diodes. Each light emitting diode is adapted to emit light of a different wavelength. The sensor also includes a detector, where the detector is adapted to receive light from the three light emitting diodes after being attenuated by tissue. The detector generates an output signal based at least in part upon the received light. The signal processor determines blood oxygen saturation based at least upon the output signal, and the display provides an indication of the blood oxygen saturation. Lamego at [Abstract] The present invention relates to the field of signal processing. More specifically, the present invention relates to the processing of measured signals which contain a primary signal portion and a secondary signal portion for the removal or derivation of either signal portion. The present invention is especially useful for physiological monitoring systems, including blood oxygen saturation measurement systems and oximeters. Lamego at [0003] A practical application of this technique is pulse oximetry, which utilizes a noninvasive sensor to measure blood oxygen saturation (SpO2) and pulse rate. A multi-wavelength physiological monitor in accordance with one embodiment determines blood oxygen saturation by propagating multi-wavelength energy through a medium, such as a portion of a patient's body where blood flows close to the body surface. For example, in one embodiment, energy is propagated through an ear lobe, a digit (such as a finger or toe), a forehead, or a scalp (such as a fetus's scalp). An attenuated signal is measured after energy propagation through, or reflection from the medium. The physiological monitor determines the saturation of oxygenated blood in the patient based at least in part upon the measured signal. Lamego at [0024]

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	In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion. Lamego at [0029] The arterial blood oxygen saturation curve 120 of a multi-wavelength physiological monitor in accordance with one embodiment of the present invention is shown in FIG. 2. The multi-wavelength system utilizes at least three different wavelengths of light (λ1, λ2, . . . λn) to determine blood oxygen saturation. Arterial blood oxygen saturation (SaO2) is represented on the y-axis of the curve 120. The x-axis represents ratios of composite signals, each comprising signals based upon the light transmission of the various light wavelengths (λ1, λ2, . . . λn). Each ratio r can be expressed by: $$r = \frac{\sum_{i=1}^{n} \alpha_i NP_{RMS,i}}{\sum_{i=1}^{n} \beta_i NP_{RMS,i}}$$ where n is the number of wavelengths of light utilized by the multi-wavelength physiological monitor, NPRMS,i is the normalized plethysmographic waveform of the ith wavelength light source, and αi and βi are vector coefficients of known constants that are determined based upon fitting and/or calibration using experimental data and/or model(s). The curve 120 contains lower and upper limit range curves 122, 124. However, the lower and upper limit range curves 122, 124 of the multi-wavelength physiological monitor are more linear than the lower and upper range curves 104, 106 of the dual-wavelength blood oximeter described above, as illustrated in FIG. 1. In addition, the lower and upper limit range curves 122, 124 of the multi-wavelength physiological monitor exhibit higher accuracy and lower tolerance 126 than the dual-wavelength blood

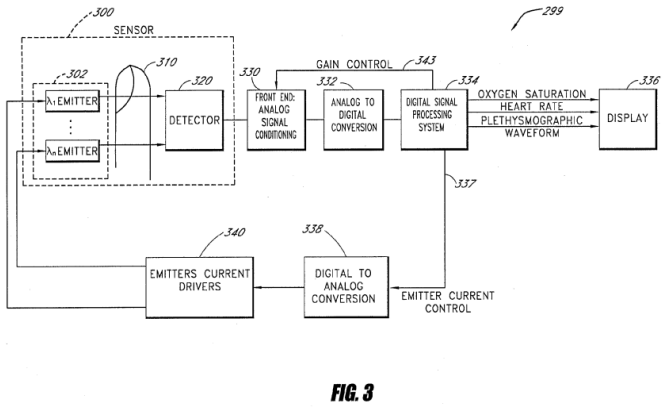
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	oximeter of FIG. 1, particularly at lower arterial blood oxygen saturation levels. In certain cases, such as during the monitoring of neonates, or persons with low blood-oxygen saturation, it is desirable for the physiological monitor to exhibit increased accuracy at lower saturation levels. For example, when providing oxygen to a neonate, it is often critical that neither too much oxygen nor too little oxygen is provided. A multi-wavelength physiological monitor provides improved accuracy as well as an improved signal-to-noise ratio at lower perfusion levels. A multi-wavelength physiological monitor provides additional advantages over a two-wavelength device, as well. For example, utilizing multiple wavelengths provide a multi-dimensional calibration curve, which can be used to provide multiple degrees of freedom to compensate for variation in other physiologically-related parameters. As discussed above, when only two wavelengths are used but there are more than two significant absorbers in the patient's tissue, the system may be underdetermined. Therefore, adding wavelengths 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. For example, an eight wavelength physiological monitor utilizes an eight-dimensional calibration curve, which provides eight degrees of freedom to compensate for various physiologically-related parameters. Such parameters can include, for example, noise, motion, various hemodynamic parameters, and/or blood constituent concentrations and/or levels. On the other hand, the system may be overdetermined if, for example, more wavelengths are used than there are significant absorbers and/or wavelengths are used for constituents not present in the particular patient's blood. Furthermore, traditional physiological monitors that utilize two light sources to derive a patient's plethysmographic signal generally require one light source's wavelength to fall in the red spectrum and the other light source's wavelength to fall in the infrared spectrum. However, a multi-wavelength physiological monitor advantageously provides the ability to utilize all infrared wavelength light sources and/or other non-red infrared light sources to derive an accurate plethysmographic waveform. One advantage of utilizing non-red wavelength light sources (for example, all infrared wavelength light sources) is that the multi-wavelength physiological monitor can be further configured to determine several blood constituent concentrations based upon signals measured from just the non-red light sources. For example, such a multi-wavelength physiological monitor can determine levels and/or concentrations of: methemoglobin (MetHb), carboxyhemoglobin (COHb), low hemoglobin levels, high hemoglobin levels, bilirubin, methylene blue, deoxyhemoglobin, and lipids. The ability to measure a physiological parameter with a multi-dimensional system allows the system to compensate and account for the presence of other conditions that may affect the particular physiological

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	parameter being measured. For example, many drugs cause the level of MetHb within a patient's blood to increase. MetHb also absorbs light at the two wavelengths used in a typical two-wavelength physiological monitor, which may cause inaccurate SpO2 readings. Increased levels of MetHb generally cause blood oxygen concentration level (e.g., SpO2) readings to decrease. A two-wavelength physiological monitor would provide reduced readings of blood oxygen concentration, but would not be able to identify the cause for the decreased reading, or to compensate for such readings. On the other hand, a multi-wavelength physiological monitor, such as any of the multi-wavelength physiological monitors described below, could not only identify the cause of decreased SpO2 readings, but also (or alternatively) compensate for such cause when calculating the patient's SpO2 level and/or signal. For example, to compensate for MetHb, one or more wavelengths sensitive to MetHb can be used. The wavelength(s) used can be, for example, about 760 nm and/or about 805 nm or the like. This allows for one or more additional equation (s) and degree(s) of freedom so that solving the system may account for the effect of the level of MetHb on blood oxygen saturation readings. Similarly, the system can compensate for other blood constituents with the addition of wavelengths sensitive to the other blood constituents of interest. For example, carboxyhemoglobin absorbs about the same amount of 660 nm light as oxyhemoglobin. Therefore, a typical two-wavelength physiological monitor can mistake carboxyhemoglobin for oxyhemoglobin, which can result in normal blood oxygen saturation level readings even though the actual level is abnormal. For example, for every about 1% of carboxyhemoglobin circulating in the blood, the monitor may over read by about 1%. Selecting one or more additional wavelengths sensitive to carboxyhemoglobin, for example, about 610, 630, and/or 640 or the like, can allow the system to compensate for this effect. The system can compensate for other blood constituents, such as deoxyhemoglobin or lipids, with the addition of wavelengths sensitive to those constituents. More wavelengths can allow the system to compensate for more variables. Lamego at [0033]-[0038]

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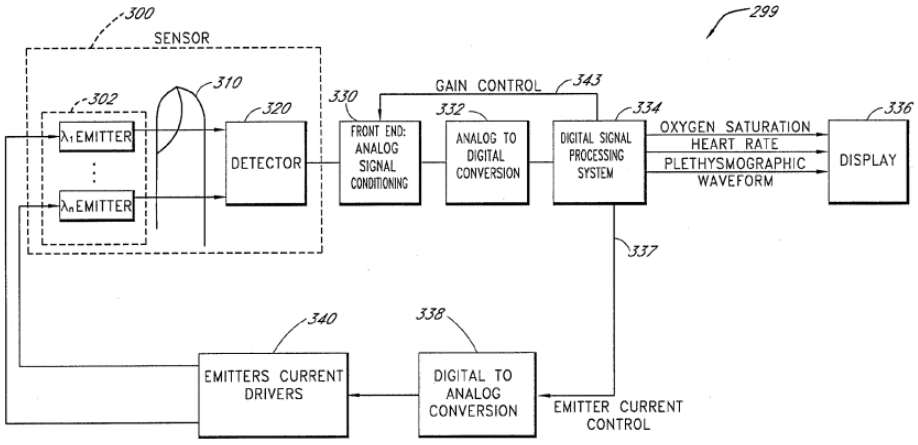
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	 FIG. 3 Lamego at Fig. 3 In one embodiment, the multi-wavelength physiological monitor compensates for conditions, such as motion and/or blood constituents that would cause a standard two-wavelength system to over- or under-react to the presence of such condition. Such compensation provides a more accurate, stable reading or a patient's physiological condition, including, but not limited to, their blood oxygen concentration and/or plethysmographic signal. A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. The front end analog signal conditioning circuitry 330 has outputs that are coupled to an analog to digital conversion circuit 332. The analog to digital conversion circuit 332 has outputs that are coupled to a digital signal processing system 334. The digital signal processing system 334 provides desired parameters as outputs for a display 336. Outputs for the display 336 include, for example, blood oxygen saturation, heart rate, and a clean plethysmographic waveform.

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	Lamego at [0040]-[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 art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, and	Lamego discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. Blood oxygen saturation measurement systems, oximeters, and physiological monitors of the prior art generally utilize two different wavelengths of light to determine a patient's blood oxygen saturation level. In general, such systems provide two wavelengths of light to a target location on a patient's body. The systems then measure at least one signal indicative of the transmission or reflection of the two light wavelengths with respect to the tissue at the target location. One such physiological monitor is taught by Diab et al. in U.S. Pat. No. 5,632,272, incorporated by reference herein in its entirety. One embodiment of Diab's physiological monitor provides light having a red wavelength and light having an infrared wavelength to one side of a patient's finger. A detector on the opposite side of the patient's finger measures the red and infrared wavelength light transmitted through the patient's finger and generates a measurement signal. A processor analyzes the measurement signal to determine red and infrared component signals. Possible saturation values are input to a saturation equation module which provides reference coefficients. The red or infrared component signal is processed with the reference coefficients to yield reference signal vectors. Lamego at [0005]-[0006] A practical application of this technique is pulse oximetry, which utilizes a noninvasive sensor to measure blood oxygen saturation (SpO2) and pulse rate. A multi-wavelength physiological monitor in accordance with one embodiment determines blood oxygen saturation by propagating multi-wavelength energy through a medium, such as a portion of a patient's body where blood flows close to the body

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	surface. For example, in one embodiment, energy is propagated through an ear lobe, a digit (such as a finger or toe), a forehead, or a scalp (such as a fetus's scalp). An attenuated signal is measured after energy propagation through, or reflection from the medium. The physiological monitor determines the saturation of oxygenated blood in the patient based at least in part upon the measured signal. Lamego at [0024] In one embodiment, absorption measurements are based upon the transmission of energy through a medium. In one embodiment, multiple light emitting diodes (LEDs) are positioned on one side of a portion of the body where blood flows close to the body's surface, such as a finger, and a photodetector is positioned on the opposite side of the surface. In another embodiment one or more such LEDs emit light of different wavelengths. In one embodiment, one LED emits a visible wavelength, such as red, and the other LED emits an infrared wavelength. However, one skilled in the art will realize that other wavelength combinations could be used. The finger comprises skin, tissue, muscle, both arterial blood and venous blood, fat, etc., each of which absorbs light energy differently due to different absorption coefficients, different concentrations, different thicknesses, and changing optical pathlengths. When the patient is not moving, absorption is substantially constant except for variations due to the flow of blood through the skin, tissue, muscle, etc. A constant attenuation can be determined and subtracted from the measured signal via traditional filtering techniques. However, when the patient moves, perturbations such as changing optical pathlengths occur. Such perturbations may be due to movement of background fluids, (such as venous blood, which has a different saturation than arterial blood). Therefore, the measured signal becomes erratic. Erratic, motion-induced noise typically cannot be predetermined and subtracted from the measured signal via traditional filtering techniques. Thus, determining the oxygen saturation of arterial blood and venous in erratic, motion-induced noise environments, blood becomes more difficult. In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion.

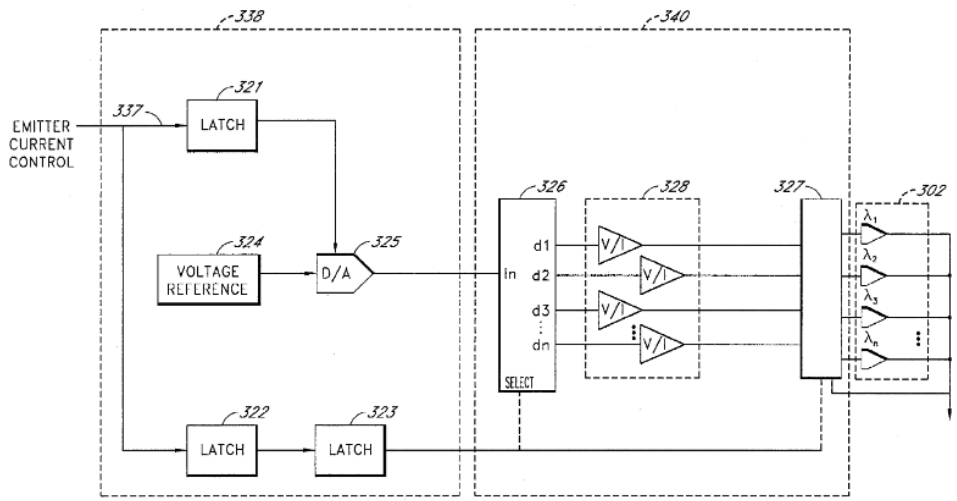
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	Lamego at [0027]-[0029] A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	Lamego discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. In one embodiment, absorption measurements are based upon the transmission of energy through a medium. In one embodiment, multiple light emitting diodes (LEDs) are positioned on one side of a portion of the body where blood flows close to the body's surface, such as a finger, and a photodetector is positioned on the opposite side of the surface. In another embodiment one or more such LEDs emit light of different wavelengths. In one embodiment, one LED emits a visible wavelength, such as red, and

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	the other LED emits an infrared wavelength. However, one skilled in the art will realize that other wavelength combinations could be used. Lamego at [0027] However, a multi-wavelength physiological monitor advantageously provides the ability to utilize all infrared wavelength light sources and/or other non-red infrared light sources to derive an accurate plethysmographic waveform. One advantage of utilizing non-red wavelength light sources (for example, all infrared wavelength light sources) is that the multi-wavelength physiological monitor can be further configured to determine several blood constituent concentrations based upon signals measured from just the non-red light sources. Lamego at [0036]  ***FIG. 3*** Lamego at Fig. 3

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	A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] The signal processing system also provides an emitter current control output 337 to a digital-to-analog converter circuit 338. The digital-to-analog converter circuit 338 provides control information to emitter current drivers 340. The emitter drivers 340 are coupled to the n light emitters 302. The digital signal processing system 334 also provides a gain control output 342 for front end analog signal conditioning circuitry 330. Lamego at [0043]

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	 ***FIG. 3A*** Lamego at Fig. 3A FIG. 3A illustrates one embodiment of the drivers 340 and the digital to analog conversion circuit 338. As depicted in FIG. 3A, the digital-to-analog conversion circuit 338 includes first and second input latches 321, 322, a synchronizing latch 323, a voltage reference 324, and a digital to analog conversion circuit 325. The emitter current drivers 340 include first and second switch banks 326, 327, and n voltage to current converters 328. LED emitters 302 of FIG. 3 are coupled to the output of the emitter current drives 340. The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks

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	326, 327. The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. The voltage reference is chosen as a low noise DC voltage reference for the digital to analog conversion circuit 325. In addition, in the present embodiment, the voltage reference has a lowpass output filter with a very low corner frequency (e.g., 1 Hz in the present embodiment). The digital to analog converter 325 also has a lowpass filter at its output with a very low corner frequency (e.g., 1 Hz). The digital to analog converter provides signals used to drive each of the emitters 302. In the present embodiment, the output of the voltage to current converters 328 are switched such that, only one emitter is active at any given time. In addition, the voltage to current converter for the inactive emitter is switched off at its input as well, such that it is deactivated. This reduces noise from the switching and voltage to current conversion circuitry. In the present embodiment, low noise voltage to current converters 328 are selected (e.g., Op 27 Op Amps), and the feedback loop is configured to have a low pass filter to reduce noise. In the present embodiment, the low pass filtering function of the voltage to current converters 328 has a corner frequency of just above 625 Hz, which is the switching speed for the emitters 302, as further discussed below. Accordingly, the driver circuit embodiment of FIG. 3A, minimizes the noise of the emitters 302. In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a “saturation transform.” It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term “saturation transform” is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. It should be understood that in different embodiments of the present invention, one or more of the outputs may be provided. The digital signal processing system 334 also provides control for driving the

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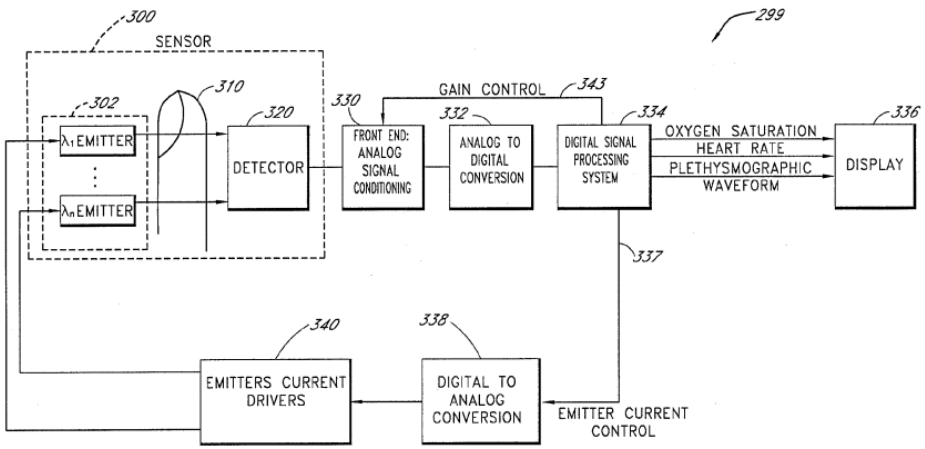
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	n light emitters 302 with an emitter current control signal on the emitter current control output 337. This value is a digital value which is converted by the digital-to-analog conversion circuit 338, which provides a control signal to the emitter current drivers 340. The emitter current drivers 340 provide the appropriate current drive for the n light emitters 302. Further detail of the operation of the multi-wavelength physiological monitor for pulse oximetry is explained below. In the present embodiment, the n light emitters 302 are driven via the emitter current driver 340 to provide light transmission with digital modulation at 625 Hz. In the present embodiment, the n light emitters 302 are driven at a power level that provides an acceptable intensity for detection by the detector 320 and for conditioning by the front end analog signal conditioning circuitry 330. Once this energy level is determined for a given patient by the digital signal processing system 334, the current level for the n light emitters 302 is maintained substantially constant. It should be understood, however, that the current could be adjusted for changes in the ambient room light and other changes that would affect the voltage input to the front end analog signal conditioning circuitry 330. In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. The composite time division signal is provided to the front analog signal conditioning circuitry 330. Additional detail regarding the front end analog signal conditioning circuitry 330 and the analog to digital converter circuit 332 is illustrated in FIG. 4. As depicted in FIG. 4, in one embodiment, the front end circuitry 330 has a preamplifier 342, a high pass filter 344, an amplifier 346, a programmable gain amplifier 348, and a low pass filter 350. In one embodiment, the preamplifier 342 is a transimpedance amplifier that converts the composite current signal from the photodetector 320 to a corresponding voltage signal, and amplifies the signal. In the present embodiment, the preamplifier has a predetermined gain to boost the signal amplitude for ease of processing. In the present embodiment, the source voltages for the preamplifier 342 are −15 VDC and +15 VDC. As will be understood, the attenuated signal contains a component representing ambient light as well as a component representing the each of the multi-wavelengths of light over time. If there is light in the vicinity of the sensor 300

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	other than the multi-wavelengths of light from the n light emitters 302, this ambient light is detected by the photodetector 320. Accordingly, the gain of the preamplifier is selected in order to prevent the ambient light in the signal from saturating the preamplifier under normal and reasonable operating conditions. Lamego at [0044]-[0052] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. the 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;	Lamego discloses or renders obvious the 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. A physiological monitor for determining blood oxygen saturation of a medical patient includes a sensor, a signal processor and a display. The sensor includes at least three light emitting diodes. Each light emitting diode is adapted to emit light of a different wavelength. The sensor also includes a detector, where the detector is adapted to receive light from the three light emitting diodes after being attenuated by tissue. The detector generates an output signal based at least in part upon the received light. The signal processor determines blood oxygen saturation based at least upon the output signal, and the display provides an indication of the blood oxygen saturation. Lamego at [Abstract] In one embodiment, absorption measurements are based upon the transmission of energy through a medium. In one embodiment, multiple light emitting diodes (LEDs) are positioned on one side of a portion of the body where blood flows close to the body's surface, such as a finger, and a photodetector is positioned on the opposite side of the surface. In another embodiment one or more such LEDs emit light of different wavelengths. In one embodiment, one LED emits a visible wavelength, such as red, and

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	the other LED emits an infrared wavelength. However, one skilled in the art will realize that other wavelength combinations could be used. Lamego at [0027] A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] FIG. 3A illustrates one embodiment of the drivers 340 and the digital to analog conversion circuit 338. As depicted in FIG. 3A, the digital-to-analog conversion circuit 338 includes first and second input latches 321, 322, a synchronizing latch 323, a voltage reference 324, and a digital to analog conversion circuit 325. The emitter current drivers 340 include first and second switch banks 326, 327, and n voltage to current converters 328. LED emitters 302 of FIG. 3 are coupled to the output of the emitter current drives 340. The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327.

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	The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. Lamego at [0044]-[0045] 17. A physiological monitor sensor comprising: three or more emitters configured to transmit light through a tissue site of a medical patient; and at least one detector configured to: measure the light transmitted through the tissue site of the medical patient by the three or more emitters; and generate at least one signal configured to be used by a processor to compute a ratio based at least in part on the at least one signal, the processor further configured to determine the blood oxygen saturation of said medical patient based upon said ratio and one or more blood constituents identified from said signal. Lamego 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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. the wearable device further comprising 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,	Lamego discloses or renders obvious the wearable device further comprising 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 practical application of this technique is pulse oximetry, which utilizes a noninvasive sensor to measure blood oxygen saturation (SpO2) and pulse rate. A multi-wavelength physiological monitor in accordance with one embodiment determines blood oxygen saturation by propagating multi-wavelength energy through a medium, such as a portion of a patient's body where blood flows close to the body surface. For example, in one embodiment, energy is propagated through an ear lobe, a digit (such as a

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	finger or toe), a forehead, or a scalp (such as a fetus's scalp). An attenuated signal is measured after energy propagation through, or reflection from the medium. The physiological monitor determines the saturation of oxygenated blood in the patient based at least in part upon the measured signal. Lamego at [0024]  ***FIG. 3*** Lamego at Fig. 3 The finger comprises skin, tissue, muscle, both arterial blood and venous blood, fat, etc., each of which absorbs light energy differently due to different absorption coefficients, different concentrations, different thicknesses, and changing optical pathlengths. When the patient is not moving, absorption is substantially constant except for variations due to the flow of blood through the skin, tissue, muscle, etc. A constant attenuation can be determined and subtracted from the measured signal via traditional filtering techniques. However, when the patient moves, perturbations such as changing optical pathlengths occur. Such perturbations may be due to movement of background fluids, (such as venous blood, which has a different saturation than arterial blood). Therefore, the measured signal becomes erratic. Erratic, motion-induced noise typically cannot be predetermined and subtracted from the measured signal via traditional

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	filtering techniques. Thus, determining the oxygen saturation of arterial blood and venous in erratic, motion-induced noise environments, blood becomes more difficult. In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion. Lamego at [0028]-[0029] In FIG. 1, arterial blood oxygen saturation (SaO2) is represented on the y-axis of the curve 100. The x-axis represents ratios of a red wavelength light transmission signal and an infrared wavelength light transmission signal. An ideal saturation curve 102 would be highly accurate at all values. However, due to the limitations of using only two wavelengths of light, such systems typically operate between a lower range curve 104 and an upper range curve 106. Such blood oxygen saturation systems typically exhibit highly accurate, low tolerance 107 measurements at high saturation values 108, but at lower saturation values 110, that accuracy decreases, and increased tolerance 111 results. Lamego at [0032] A multi-wavelength physiological monitor provides additional advantages over a two-wavelength device, as well. For example, utilizing multiple wavelengths provide a multi-dimensional calibration curve, which can be used to provide multiple degrees of freedom to compensate for variation in other physiologically-related parameters. As discussed above, when only two wavelengths are used but there are more than two significant absorbers in the patient's tissue, the system may be underdetermined. Therefore, adding wavelengths 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. For example, an eight wavelength physiological monitor utilizes an eight-dimensional calibration curve, which provides eight degrees of freedom to compensate for various physiologically-related parameters. Such parameters can include, for example, noise, motion, various hemodynamic parameters, and/or blood constituent concentrations

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	and/or levels. On the other hand, the system may be overdetermined if, for example, more wavelengths are used than there are significant absorbers and/or wavelengths are used for constituents not present in the particular patient's blood. Lamego at [0035] In one embodiment, the multi-wavelength physiological monitor compensates for conditions, such as motion and/or blood constituents that would cause a standard two-wavelength system to over- or under-react to the presence of such condition. Such compensation provides a more accurate, stable reading or a patient's physiological condition, including, but not limited to, their blood oxygen concentration and/or plethysmographic signal. A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0040]-[0041] The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327.

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	The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. The voltage reference is chosen as a low noise DC voltage reference for the digital to analog conversion circuit 325. In addition, in the present embodiment, the voltage reference has a lowpass output filter with a very low corner frequency (e.g., 1 Hz in the present embodiment). The digital to analog converter 325 also has a lowpass filter at its output with a very low corner frequency (e.g., 1 Hz). The digital to analog converter provides signals used to drive each of the emitters 302. In the present embodiment, the output of the voltage to current converters 328 are switched such that, only one emitter is active at any given time. In addition, the voltage to current converter for the inactive emitter is switched off at its input as well, such that it is deactivated. This reduces noise from the switching and voltage to current conversion circuitry. In the present embodiment, low noise voltage to current converters 328 are selected (e.g., Op 27 Op Amps), and the feedback loop is configured to have a low pass filter to reduce noise. In the present embodiment, the low pass filtering function of the voltage to current converters 328 has a corner frequency of just above 625 Hz, which is the switching speed for the emitters 302, as further discussed below. Accordingly, the driver circuit embodiment of FIG. 3A, minimizes the noise of the emitters 302. In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a “saturation transform.” It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term “saturation transform” is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336.

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	Lamego at [0045]-[0048] The composite time division signal is provided to the front analog signal conditioning circuitry 330. Additional detail regarding the front end analog signal conditioning circuitry 330 and the analog to digital converter circuit 332 is illustrated in FIG. 4. As depicted in FIG. 4, in one embodiment, the front end circuitry 330 has a preamplifier 342, a high pass filter 344, an amplifier 346, a programmable gain amplifier 348, and a low pass filter 350. In one embodiment, the preamplifier 342 is a transimpedance amplifier that converts the composite current signal from the photodetector 320 to a corresponding voltage signal, and amplifies the signal. In the present embodiment, the preamplifier has a predetermined gain to boost the signal amplitude for ease of processing. In the present embodiment, the source voltages for the preamplifier 342 are −15 VDC and +15 VDC. As will be understood, the attenuated signal contains a component representing ambient light as well as a component representing the each of the multi-wavelengths of light over time. If there is light in the vicinity of the sensor 300 other than the multi-wavelengths of light from the n light emitters 302, this ambient light is detected by the photodetector 320. Accordingly, the gain of the preamplifier is selected in order to prevent the ambient light in the signal from saturating the preamplifier under normal and reasonable operating conditions. Lamego at [0052] In general, the demodulation operation separates each of the multi-wavelength signals from the composite signal and removes the carrier frequency, leaving raw data points. The raw data points are provided at intervals (e.g., at 625 Hz) to the sub-sampling operation 402, which in one embodiment, reduces the samples by an order of 10 from samples at 625 Hz to samples at 62.5 Hz. The sub-sampling operation also provides some filtering on the samples. The resulting data is subjected to statistics and saturation transform operations 404, 406 to calculate a saturation value, which is very tolerant to motion artifacts and other noise in the signal. The saturation value is ascertained in the saturation calculation module 408, and a pulse rate and a clean plethysmographic waveform are obtained through the pulse rate module 410. Additional details regarding the various operations are provided in connection with FIGS. 7-10. Lamego at [0065]

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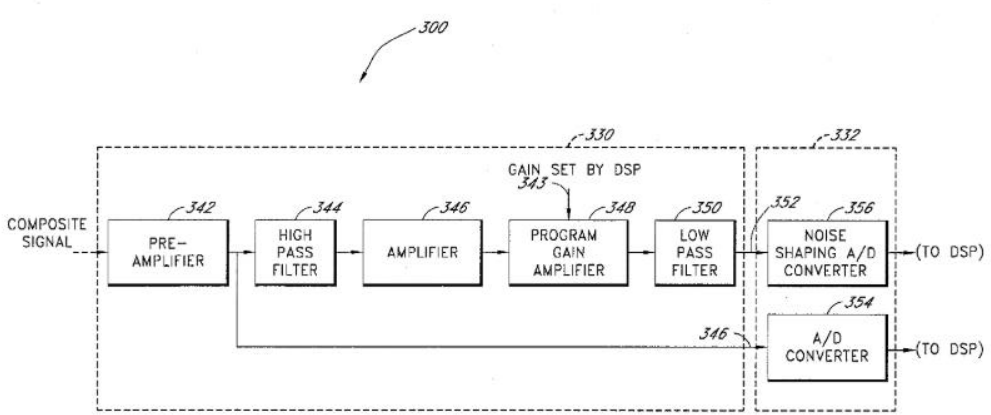
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	A physiological monitor for determining blood oxygen saturation of a medical patient includes a sensor, a signal processor and a display. The sensor includes at least three light emitting diodes. Each light emitting diode is adapted to emit light of a different wavelength. The sensor also includes a detector, where the detector is adapted to receive light from the three light emitting diodes after being attenuated by tissue. The detector generates an output signal based at least in part upon the received light. The signal processor determines blood oxygen saturation based at least upon the output signal, and the display provides an indication of the blood oxygen saturation. Lamego at [Abstract] 17. A physiological monitor sensor comprising: three or more emitters configured to transmit light through a tissue site of a medical patient; and at least one detector configured to: measure the light transmitted through the tissue site of the medical patient by the three or more emitters; and generate at least one signal configured to be used by a processor to compute a ratio based at least in part on the at least one signal, the processor further configured to determine the blood oxygen saturation of said medical patient based upon said ratio and one or more blood constituents identified from said signal. Lamego at Claim 17 In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. Lamego at [0048]

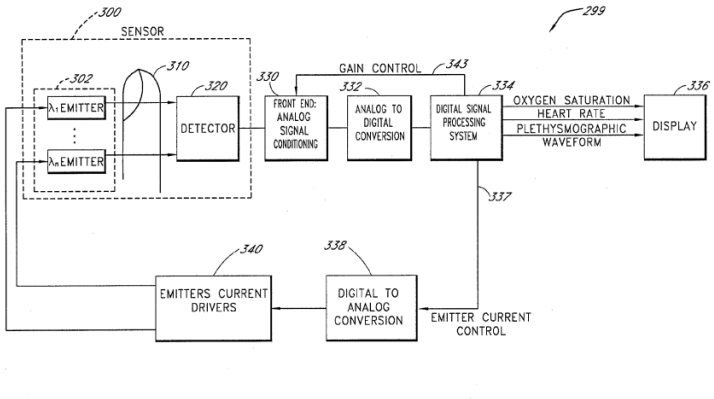
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, 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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. wherein the detection system is configured to be synchronized to the light source;	Lamego discloses or renders obvious the detection system is configured to be synchronized to the light source. A physiological monitor for determining blood oxygen saturation of a medical patient includes a sensor, a signal processor and a display. The sensor includes at least three light emitting diodes. Each light emitting diode is adapted to emit light of a different wavelength. The sensor also includes a detector, where the detector is adapted to receive light from the three light emitting diodes after being attenuated by tissue. The detector generates an output signal based at least in part upon the received light. The signal processor determines blood oxygen saturation based at least upon the output signal, and the display provides an indication of the blood oxygen saturation. Lamego at [Abstract] FIG. 3A illustrates one embodiment of the drivers 340 and the digital to analog conversion circuit 338. As depicted in FIG. 3A, the digital-to-analog conversion circuit 338 includes first and second input latches 321, 322, a synchronizing latch 323, a voltage reference 324, and a digital to analog conversion circuit 325. The emitter current drivers 340 include first and second switch banks 326, 327, and n voltage to current converters 328. LED emitters 302 of FIG. 3 are coupled to the output of the emitter current drives 340. The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter

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	circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327. The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. Lamego at [0044]-[0045] Because the signal processing system 334 controls the activation of the light emitters 302, the entire system is synchronous. In one embodiment, the data is synchronously divided (and thereby demodulated) into 2n 8-sample packets, with a time division demultiplexing operation as represented in a demultiplexing module 421. One eight-sample packet 422 represents the first wavelength of light plus ambient light signal, a second eight-sample packet 424 represents an ambient light signal, a third eight-sample packet (not shown) represents the attenuated second wavelength of light plus ambient light signal, a fourth eight-sample packet (not shown) represents the ambient light signal. This structure repeats until the (2n−1)th eight-sample packet 426, which represents the attenuated nth wavelength of light plus ambient light signal, and 2nth eight-sample packet 428, which represents an ambient light signal. A select signal synchronously controls the demultiplexing operation so as to divide the time-division multiplexed composite signal at the input of the demultiplexer 421 into its n subparts. Lamego at [0069] 17. A physiological monitor sensor comprising: three or more emitters configured to transmit light through a tissue site of a medical patient; and at least one detector configured to: measure the light transmitted through the tissue site of the medical patient by the three or more emitters; and generate at least one signal configured to be used by a processor to compute a ratio based at least in part on the at least one signal, the processor further configured to determine the blood oxygen saturation of said medical patient based upon said ratio and one or more blood constituents identified from said signal. Lamego at Claim 17

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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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. 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 spatially separated detectors;	Lamego 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 spatially separated detectors.  FIG. 4 Lamego at Fig. 4 FIG. 4 illustrates one embodiment of the front end analog signal conditioning circuitry and the analog to digital conversion circuitry of the physiological monitor of FIG. 3.

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	Lamego at [0012] A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041]  ***FIG. 3*** Lamego at Fig. 3 The front end analog signal conditioning circuitry 330 has outputs that are coupled to an analog to digital conversion circuit 332. The analog to digital conversion circuit 332 has outputs that are coupled to a digital signal processing system 334. The digital signal processing system 334 provides desired

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	parameters as outputs for a display 336. Outputs for the display 336 include, for example, blood oxygen saturation, heart rate, and a clean plethysmographic waveform. Lamego at [0042] The signal processing system also provides an emitter current control output 337 to a digital-to-analog converter circuit 338. The digital-to-analog converter circuit 338 provides control information to emitter current drivers 340. The emitter drivers 340 are coupled to the n light emitters 302. The digital signal processing system 334 also provides a gain control output 342 for front end analog signal conditioning circuitry 330. FIG. 3A illustrates one embodiment of the drivers 340 and the digital to analog conversion circuit 338. As depicted in FIG. 3A, the digital-to-analog conversion circuit 338 includes first and second input latches 321, 322, a synchronizing latch 323, a voltage reference 324, and a digital to analog conversion circuit 325. The emitter current drivers 340 include first and second switch banks 326, 327, and n voltage to current converters 328. LED emitters 302 of FIG. 3 are coupled to the output of the emitter current drives 340. The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327. The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. The voltage reference is chosen as a low noise DC voltage reference for the digital to analog conversion circuit 325. In addition, in the present embodiment, the voltage reference has a lowpass output filter with a very low corner frequency (e.g., 1 Hz in the present embodiment). The digital to analog converter 325 also has a lowpass filter at its output with a very low corner frequency (e.g., 1 Hz). The digital to analog converter provides signals used to drive each of the emitters 302. Lamego at [0043]-[0046]

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	In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a “saturation transform.” It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term “saturation transform” is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. It should be understood that in different embodiments of the present invention, one or more of the outputs may be provided. The digital signal processing system 334 also provides control for driving the n light emitters 302 with an emitter current control signal on the emitter current control output 337. This value is a digital value which is converted by the digital-to-analog conversion circuit 338, which provides a control signal to the emitter current drivers 340. The emitter current drivers 340 provide the appropriate current drive for the n light emitters 302. Further detail of the operation of the multi-wavelength physiological monitor for pulse oximetry is explained below. In the present embodiment, the n light emitters 302 are driven via the emitter current driver 340 to provide light transmission with digital modulation at 625 Hz. In the present embodiment, the n light emitters 302 are driven at a power level that provides an acceptable intensity for detection by the detector 320 and for conditioning by the front end analog signal conditioning circuitry 330. Once this energy level is determined for a given patient by the digital signal processing system 334, the current level for the n light emitters 302 is maintained substantially constant. It should be understood, however, that the current could be adjusted for changes in the ambient room light and other changes that would affect the voltage input to the front end analog signal conditioning circuitry 330. In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to

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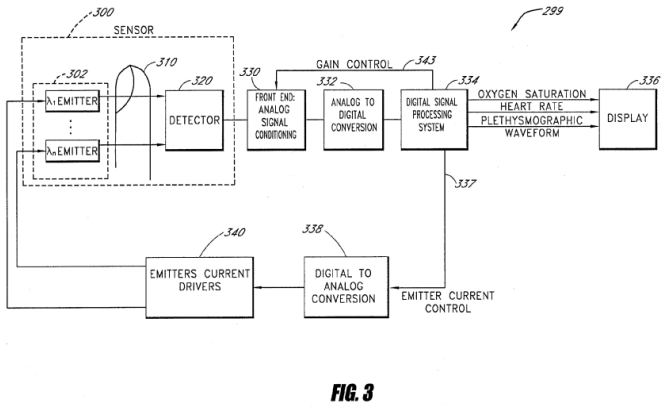
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	only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. The composite time division signal is provided to the front analog signal conditioning circuitry 330. Additional detail regarding the front end analog signal conditioning circuitry 330 and the analog to digital converter circuit 332 is illustrated in FIG. 4. As depicted in FIG. 4, in one embodiment, the front end circuitry 330 has a preamplifier 342, a high pass filter 344, an amplifier 346, a programmable gain amplifier 348, and a low pass filter 350. In one embodiment, the preamplifier 342 is a transimpedance amplifier that converts the composite current signal from the photodetector 320 to a corresponding voltage signal, and amplifies the signal. In the present embodiment, the preamplifier has a predetermined gain to boost the signal amplitude for ease of processing. In the present embodiment, the source voltages for the preamplifier 342 are −15 VDC and +15 VDC. As will be understood, the attenuated signal contains a component representing ambient light as well as a component representing the each of the multi-wavelengths of light over time. If there is light in the vicinity of the sensor 300 other than the multi-wavelengths of light from the n light emitters 302, this ambient light is detected by the photodetector 320. Accordingly, the gain of the preamplifier is selected in order to prevent the ambient light in the signal from saturating the preamplifier under normal and reasonable operating conditions. In one embodiment, the preamplifier 342 includes an Analog Devices AD743JR OpAmp. This transimpedance amplifier is particularly advantageous in that it exhibits several desired features for the system described, such as: low equivalent input voltage noise, low equivalent input current noise, low input bias current, high gain bandwidth product, low total harmonic distortion, high common mode rejection, high open loop gain, and a high power supply rejection ratio. The output of the preamplifier 342 is coupled to an input of the high pass filter 344. The output of the preamplifier also provides a first input 346 to the analog to digital conversion circuit 332. In the present embodiment, the high pass filter is a single-pole filter with a corner frequency of about ½-1 Hz. However, the corner frequency is readily raised to about 90 Hz in one embodiment. As will be understood, the 625 Hz carrier frequency of the multi-wavelength light signal is well above a 90 Hz corner frequency. The high-pass filter 344 has an output coupled as an input to an amplifier 346. In the

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	present embodiment, the amplifier 346 comprises a unity gain amplifier. However, the gain of the amplifier 346 is adjustable by the variation of a single resistor. The gain of the amplifier 346 is increased if the gain of the preamplifier 342 is decreased to compensate for the effects of ambient light. Lamego at [0048]-[0054] The programmable gain amplifier 348 is also advantageous in an alternative embodiment in which the emitter drive current is held constant. In the present embodiment, the emitter drive current is adjusted for each patient in order to obtain the proper dynamic range at the input of the analog to digital conversion circuit 332. However, changing the emitter drive current can alter the emitter wavelength, which in turn affects the end result in oximetry calculations. Accordingly, in another embodiment, it is advantageous to fix the emitter drive current for all patients. In an alternative embodiment of the present invention, the programmable gain amplifier can be adjusted by the DSP in order to obtain a signal at the input to the analog to digital conversion circuit which is properly within the dynamic range (+3 V to −3 V in the present embodiment) of the analog to digital conversion circuit 332. In this manner, the emitter drive current could be fixed for all patients, eliminating wavelength shift due to emitter current drive changes. The output of the programmable gain amplifier 348 couples as an input to a low-pass filter 350. Advantageously, the low pass filter 350 is a single-pole filter with a corner frequency of approximately 10 kHz in the present embodiment. This low pass filter provides anti-aliasing in the present embodiment. The output of the low-pass filter 350 provides a second input 352 to the analog-to-digital conversion circuit 332. In the present embodiment, the analog-to-digital conversion circuit 332 comprises a first analog-to-digital converter 354 and a second analog-to-digital converter 356. Advantageously, the first analog-to-digital converter 354 accepts input from the first input 346 to the analog-to-digital conversion circuit 332, and the second analog to digital converter 356 accepts input on the second input 352 to the analog-to-digital conversion circuitry 332. In one embodiment, the first analog-to-digital converter 354 is a diagnostic analog-to-digital converter. The diagnostic task (performed by the digital signal processing system) is to read the output of the detector as amplified by the preamplifier 342 in order to determine if the signal is saturating the input to the high-pass filter 344. In the present embodiment, if the input to the high pass filter 344 becomes saturated, the front end analog signal conditioning circuits 330 provides a “0” output. Alternatively, in another embodiment, a first analog-to-digital converter 354 is not used.

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	The second analog-to-digital converter 356 accepts the conditioned composite analog signal from the front end signal conditioning circuitry 330 and converts the signal to digital form. In the present embodiment, the second analog to digital converter 356 comprises a single-channel, delta-sigma converter. In the present embodiment, a Crystal Semiconductor CS5317-KS delta-sigma analog to digital converter is used. Such a converter is advantageous in that it is low cost and exhibits low noise characteristics. More specifically, a delta-sigma converter consists of two major portions: a noise modulator and a decimation filter. The selected converter uses a second order analog delta-sigma modulator to provide noise shaping. Noise shaping refers to changing the noise spectrum from a flat response to a response where noise at the lower frequencies has been reduced by increasing noise at higher frequencies. The decimation filter then cuts out the reshaped, higher frequency noise to provide 16-bit performance at a lower frequency. The present converter samples the data 128 times for every 16 bit data word that it produces. In this manner, the converter provides excellent noise rejection, dynamic range and low harmonic distortion, which help in critical measurement situations like low perfusion and electrocautery. In addition, by using a single-channel converter, there is no need to tune two or more channels to each other. The delta-sigma converter is also advantageous in that it exhibits noise shaping, for improved noise control. An exemplary analog to digital converter is a Crystal Semiconductor CS5317. In the present embodiment, the second analog to digital converter 356 samples the signal at a 20 kHz sample rate. The output of the second analog to digital converter 356 provides data samples at 20 kHz to the digital signal processing system 334 (FIG. 3). The digital signal processing system 334 is illustrated in additional detail in FIG. 5. In the present embodiment, the digital signal processing system includes a microcontroller 360, a digital signal processor (DSP) 362, a program memory 364, a sample buffer 366, a data memory 368, a read only memory 370 and communication registers 372. In one embodiment, the digital signal processor 362 is an Analog Devices AD 21020, although other digital signal processors may be employed, as is well known by those of skill in the art. In one embodiment, the microcontroller 360 comprises a Motorola 68HC05, with built in program memory. In the present embodiment, the sample buffer 366 is a buffer which accepts the 20 kHz sample data from the analog to digital conversion circuit 332 for storage in the data memory 368. In the present embodiment, the data memory 368 comprises 32 kWords (words being 40 bits in the present embodiment) of static random access memory. Other chips, data rates and data memory configurations may be employed, as is well known to those of skill in the art. Lamego at [0056]-[0062]

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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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Lamego discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. A physiological monitor for determining blood oxygen saturation of a medical patient includes a sensor, a signal processor and a display. The sensor includes at least three light emitting diodes. Each light emitting diode is adapted to emit light of a different wavelength. The sensor also includes a detector, where the detector is adapted to receive light from the three light emitting diodes after being attenuated by tissue. The detector generates an output signal based at least in part upon the received light. The signal processor determines blood oxygen saturation based at least upon the output signal, and the display provides an indication of the blood oxygen saturation. Lamego at [Abstract]

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	 FIG. 3 Lamego at Fig. 3 The front end analog signal conditioning circuitry 330 has outputs that are coupled to an analog to digital conversion circuit 332. The analog to digital conversion circuit 332 has outputs that are coupled to a digital signal processing system 334. The digital signal processing system 334 provides desired parameters as outputs for a display 336. Outputs for the display 336 include, for example, blood oxygen saturation, heart rate, and a clean plethysmographic waveform. Lamego at [0042] The signal processing system also provides an emitter current control output 337 to a digital-to-analog converter circuit 338. The digital-to-analog converter circuit 338 provides control information to emitter current drivers 340. The emitter drivers 340 are coupled to the n light emitters 302. The digital signal processing system 334 also provides a gain control output 342 for front end analog signal conditioning circuitry 330. Lamego at [0043] The term “saturation transform” is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic

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	waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048] It should be understood that in different embodiments of the present invention, one or more of the outputs may be provided. The digital signal processing system 334 also provides control for driving the n light emitters 302 with an emitter current control signal on the emitter current control output 337. This value is a digital value which is converted by the digital-to-analog conversion circuit 338, which provides a control signal to the emitter current drivers 340. The emitter current drivers 340 provide the appropriate current drive for the n light emitters 302. Further detail of the operation of the multi-wavelength physiological monitor for pulse oximetry is explained below. In the present embodiment, the n light emitters 302 are driven via the emitter current driver 340 to provide light transmission with digital modulation at 625 Hz. In the present embodiment, the n light emitters 302 are driven at a power level that provides an acceptable intensity for detection by the detector 320 and for conditioning by the front end analog signal conditioning circuitry 330. Once this energy level is determined for a given patient by the digital signal processing system 334, the current level for the n light emitters 302 is maintained substantially constant. It should be understood, however, that the current could be adjusted for changes in the ambient room light and other changes that would affect the voltage input to the front end analog signal conditioning circuitry 330. Lamego at [0049]-[0050] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, 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 one or	Lamego discloses or renders obvious the output signal is indicative of one or more of the physiological parameters.

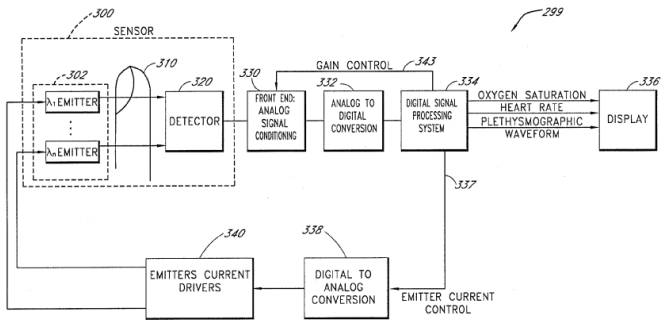
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more of the physiological parameters;	A practical application of this technique is pulse oximetry, which utilizes a noninvasive sensor to measure blood oxygen saturation (SpO2) and pulse rate. A multi-wavelength physiological monitor in accordance with one embodiment determines blood oxygen saturation by propagating multi-wavelength energy through a medium, such as a portion of a patient's body where blood flows close to the body surface. For example, in one embodiment, energy is propagated through an ear lobe, a digit (such as a finger or toe), a forehead, or a scalp (such as a fetus's scalp). An attenuated signal is measured after energy propagation through, or reflection from the medium. The physiological monitor determines the saturation of oxygenated blood in the patient based at least in part upon the measured signal. Lamego at [0024] In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion. Lamego at [0029] A multi-wavelength physiological monitor provides additional advantages over a two-wavelength device, as well. For example, utilizing multiple wavelengths provide a multi-dimensional calibration curve, which can be used to provide multiple degrees of freedom to compensate for variation in other physiologically-related parameters. As discussed above, when only two wavelengths are used but there are more than two significant absorbers in the patient's tissue, the system may be underdetermined. Therefore, adding wavelengths 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. For example, an eight wavelength physiological monitor utilizes an eight-dimensional calibration curve, which provides eight degrees of freedom to compensate for various physiologically-related parameters. Such parameters can include, for example, noise, motion, various hemodynamic parameters, and/or blood constituent concentrations and/or levels. On the other hand, the system may be overdetermined if, for example, more wavelengths

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	are used than there are significant absorbers and/or wavelengths are used for constituents not present in the particular patient's blood. Lamego at [0035] Furthermore, traditional physiological monitors that utilize two light sources to derive a patient's plethysmographic signal generally require one light source's wavelength to fall in the red spectrum and the other light source's wavelength to fall in the infrared spectrum. However, a multi-wavelength physiological monitor advantageously provides the ability to utilize all infrared wavelength light sources and/or other non-red infrared light sources to derive an accurate plethysmographic waveform. One advantage of utilizing non-red wavelength light sources (for example, all infrared wavelength light sources) is that the multi-wavelength physiological monitor can be further configured to determine several blood constituent concentrations based upon signals measured from just the non-red light sources. For example, such a multi-wavelength physiological monitor can determine levels and/or concentrations of: methemoglobin (MetHb), carboxyhemoglobin (COHb), low hemoglobin levels, high hemoglobin levels, bilirubin, methylene blue, deoxyhemoglobin, and lipids. The ability to measure a physiological parameter with a multi-dimensional system allows the system to compensate and account for the presence of other conditions that may affect the particular physiological parameter being measured. For example, many drugs cause the level of MetHb within a patient's blood to increase. MetHb also absorbs light at the two wavelengths used in a typical two-wavelength physiological monitor, which may cause inaccurate SpO2 readings. Increased levels of MetHb generally cause blood oxygen concentration level (e.g., SpO2) readings to decrease. A two-wavelength physiological monitor would provide reduced readings of blood oxygen concentration, but would not be able to identify the cause for the decreased reading, or to compensate for such readings. On the other hand, a multi-wavelength physiological monitor, such as any of the multi-wavelength physiological monitors described below, could not only identify the cause of decreased SpO2 readings, but also (or alternatively) compensate for such cause when calculating the patient's SpO2 level and/or signal. For example, to compensate for MetHb, one or more wavelengths sensitive to MetHb can be used. The wavelength(s) used can be, for example, about 760 nm and/or about 805 nm or the like. This allows for one or more additional equation (s) and degree(s) of freedom so that solving the system may account for the effect of the level of MetHb on blood oxygen saturation readings. Lamego at [0036]-[0037]

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	The various blood constituents mentioned above may not be orthogonal; rather they are often highly correlated with one another. Therefore, even using multiple wavelengths may not fully eliminate the effect of such constituents on the blood oxygen saturation level calculations, but it can reduce or minimize the effect and produce more accurate blood oxygen saturation level readings. In one embodiment, using eight wavelengths (including, for example, any of the wavelengths mentioned herein) can provide relatively more accurate readings of blood oxygen saturation levels relative to other numbers of wavelengths. However, the number of wavelengths that is most appropriate for a particular patient and that will provide the most accurate readings can vary based on such factors as the actual concentrations of blood constituents in the patient's blood, as well as the patient's condition, gender, age, or the like. In addition to improving the accuracy of blood oxygen saturation level readings, using multiple wavelengths can also provide relatively more accurate measurements of other parameters, including, for example, the concentrations of any of the blood constituents or other parameters mentioned herein. In one embodiment, the multi-wavelength physiological monitor compensates for conditions, such as motion and/or blood constituents that would cause a standard two-wavelength system to over- or under-react to the presence of such condition. Such compensation provides a more accurate, stable reading or a patient's physiological condition, including, but not limited to, their blood oxygen concentration and/or plethysmographic signal. Lamego at [0039]-[0040]  FIG. 3

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	Lamego at Fig. 3 The front end analog signal conditioning circuitry 330 has outputs that are coupled to an analog to digital conversion circuit 332. The analog to digital conversion circuit 332 has outputs that are coupled to a digital signal processing system 334. The digital signal processing system 334 provides desired parameters as outputs for a display 336. Outputs for the display 336 include, for example, blood oxygen saturation, heart rate, and a clean plethysmographic waveform. Lamego at [0042] In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a "saturation transform." It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term "saturation transform" is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. 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;	Lamego discloses or renders obvious 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. In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a "saturation transform." It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term "saturation transform" is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048] In the present embodiment, the n light emitters 302 are driven via the emitter current driver 340 to provide light transmission with digital modulation at 625 Hz. In the present embodiment, the n light emitters 302 are driven at a power level that provides an acceptable intensity for detection by the detector 320 and for conditioning by the front end analog signal conditioning circuitry 330. Once this energy level is determined for a given patient by the digital signal processing system 334, the current level for the n light emitters 302 is maintained substantially constant. It should be understood, however, that the current could be adjusted for changes in the ambient room light and other changes that would affect the voltage input to the front end analog signal conditioning circuitry 330. Lamego at [0050]

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	The driver depicted in FIG. 3A is advantageous in that the present inventors recognized that much of the noise in the oximeter 299 of FIG. 3 is caused by the LED emitters 302. Therefore, the emitter driver circuit of FIG. 3A is designed to minimize the noise from the emitters 302. The first and second input latches 321, 322 are connected directly to the DSP bus. Therefore, these latches significantly minimizes the bandwidth (resulting in noise) present on the DSP bus which passes through to the driver circuitry of FIG. 3A. The output of the first and second input latches only changes when these latched detect their address on the DSP bus. The first input latch 321 receives the setting for the digital to analog converter circuit 325. The second input latch 322 receives switching control data for the switch banks 326, 327. The synchronizing latch 323 accepts the synchronizing pulses which maintain synchronization between the activation of emitters 302 and the analog to digital conversion circuit 332. Lamego at [0045] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, 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 semiconductor sources are off,	Lamego discloses or renders obvious the detection system further configured to generate a first signal responsive to light received while the semiconductor sources are off. In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a "saturation transform." It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could

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	be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term "saturation transform" is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0050] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0051]

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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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, 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 semiconductor sources is on; and	Lamego discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the semiconductor sources is on. In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a "saturation transform." It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term "saturation transform" is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other

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	sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0050] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0051] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, 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	Lamego discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. In general, the n light emitters 302 each emit light energy of a different wavelength, which is absorbed by the finger 310 and received by the photodetector 320. The photodetector 320 produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector 320. The front end analog signal conditioning circuitry 330 receives the intensity signals and filters and conditions these

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	signals as further described below for further processing. The resultant signals are provided to the analog-to-digital conversion circuitry 332, which converts the analog signals to digital signals for further processing by the digital signal processing system 334. The digital signal processing system 334 utilizes the signals in order to provide what will be called herein a “saturation transform.” It should be understood, that for parameters other than blood saturation monitoring, the saturation transform could be referred to as a concentration transform, in-vivo transform, or the like, depending on the desired parameter. The term “saturation transform” is used to describe an operation which converts the sample data from time domain to saturation domain values, as will be apparent from the discussion below. In the present embodiment, the output of the digital signal processing system 334 provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display 336. Lamego at [0048] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320 is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0050] In one embodiment, the n light emitters 302 are modulated as follows: for one complete 625 Hz cycle, each emitter 302 is activated for one ½n cycle, and off for the remaining (2n−1)/2n cycle. In order to only receive one signal at a time 302, the emitters are cycled on and off alternatively, in sequence, with each only active for a ½n cycle per 625 Hz cycle, with a ½n cycle separating the active times. The light signal is attenuated (e.g., amplitude modulated) by the pumping of blood through the finger 310 (or other sample medium). The attenuated (e.g., amplitude modulated) signal is detected by the photodetector 320 at the 625 Hz carrier frequency for the multi-wavelength light. Because only a single photodetector 320

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	is used, the photodetector 320 receives all light wavelength signals to form a composite time division signal. Lamego at [0051] 1. A physiological monitor for determining blood oxygen saturation of a patient, the physiological monitor comprising: a pulse oximetry sensor, wherein the pulse oximetry sensor comprises: three or more light emitting diodes, wherein each light emitting diode is operative to emit light of a different wavelength; and a detector adapted to receive light from the at least three light emitting diodes after being attenuated by tissue of a medical patient, wherein the detector provides an output signal based at least in part upon the received light; and a processor configured to compute a ratio based at least in part on three or more plethysmographic signals obtained from the output signal, the processor further configured to determine the blood oxygen saturation of said medical patient based upon said ratio and one or more blood constituents identified from said output signal. Lamego 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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological	Lamego discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. A practical application of this technique is pulse oximetry, which utilizes a noninvasive sensor to measure blood oxygen saturation (SpO2) and pulse rate. A multi-wavelength physiological monitor in

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parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	accordance with one embodiment determines blood oxygen saturation by propagating multi-wavelength energy through a medium, such as a portion of a patient's body where blood flows close to the body surface. For example, in one embodiment, energy is propagated through an ear lobe, a digit (such as a finger or toe), a forehead, or a scalp (such as a fetus's scalp). An attenuated signal is measured after energy propagation through, or reflection from the medium. The physiological monitor determines the saturation of oxygenated blood in the patient based at least in part upon the measured signal. Lamego at [0024] In one embodiment, absorption measurements are based upon the transmission of energy through a medium. In one embodiment, multiple light emitting diodes (LEDs) are positioned on one side of a portion of the body where blood flows close to the body's surface, such as a finger, and a photodetector is positioned on the opposite side of the surface. In another embodiment one or more such LEDs emit light of different wavelengths. In one embodiment, one LED emits a visible wavelength, such as red, and the other LED emits an infrared wavelength. However, one skilled in the art will realize that other wavelength combinations could be used. Lamego at [0027] The arterial blood oxygen saturation curve 120 of a multi-wavelength physiological monitor in accordance with one embodiment of the present invention is shown in FIG. 2. The multi-wavelength system utilizes at least three different wavelengths of light (λ1, λ2, . . . λn) to determine blood oxygen saturation. Arterial blood oxygen saturation (SaO2) is represented on the y-axis of the curve 120. The x-axis represents ratios of composite signals, each comprising signals based upon the light transmission of the various light wavelengths (λ1, λ2, . . . λn). Each ratio r can be expressed by: $$r = \frac{\sum_{i=1}^{n} \alpha_i NP_{RMS,i}}{\sum_{i=1}^{n} \beta_i NP_{RMS,i}}$$

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	where n is the number of wavelengths of light utilized by the multi-wavelength physiological monitor, NPRMS,i is the normalized plethysmographic waveform of the ith wavelength light source, and αi and βi are vector coefficients of known constants that are determined based upon fitting and/or calibration using experimental data and/or model(s). The curve 120 contains lower and upper limit range curves 122, 124. However, the lower and upper limit range curves 122, 124 of the multi-wavelength physiological monitor are more linear than the lower and upper range curves 104, 106 of the dual-wavelength blood oximeter described above, as illustrated in FIG. 1. In addition, the lower and upper limit range curves 122, 124 of the multi-wavelength physiological monitor exhibit higher accuracy and lower tolerance 126 than the dual-wavelength blood oximeter of FIG. 1, particularly at lower arterial blood oxygen saturation levels. In certain cases, such as during the monitoring of neonates, or persons with low blood-oxygen saturation, it is desirable for the physiological monitor to exhibit increased accuracy at lower saturation levels. For example, when providing oxygen to a neonate, it is often critical that neither too much oxygen nor too little oxygen is provided. A multi-wavelength physiological monitor provides improved accuracy as well as an improved signal-to-noise ratio at lower perfusion levels. A multi-wavelength physiological monitor provides additional advantages over a two-wavelength device, as well. For example, utilizing multiple wavelengths provide a multi-dimensional calibration curve, which can be used to provide multiple degrees of freedom to compensate for variation in other physiologically-related parameters. As discussed above, when only two wavelengths are used but there are more than two significant absorbers in the patient's tissue, the system may be underdetermined. Therefore, adding wavelengths 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. For example, an eight wavelength physiological monitor utilizes an eight-dimensional calibration curve, which provides eight degrees of freedom to compensate for various physiologically-related parameters. Such parameters can include, for example, noise, motion, various hemodynamic parameters, and/or blood constituent concentrations and/or levels. On the other hand, the system may be overdetermined if, for example, more wavelengths are used than there are significant absorbers and/or wavelengths are used for constituents not present in the particular patient's blood. Furthermore, traditional physiological monitors that utilize two light sources to derive a patient's plethysmographic signal generally require one light source's wavelength to fall in the red spectrum and the other light source's wavelength to fall in the infrared spectrum. However, a multi-wavelength physiological monitor advantageously provides the ability to utilize all infrared wavelength light sources

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	and/or other non-red infrared light sources to derive an accurate plethysmographic waveform. One advantage of utilizing non-red wavelength light sources (for example, all infrared wavelength light sources) is that the multi-wavelength physiological monitor can be further configured to determine several blood constituent concentrations based upon signals measured from just the non-red light sources. For example, such a multi-wavelength physiological monitor can determine levels and/or concentrations of: methemoglobin (MetHb), carboxyhemoglobin (COHb), low hemoglobin levels, high hemoglobin levels, bilirubin, methylene blue, deoxyhemoglobin, and lipids. The ability to measure a physiological parameter with a multi-dimensional system allows the system to compensate and account for the presence of other conditions that may affect the particular physiological parameter being measured. For example, many drugs cause the level of MetHb within a patient's blood to increase. MetHb also absorbs light at the two wavelengths used in a typical two-wavelength physiological monitor, which may cause inaccurate SpO2 readings. Increased levels of MetHb generally cause blood oxygen concentration level (e.g., SpO2) readings to decrease. A two-wavelength physiological monitor would provide reduced readings of blood oxygen concentration, but would not be able to identify the cause for the decreased reading, or to compensate for such readings. On the other hand, a multi-wavelength physiological monitor, such as any of the multi-wavelength physiological monitors described below, could not only identify the cause of decreased SpO2 readings, but also (or alternatively) compensate for such cause when calculating the patient's SpO2 level and/or signal. For example, to compensate for MetHb, one or more wavelengths sensitive to MetHb can be used. The wavelength(s) used can be, for example, about 760 nm and/or about 805 nm or the like. This allows for one or more additional equation (s) and degree(s) of freedom so that solving the system may account for the effect of the level of MetHb on blood oxygen saturation readings. Similarly, the system can compensate for other blood constituents with the addition of wavelengths sensitive to the other blood constituents of interest. For example, carboxyhemoglobin absorbs about the same amount of 660 nm light as oxyhemoglobin. Therefore, a typical two-wavelength physiological monitor can mistake carboxyhemoglobin for oxyhemoglobin, which can result in normal blood oxygen saturation level readings even though the actual level is abnormal. For example, for every about 1% of carboxyhemoglobin circulating in the blood, the monitor may over read by about 1%. Selecting one or more additional wavelengths sensitive to carboxyhemoglobin, for example, about 610, 630, and/or 640 or the like, can allow the system to compensate for this effect. The system can compensate for other blood constituents, such as deoxyhemoglobin or lipids, with the addition of wavelengths sensitive to those constituents. More wavelengths can allow the system to compensate for more variables.

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	The various blood constituents mentioned above may not be orthogonal; rather they are often highly correlated with one another. Therefore, even using multiple wavelengths may not fully eliminate the effect of such constituents on the blood oxygen saturation level calculations, but it can reduce or minimize the effect and produce more accurate blood oxygen saturation level readings. In one embodiment, using eight wavelengths (including, for example, any of the wavelengths mentioned herein) can provide relatively more accurate readings of blood oxygen saturation levels relative to other numbers of wavelengths. However, the number of wavelengths that is most appropriate for a particular patient and that will provide the most accurate readings can vary based on such factors as the actual concentrations of blood constituents in the patient's blood, as well as the patient's condition, gender, age, or the like. In addition to improving the accuracy of blood oxygen saturation level readings, using multiple wavelengths can also provide relatively more accurate measurements of other parameters, including, for example, the concentrations of any of the blood constituents or other parameters mentioned herein. In one embodiment, the multi-wavelength physiological monitor compensates for conditions, such as motion and/or blood constituents that would cause a standard two-wavelength system to over- or under-react to the presence of such condition. Such compensation provides a more accurate, stable reading or a patient's physiological condition, including, but not limited to, their blood oxygen concentration and/or plethysmographic signal. Lamego at [0033]-[0040] A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041]

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	1. A physiological monitor for determining blood oxygen saturation of a patient, the physiological monitor comprising: a pulse oximetry sensor, wherein the pulse oximetry sensor comprises: three or more light emitting diodes, wherein each light emitting diode is operative to emit light of a different wavelength; and a detector adapted to receive light from the at least three light emitting diodes after being attenuated by tissue of a medical patient, wherein the detector provides an output signal based at least in part upon the received light; and a processor configured to compute a ratio based at least in part on three or more plethysmographic signals obtained from the output signal, the processor further configured to determine the blood oxygen saturation of said medical patient based upon said ratio and one or more blood constituents identified from said output signal. 2. The physiological monitor of claim 1, wherein the processor is further configured to determine the blood oxygen saturation of said medical patient by compensating the blood oxygen saturation with data regarding the one or more blood constituents. 3. The physiological monitor of claim 1, wherein the ratio comprises a quotient of a first value and a second value, wherein: the first value comprises a first sum of first electrical signals corresponding to the three or more light emitting diodes, the first electrical signals multiplied by a first set of vector coefficients; and the second value comprises a second sum of second electrical signals corresponding to the three or more light emitting diodes, the second electrical signals multiplied by a second set of vector coefficients. Lamego at Claim 1-3 17. A physiological monitor sensor comprising: three or more emitters configured to transmit light through a tissue site of a medical patient; and at least one detector configured to: measure the light transmitted through the tissue site of the medical patient by the three or more emitters; and generate at least one signal configured to be used by a processor to compute a ratio based at least in part on the at least one signal, the processor further configured to determine the blood oxygen saturation of said medical patient based upon said ratio and one or more blood constituents identified from said signal.

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	Lamego at Claim 17. 23. A method of determining the blood oxygen saturation of a patient, the method comprising: receiving at least three photoplethysmographic signals indicative of at least three wavelengths of light that have been attenuated by tissue; determining at least three output signals based upon the at least three photoplethysmographic signals; calculating a ratio based at least in part on the at least three output signals; and Lamego at Claim 23. 25. The method of claim 23, further comprising selecting a data signal corresponding to attenuated light from one of the at least three photoplethysmographic signals. Lamego at Claim 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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors	*See* claim 1 above. Lamego discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.

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are located on one or more arcs.	A schematic of one embodiment of a multi-wavelength physiological monitor for pulse oximetry is shown in FIGS. 3-5. FIG. 3 depicts a general hardware block diagram of a multi-wavelength pulse oximeter 299. A sensor 300 has n LEDs 302, which in one embodiment are at least three light emitters. The n LEDs 302 emit light of different wavelengths (λ1, λ2, . . . λn). In one embodiment, the n LEDs 302 include four, six, eight or sixteen LEDs of different wavelengths. In one embodiment, the n LEDs 302 are placed adjacent a finger 310. A photodetector 320 receives light from the n LEDs 302 after it has been attenuated by passing through the finger. The photodetector 320 produces at least one electrical signal corresponding to the received, attenuated light. In one embodiment, the photodetector 320 is located opposite the n LEDs 302 on the opposite side of the finger 310. The photodetector 320 is connected to front end analog signal conditioning circuitry 330. Lamego at [0041] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	*See* claim 2 above. Lamego discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. The present invention relates to the field of signal processing. More specifically, the present invention relates to the processing of measured signals which contain a primary signal portion and a secondary signal portion for the removal or derivation of either signal portion. The present invention is especially useful for physiological monitoring systems, including blood oxygen saturation measurement systems and oximeters.

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	Lamego at [0003] A practical application of this technique is pulse oximetry, which utilizes a noninvasive sensor to measure blood oxygen saturation (SpO2) and pulse rate. A multi-wavelength physiological monitor in accordance with one embodiment determines blood oxygen saturation by propagating multi-wavelength energy through a medium, such as a portion of a patient's body where blood flows close to the body surface. For example, in one embodiment, energy is propagated through an ear lobe, a digit (such as a finger or toe), a forehead, or a scalp (such as a fetus's scalp). An attenuated signal is measured after energy propagation through, or reflection from the medium. The physiological monitor determines the saturation of oxygenated blood in the patient based at least in part upon the measured signal. It is well known by those of skill in the art that freshly oxygenated blood is pumped at high pressure from the heart into the arteries for use by the body. The volume of blood in the arteries varies with the heartbeat. This variation gives rise to a variation in energy absorption at the heartbeat rate, or the pulse. Oxygen depleted, or deoxygenated, blood is returned to the heart through the veins with unused oxygenated blood. Unlike the arteries, the volume of blood in the veins varies with the rate of breathing, which is typically much slower than the heartbeat. Since the blood pressure in the veins is typically much lower than that of the arteries, the volume of blood in the veins varies in response to motion, such as a patient raising or lowering her arm. Changes in blood volume within the veins cause changes in vein thicknesses. Therefore, when there is no motion induced variation in the thickness of the veins, venous blood causes a low frequency variation in energy absorption, which is related to the rate of breathing. However, when erratic, motion-induced variations in the thickness of the veins occur, the low frequency variation in absorption is coupled with an erratic variation in energy absorption due to the erratic motion. Lamego at [0024]-[0026] In one embodiment, a physiological monitor measures light transmission through a patient's finger to determine arterial blood oxygen saturation. In some cases, however, the measured light signal contains noise, or other secondary signal, due to an event, such as patient movement during signal measurement. In such case, the signal measured by the physiological monitor includes a primary portion, related to the blood oxygen saturation of the patient, and a secondary portion, related to the noisy, erratic, motion-induced secondary signal. The physiological monitor processes the measured signal to determine the patient's blood oxygen saturation based upon the signal's primary portion.

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	In one embodiment, the physiological monitor utilizes a processor to determine a secondary reference signal n′(t) or Nref. The secondary reference signal n′(t) is used to determine the primary portion of the measured signal. In one embodiment, the secondary reference signal n′(t) is input to a multi-variate process estimator, which removes the erratic, motion-induced secondary signal portions from the measured signal. In another embodiment, the processor determines a primary signal reference signal s′(t) which is used for display purposes or for input to a multi-variate process estimator to derive information about patient movement and venous blood oxygen saturation. FIG. 1 illustrates an arterial blood oxygen saturation curve 100 representative of the sensitivity of blood oxygen saturation systems of the prior art. Such systems utilize two different wavelengths of light (such as red and infrared wavelength light) to determine blood oxygen saturation. The wavelengths used may be, for example, about 660 nm and about 905 nm. At 660 nm, deoxyhemoglobin has a higher absorption than oxyhemoglobin, while the reverse is the case at 905 nm. This difference in absorption between oxyhemoglobin and deoxyhemoglobin allows for the calculation of blood oxygen saturation levels. In FIG. 1, arterial blood oxygen saturation (SaO2) is represented on the y-axis of the curve 100. The x-axis represents ratios of a red wavelength light transmission signal and an infrared wavelength light transmission signal. An ideal saturation curve 102 would be highly accurate at all values. However, due to the limitations of using only two wavelengths of light, such systems typically operate between a lower range curve 104 and an upper range curve 106. Such blood oxygen saturation systems typically exhibit highly accurate, low tolerance 107 measurements at high saturation values 108, but at lower saturation values 110, that accuracy decreases, and increased tolerance 111 results. The arterial blood oxygen saturation curve 120 of a multi-wavelength physiological monitor in accordance with one embodiment of the present invention is shown in FIG. 2. The multi-wavelength system utilizes at least three different wavelengths of light (λ1, λ2, . . . λn) to determine blood oxygen saturation. Arterial blood oxygen saturation (SaO2) is represented on the y-axis of the curve 120. The x-axis represents ratios of composite signals, each comprising signals based upon the light transmission of the various light wavelengths (λ1, λ2, . . . λn). Each ratio r can be expressed by: $$r = \frac{\sum_{i=1}^{n} \alpha_i NP_{RMS,i}}{\sum_{i=1}^{n} \beta_i NP_{RMS,i}}$$

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	where n is the number of wavelengths of light utilized by the multi-wavelength physiological monitor, NPRMS,i is the normalized plethysmographic waveform of the ith wavelength light source, and αi and βi are vector coefficients of known constants that are determined based upon fitting and/or calibration using experimental data and/or model(s). The curve 120 contains lower and upper limit range curves 122, 124. However, the lower and upper limit range curves 122, 124 of the multi-wavelength physiological monitor are more linear than the lower and upper range curves 104, 106 of the dual-wavelength blood oximeter described above, as illustrated in FIG. 1. In addition, the lower and upper limit range curves 122, 124 of the multi-wavelength physiological monitor exhibit higher accuracy and lower tolerance 126 than the dual-wavelength blood oximeter of FIG. 1, particularly at lower arterial blood oxygen saturation levels. In certain cases, such as during the monitoring of neonates, or persons with low blood-oxygen saturation, it is desirable for the physiological monitor to exhibit increased accuracy at lower saturation levels. For example, when providing oxygen to a neonate, it is often critical that neither too much oxygen nor too little oxygen is provided. A multi-wavelength physiological monitor provides improved accuracy as well as an improved signal-to-noise ratio at lower perfusion levels. Lamego at [0029]-[0034] Furthermore, traditional physiological monitors that utilize two light sources to derive a patient's plethysmographic signal generally require one light source's wavelength to fall in the red spectrum and the other light source's wavelength to fall in the infrared spectrum. However, a multi-wavelength physiological monitor advantageously provides the ability to utilize all infrared wavelength light sources and/or other non-red infrared light sources to derive an accurate plethysmographic waveform. One advantage of utilizing non-red wavelength light sources (for example, all infrared wavelength light sources) is that the multi-wavelength physiological monitor can be further configured to determine several blood constituent concentrations based upon signals measured from just the non-red light sources. For example, such a multi-wavelength physiological monitor can determine levels and/or concentrations of: methemoglobin (MetHb), carboxyhemoglobin (COHb), low hemoglobin levels, high hemoglobin levels, bilirubin, methylene blue, deoxyhemoglobin, and lipids. Lamego at [0036]

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	Similarly, the system can compensate for other blood constituents with the addition of wavelengths sensitive to the other blood constituents of interest. For example, carboxyhemoglobin absorbs about the same amount of 660 nm light as oxyhemoglobin. Therefore, a typical two-wavelength physiological monitor can mistake carboxyhemoglobin for oxyhemoglobin, which can result in normal blood oxygen saturation level readings even though the actual level is abnormal. For example, for every about 1% of carboxyhemoglobin circulating in the blood, the monitor may over read by about 1%. Selecting one or more additional wavelengths sensitive to carboxyhemoglobin, for example, about 610, 630, and/or 640 or the like, can allow the system to compensate for this effect. The system can compensate for other blood constituents, such as deoxyhemoglobin or lipids, with the addition of wavelengths sensitive to those constituents. More wavelengths can allow the system to compensate for more variables. Lamego at [0038] The various blood constituents mentioned above may not be orthogonal; rather they are often highly correlated with one another. Therefore, even using multiple wavelengths may not fully eliminate the effect of such constituents on the blood oxygen saturation level calculations, but it can reduce or minimize the effect and produce more accurate blood oxygen saturation level readings. In one embodiment, using eight wavelengths (including, for example, any of the wavelengths mentioned herein) can provide relatively more accurate readings of blood oxygen saturation levels relative to other numbers of wavelengths. However, the number of wavelengths that is most appropriate for a particular patient and that will provide the most accurate readings can vary based on such factors as the actual concentrations of blood constituents in the patient's blood, as well as the patient's condition, gender, age, or the like. In addition to improving the accuracy of blood oxygen saturation level readings, using multiple wavelengths can also provide relatively more accurate measurements of other parameters, including, for example, the concentrations of any of the blood constituents or other parameters mentioned herein. In one embodiment, the multi-wavelength physiological monitor compensates for conditions, such as motion and/or blood constituents that would cause a standard two-wavelength system to over- or under-react to the presence of such condition. Such compensation provides a more accurate, stable reading or a patient's physiological condition, including, but not limited to, their blood oxygen concentration and/or plethysmographic signal. Lamego at [0039]-[0040]

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	The front end analog signal conditioning circuitry 330 has outputs that are coupled to an analog to digital conversion circuit 332. The analog to digital conversion circuit 332 has outputs that are coupled to a digital signal processing system 334. The digital signal processing system 334 provides desired parameters as outputs for a display 336. Outputs for the display 336 include, for example, blood oxygen saturation, heart rate, and a clean plethysmographic waveform. Lamego 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 art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lamego discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a wearable device adapted to be placed on a wrist or an ear of a user,	Lamego discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. *See* above at claim 1[a].

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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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Lamego discloses or renders obvious the wearable devices includes a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. the 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;	Lamego discloses or renders obvious the 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. *See* above at claim 1[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 Lamego, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. the wearable device further comprising 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,	Lamego discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. *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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. wherein the detection system is configured to be synchronized to the light source;	Lamego discloses or renders obvious the detection system is configured to be synchronized to the light source. *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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. wherein the detection system comprises a plurality of detectors that are spatially separated from each other, and wherein at least one	Lamego 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 spatially separated detectors. *See* above at claim 1[f].

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analog to digital converter is coupled to at least one of the spatially separated detectors;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link.	Lamego discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Lamego discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly 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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[i]. 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; and	Lamego discloses or renders obvious 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. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Lamego 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* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[k]. generate a second signal responsive to light received while at least one of	Lamego discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[k].

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the light emitting diode is on; and	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Lamego discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Lamego discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. *See* above 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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 9	

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9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 8 above. Lamego discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	*See* claim 9 above. Lamego discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. *See* above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	

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15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lamego discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Lamego discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, and *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having	Lamego discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly 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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one or more optical wavelengths;	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[c]. the 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;	Lamego discloses or renders obvious the 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. *See* above at claim 1[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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[d]. the wearable device further comprising 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,	Lamego discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. *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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[e]. wherein the detection system is configured to be	Lamego discloses or renders obvious the detection system is configured to be synchronized to the light source.

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synchronized to the light source;	*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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[f]. 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 spatially separated detectors;	Lamego 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein	Lamego discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g].

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the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Lamego discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[i]. 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; and	Lamego discloses or renders obvious 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. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Lamego 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* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on; and	Lamego discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Lamego discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of 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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Lamego discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[n]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Lamego discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. *See* above at claim 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 Lamego, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Lamego, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT E7

U.S. Pat. No. 11,160,455 in view of U.S. Patent Publication No. 2010/0217102 to Steven Francis LeBoeuf ("LeBoeuf")

As described in detail below, LeBoeuf (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 B2 (the "'455 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 E1-E6 and E8-E18, 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 '455 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 '455 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.

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EXHIBIT E7

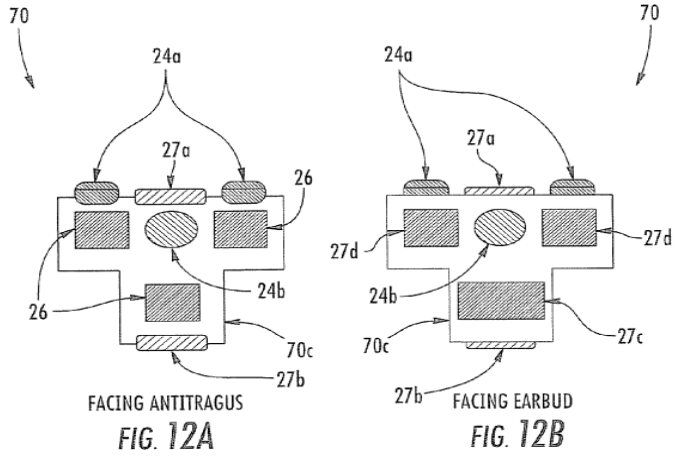
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Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. LeBoeuf discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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] 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,

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	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] 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] The present invention will now be described more fully hereinafter with reference to the accompanying figures, in which embodiments of the invention are shown. This invention may, however, be embodied

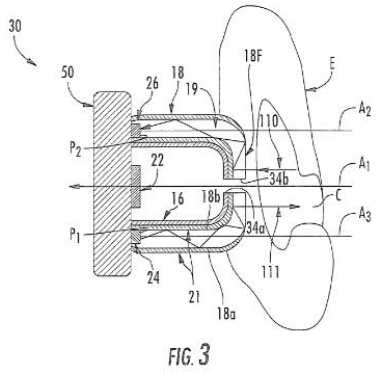
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	in many different forms and should not be construed as limited to the embodiments set forth herein. Like numbers refer to like elements throughout. In the figures, certain layers, components or features may be exaggerated for clarity, and broken lines illustrate optional features or operations unless specified otherwise. In addition, the sequence of operations (or steps) is not limited to the order presented in the figures and/or claims unless specifically indicated otherwise. Features described with respect to one figure or embodiment can be associated with another embodiment or figure although not specifically described or shown as such. LeBoeuf at [0073] 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

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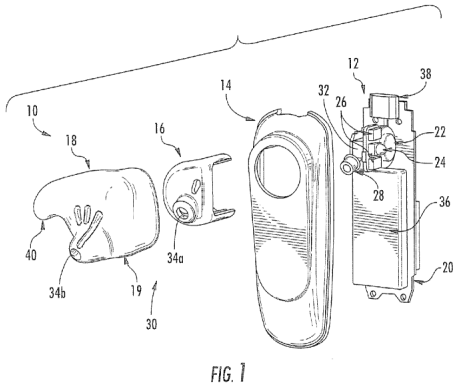
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	board 20, or on another circuit board, such as the secondary circuit board 32, attached to the main circuit board. LeBoeuf at [0093]  LeBoeuf at Fig. 12A-12B The filter 203 properties are updated to minimize the difference between Channel A and the 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

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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[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, and	LeBoeuf discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a 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, 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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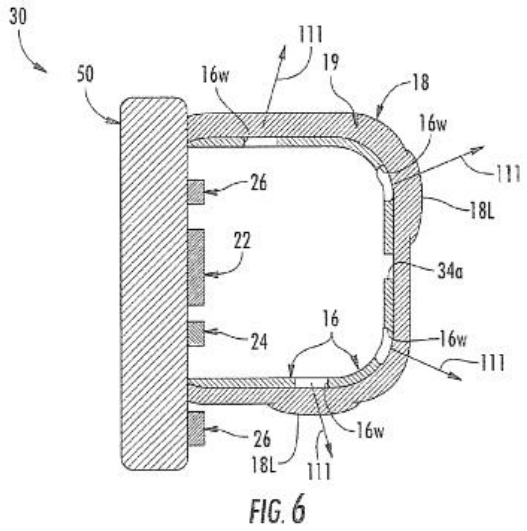
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	 FIG. 3 LeBoeuf at Fig. 3 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at 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 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]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	LeBoeuf discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. 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

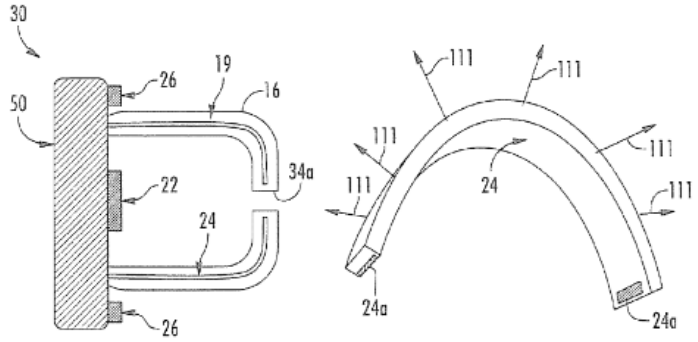
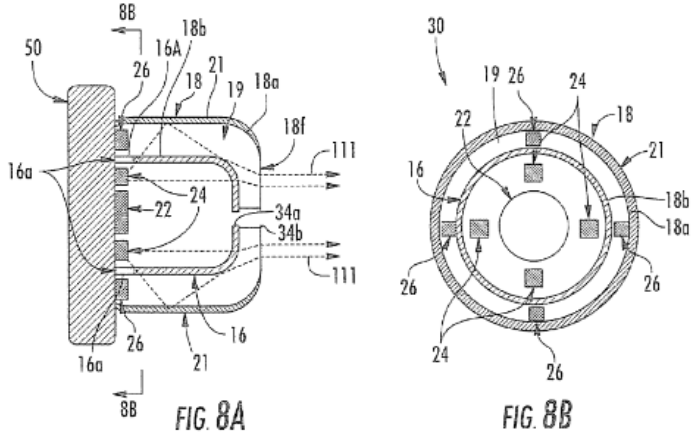
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	from the ear region. In some embodiments, the optical detector may include an optical filter configured to pass secondary optical energy at selective wavelengths. In some embodiments, the light transmissive material of the cover may be configured, 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] 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 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

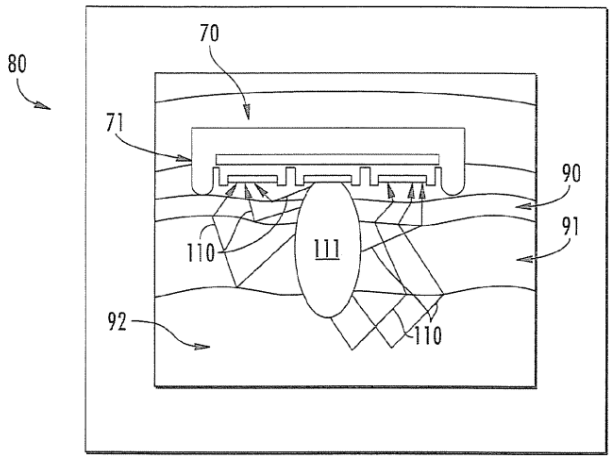
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	towards/away-from the ear. Additionally, this may allow localized control of light wavelength to selected areas. Referring now to FIGS. 8A-8B, a light guiding earbud 30, according to some embodiments of the present invention, includes a base 50, an 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. 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 [0122]-[0124]

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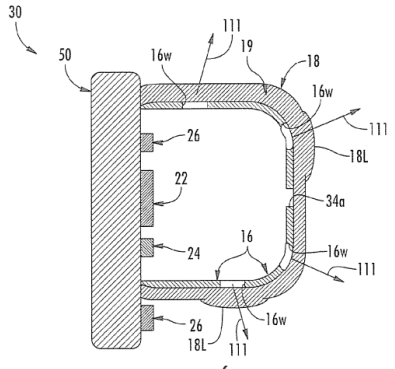
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	 FIG. 6 LeBoeuf at Fig.6

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	 FIG. 7A FIG. 7B  FIG. 8A FIG. 8B LeBoeuf at Fig. 7A,7B,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

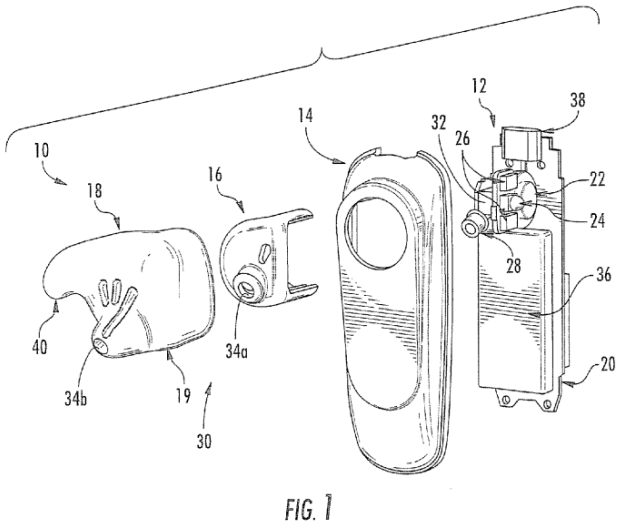
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	is configured to be positioned within an ear of a subject, and a cover 18 surrounding the earbud housing 16. The earbud housing 16 is in acoustical communication with a speaker 22 and includes at least one aperture 34 a through which sound from the 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. 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 [0127]-[0128]

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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. 19 LeBoeuf at Fig. 19 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

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	configured to measure light at different wavelengths (e.g., light detectors 26 and 26′ may be configured to measure light at different wavelengths). LeBeouf at [0163] 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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the 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;	LeBoeuf discloses or renders obvious the 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. 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]

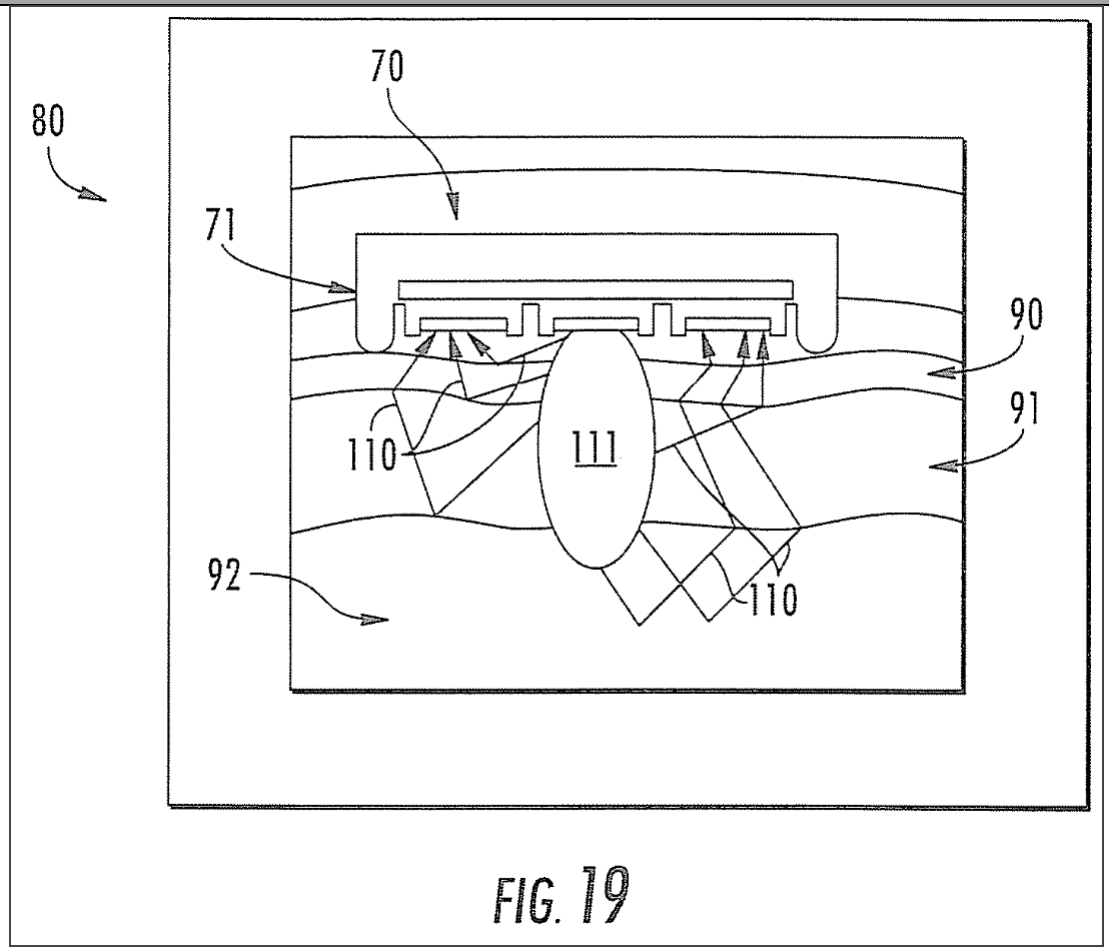
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	The cover 18 includes light transmissive material in a portion 19 thereof that is referred to as a light-guiding region. The light transmissive material in light-guiding region 19 is in optical communication with the optical emitter 24 and detectors 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

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	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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the wearable device further comprising 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 the wearable device further comprising 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. 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

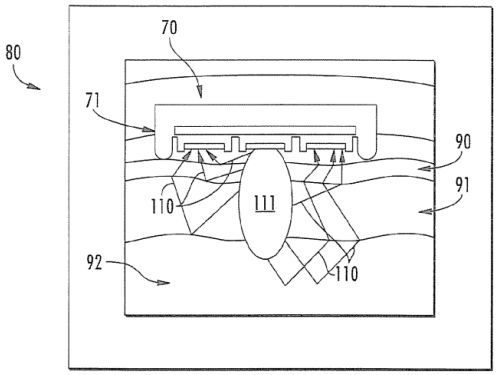
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	an earbud 30. The headset housing 14 is secured to the base 12 and is configured to enclose and protect the various electronic components mounted to the base (e.g., main circuit board 20 and components secured thereto, etc.) from ambient interference (air, humidity, particulates, electromagnetic interference, etc). LeBoeuf at [0091]  FIG. 1 LeBoeuf at Fig. 1 In 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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	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. LeBoeuf at [0037] 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] 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

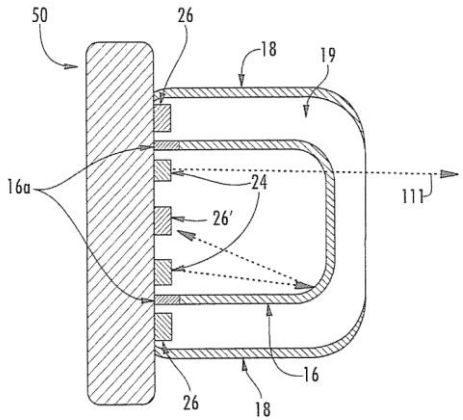
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	coupling. In this embodiment, light may couple into the extended light-guiding region 19 a, from an optical emitter 24, and into the ear region. Similarly, light may couple from the ear region, into the extended light-guiding region 19 a, and to the 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] 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 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

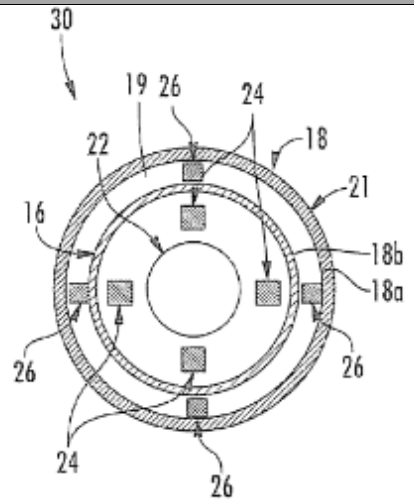
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	scattered by a physiological region but rather light that has been scattered from a region of the associated earpiece that may move along with the ear. Thus, the scattered light reaching the optical detectors 27 *d* may be used to generate a measure 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 identified in Defendants’ Invalidity 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]. wherein the detection system is configured to be synchronized to the light source;	LeBoeuf discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. 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]

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	 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. 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

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	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 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 spatially separated detectors	LeBoeuf 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 spatially separated 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 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 8D LeBoeuf at Fig. 8D 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 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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of

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	the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	LeBoeuf discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. 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] 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.

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	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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 one or more of the physiological parameters;	LeBoeuf discloses or renders obvious the output signal is indicative of one or more of the 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

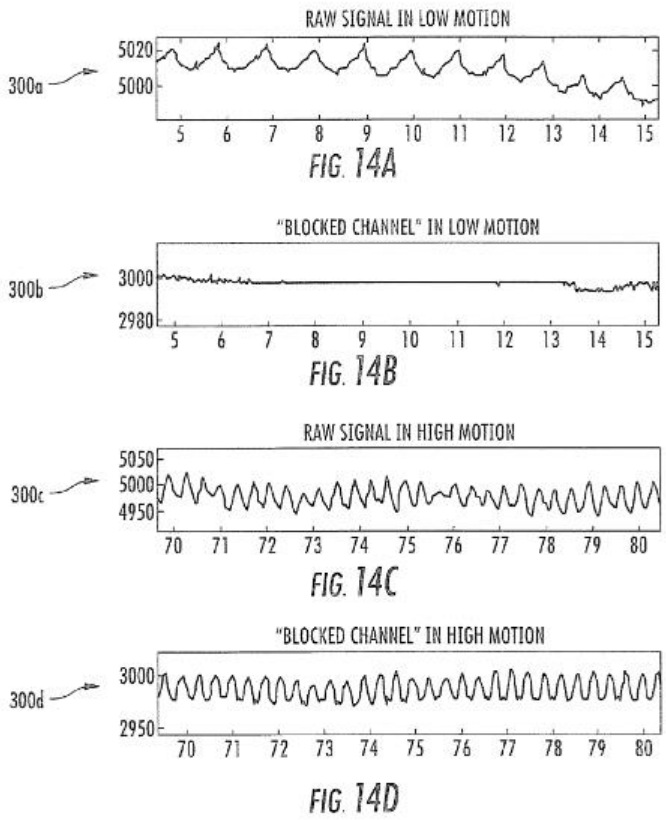
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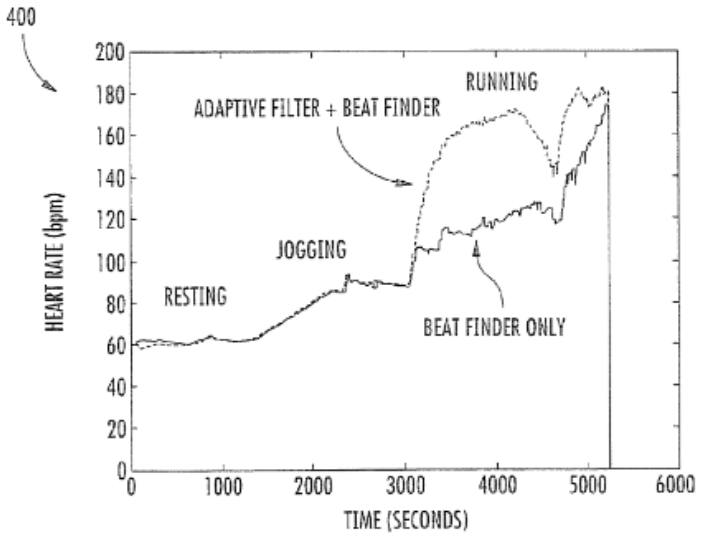
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	include a transmitter configured to transmit signals processed by the signal processor to a remote device in real time. Headsets according to embodiments of the present invention may utilize, for example, Bluetooth®, Wi-Fi, ZigBee, or other wireless 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] 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] 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

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	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] 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] 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

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	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]

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	 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 wearable device configured to increase the signal-to-noise ratio by	LeBoeuf discloses or renders obvious 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.

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increasing light intensity of at least one of the semiconductor sources from an initial light intensity;	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] 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.
1[j]. the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off,	LeBoeuf discloses or renders obvious the detection system further configured to generate a first signal responsive to light received while the semiconductor sources 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 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

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	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] 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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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[k]. generate a second signal responsive to light received while at least one of the semiconductor sources is on; and	LeBoeuf discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the semiconductor sources 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 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

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	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] 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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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	LeBoeuf discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal.

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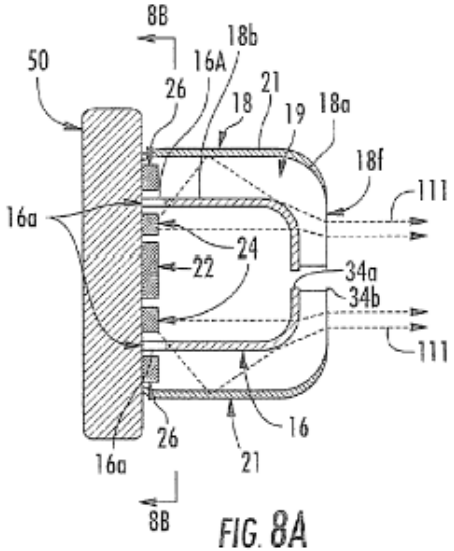
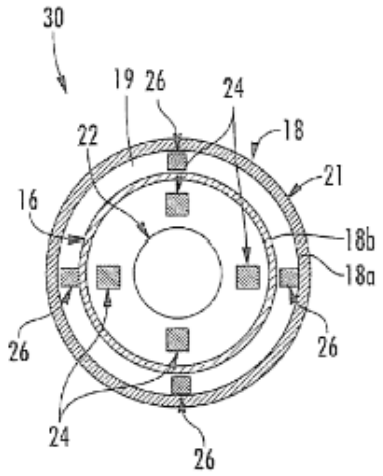
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first signal and the second signal; and	The optical detectors 26 positioned outside the earbud housing 16 of the earbud 30 of FIGS. 7A-7B collect scattered light from an ear originating from inspection light 111 generated by the flexible optical emitter 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

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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. LeBeouf 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. LeBeouf at [0139] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths	LeBeouf discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. 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

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comprise near infrared or visible wavelengths.	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. LeBeouf at [0153] 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. LeBeouf at [0112] 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. LeBeouf at [0143] 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). LeBeouf 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

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	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 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 1 above. LeBeouf discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. 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. LeBeouf 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. LeBeouf 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

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	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 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]

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	 FIG. 8A  FIG. 8B LeBoeuf at Figs. 8A & 8B 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). LeBeouf 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

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	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 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	*See* claim 2 above. LeBeouf discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. 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. LeBeouf at [0153] 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. LeBeouf at [0112] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBeouf, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of LeBeouf, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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Claim 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. LeBoeuf discoses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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.
8[a]. A wearable device adapted to be placed on a wrist or an ear of a user,	LeBoeuf discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured	LeBoeuf discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. *See* above at claim 1[b].

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to generate an output optical light having one or more optical wavelengths;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the 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;	LeBoeuf discloses or renders obvious the 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. *See* above at claim 1[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 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]. the wearable device further comprising 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 the wearable device further comprising 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. *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 LeBoeuf, it

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	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]. 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. *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 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]. 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 spatially separated 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a	LeBoeuf discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal. The smart phone or tablet is configured to store and display the processed output signal, and wherein at least

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microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal; wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link	a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[h]. wherein the output signal is indicative of one or more of the physiological parameters;	LeBoeuf discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[i]. the wearable device 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 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. *See* above at claim 1[i].

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semiconductor sources from an initial light intensity; and	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[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 detection system further configured to generate a first signal responsive to light received while the light emitting diodes are off. *See* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[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 the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[l] increase the signal-to-noise ratio by comparing the first signal and the second signal; and	LeBoeuf discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	LeBeouf discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. *See* above 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 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 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 8 above. LeBeouf discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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 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 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	*See* claim 9 above. LeBeouf discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. *See* above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. LeBoeuf discoses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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

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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 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.
15[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	LeBoeuf discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	LeBoeuf discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[c]. the wearable device comprising one or more lenses configured to receive	LeBoeuf discloses or renders obvious the 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.

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at least a portion of the output optical light and to deliver a lens output light to tissue;	*See* above at claim 1[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 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.
15[d]. the wearable device further comprising 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 the wearable device further comprising 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. *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 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.
15[e]. 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. *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 incorporated by reference into this chart. To the extent this limitation is not disclosed by LeBoeuf, it

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	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.
15[f]. 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 spatially separated 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured	LeBoeuf discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, whereinthe smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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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to be transmitted over a wireless transmission link;	
15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	LeBoeuf discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[i]. 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; and	LeBoeuf discloses or renders obvious 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. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[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. *See* above at claim 1[j].

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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.
15[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 the detection system further configured to: generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	LeBoeuf discloses or renders obvious the detection system further configured to: increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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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15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	LeBeouf discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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 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.
15[n]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	LeBeouf discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. *See* above at claim 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 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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EXHIBIT E8

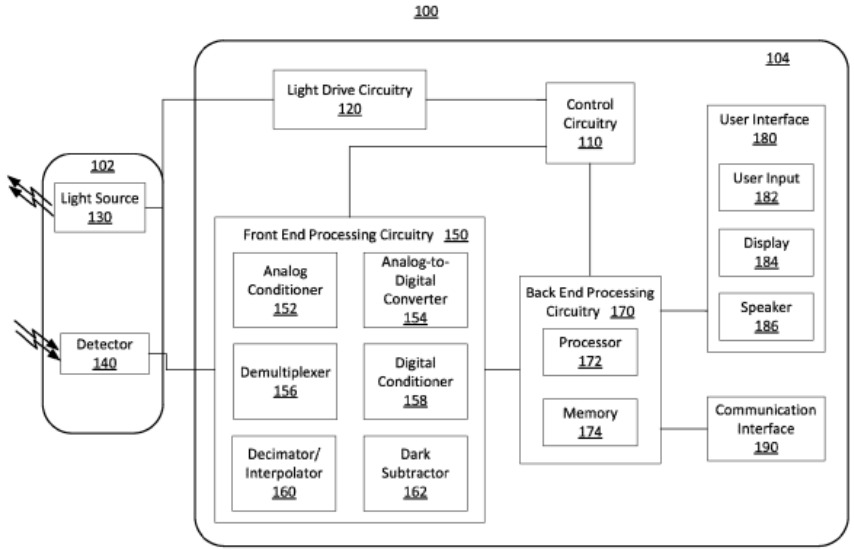
U.S. Pat. No. 11,160,455 in view of U.S. Patent No. 9,241,676 to Lisogurski et al. ("Lisogurski")

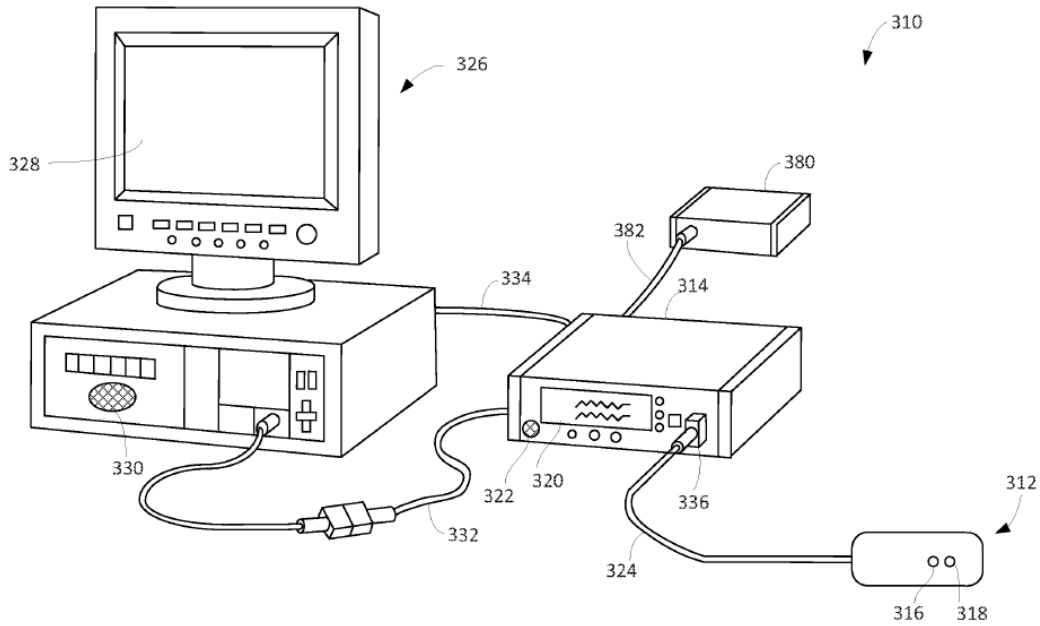
As described in detail below, Lisogurski (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 Patent") under 35 U.S.C. §102 and/or §103, either alone in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits E1-E7 and E9-E18, 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 '455 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 '455 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.

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Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lisogurski discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet.  FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 3 Lisogurski at Fig. 3. 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. Lisogurski at Abstract.

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	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. In some embodiments, the system may vary light levels with other periodic (or mostly periodic) physiological changes. For example, venous return changes with intrathoracic pressure during a respiration cycle can affect the baseline level of the photoplethysmography waveform. The system may vary the emitter output such that similar signal quality is available at the detector over time varying volumes of venous blood present in the path of light. 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.

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	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 1:10-2:3. 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. Providing a light drive signal to the light source may account for a significant portion of the systems 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 under stood 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

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	to monitor carotid artery pulsatile flow, the wrist to monitor radial artery pulsatile flow, the inside of a patients 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. Lisogurski at 3:43-4:25. 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. 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. Lisogurski at 4:52-5:12. 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.

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	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. 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 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. Lisogurski at 11:9-32. 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. Lisogurski at 12:42-45. 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.

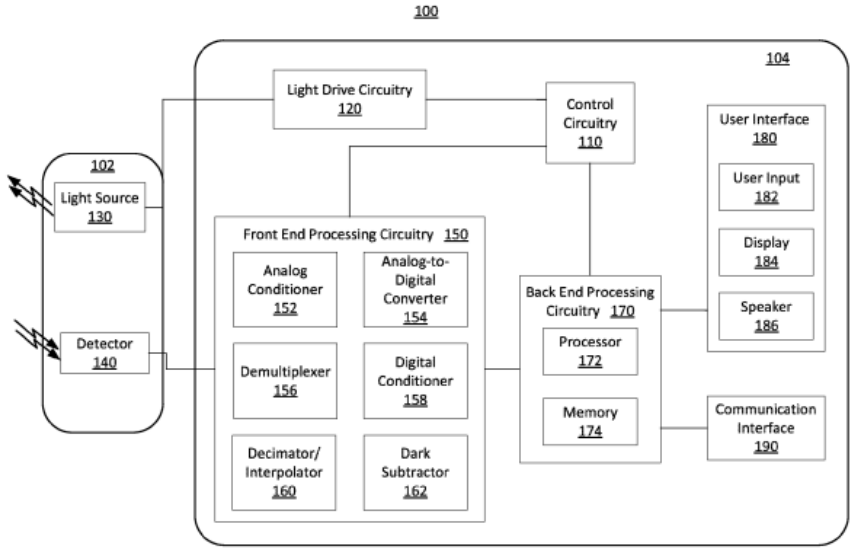
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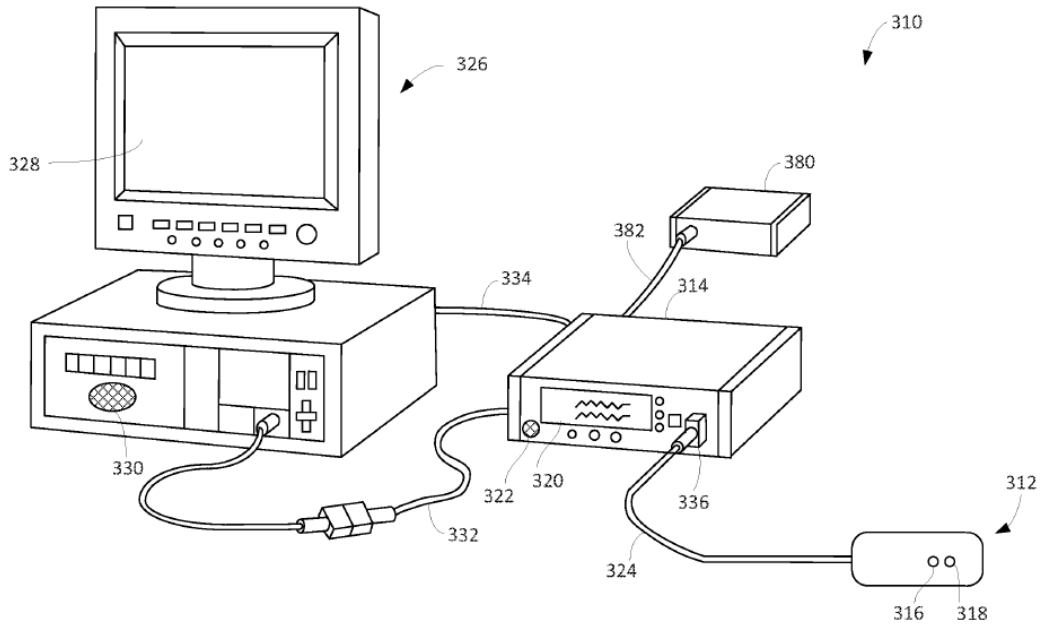
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	User interface 180 may include user input 182, display 184, and speaker 186. User input 182 may include any type of user input device such as a keyboard, a mouse, a touch screen, buttons, switches, a microphone, a joy stick, a touch pad, or any other suitable input device. Lisogurski at 15:19-23. Additionally, display 184 may display, 30 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. 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

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	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 15:43-16:16. 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 anoximeter. 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 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 subjects 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). Lisogurski at 17:30-59. 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

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	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. 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. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, and	Lisogurski discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of 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

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	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. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	Lisogurski discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths.

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	 FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 3 Lisogurski at Fig. 3. 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.

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	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 1:10-41. 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. 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

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	blood perfused tissue and photoelectrically sense the absorption of the light in the tissue. In addition, locations which are not typically under stood 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 patients 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) 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. 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.

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	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 heart beats. 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 of arrhythmia and fibrillation. Lisogurski at 3:43-5:24 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

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	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 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

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	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 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

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	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 10:42-11:8 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.

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	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. “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

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	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 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 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. 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

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	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 14:27-55 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 subjects 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). Lisogurski at 17:37-59 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

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	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.
1[c]. the 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;	Lisogurski discloses or renders obvious the 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. In some embodiments, the system may correct for non-linearity of light sources. For example, the emitted intensity of light from an LED may not vary linearly with the drive current. The system may account for non-linearity by adjusting drive signals, by adjusting amplification of received signal gain, by adjusting received signal processing, by any other suitable method, or any combination thereof. For example, the system may adjust the drive signal to an LED to improve the linearity. Corrections may be determined using a calibration step, lookup tables for known components, empirical data, any other suitable techniques, or any combination thereof. For example, the emission intensity relative to a drive signal may be known for a particular LED.

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	Information may be encoded in a calibration resistor or non-volatile calibration memory included in the sensor or the system. In another example, the system may calibrate emission output by comparing the intensity of received signals generated in response to a high current drive signal with those generated in response to a low current drive signal. In some embodiments, the operating range of a component (e.g., an LED) may be limited. In some embodiments, a component may operate with a linear relationship between drive signal and output intensity within a known range of drive signals, and in a non-linear relationship outside that range of drive signals. 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 7:12-8:3 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

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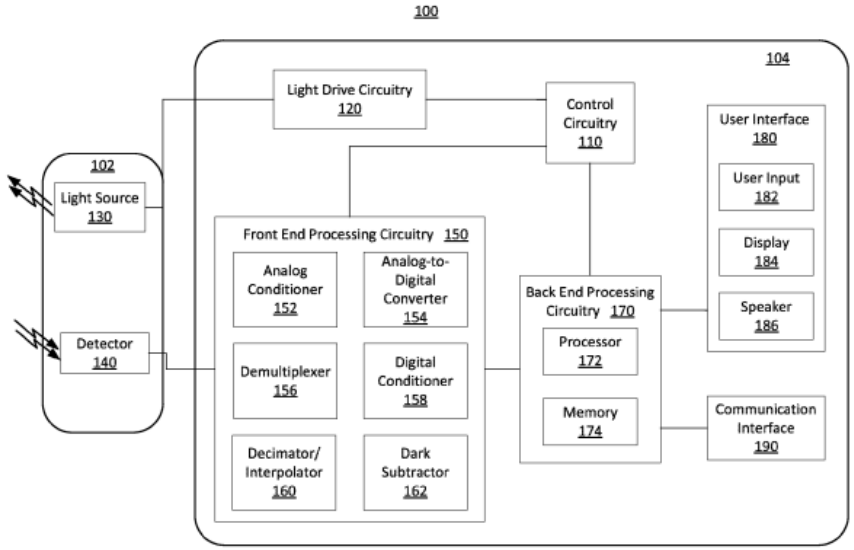
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	light emitting light source, e.g., Red and IR light emitting diodes (LEDs), for emitting light into the tissue of a subject to generate physiological signals. In one embodiment, the Red wavelength may be between about 600 nm and about 700 nm, and 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 subjects 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 trans mitted to monitor 104. Lisogurski at 11:9-27 The front end processing circuitry 150 may use the timing control signals to operate synchronously with light drive circuitry 120. For example, frontend 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. Lisgurski at 11:41-46. 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

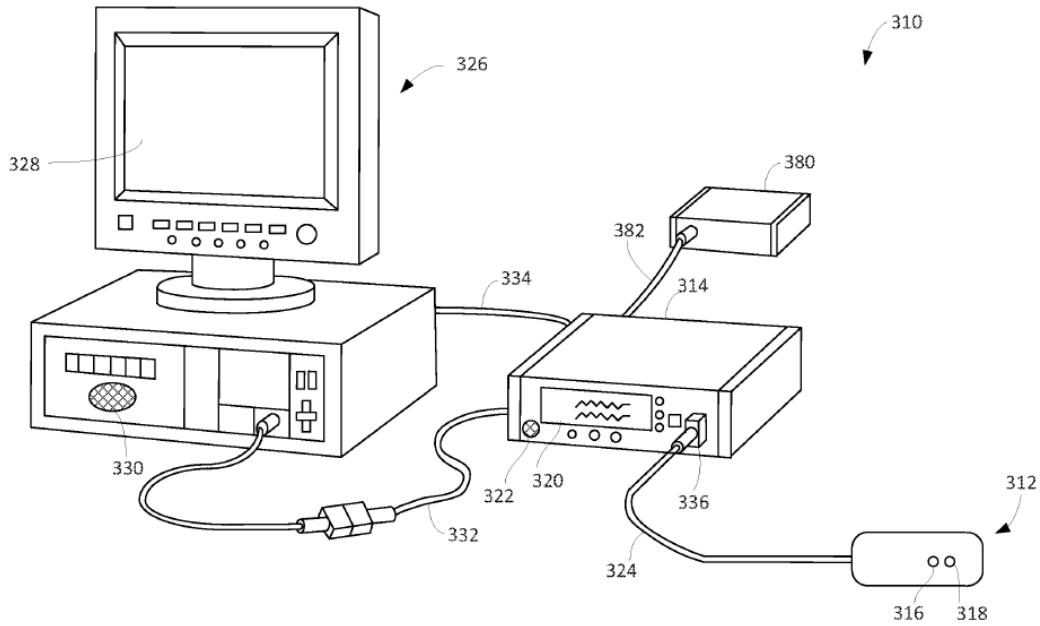
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	may be generated by light drive circuitry 120 under the control of control circuitry 110. As used herein, “on” and “off” may refer to switching power or other components, high and low output states, high and low values within a continuous modulation, 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. Lisogurski at 11:61-12:22 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.

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	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. 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

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	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. Lisogurski at 25:6-45 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 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. 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[d]. the wearable device further comprising 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 the wearable device further comprising 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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	 FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 3 Lisogurski at Fig. 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. 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

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	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 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. Lisogurski at 7:38-43. 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. Lisogurski at 7:58-61. 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

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	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. 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 Lisogurski at 10:42-56. Detector 140 may be chosen to be specifically sensitive to the chosen targeted energy spectrum of light source 130.

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	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 11:6-27. 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.

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	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 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. 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.

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	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., 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. Digital conditioner 158 may perform any suitable digital conditioning of the detector signal. The digital conditioner may include any type of digital filtering of the signal (e.g., low pass, high pass, band pass, notch, or any other suitable filtering), amplifying, performing an operation on the signal, performing any other suitable digital conditioning, or any combination thereof. Decimator/interpolator 160 may decrease the number of samples in the digital detector signal. For example, decimator/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 filtering to smooth the output signal. 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. 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 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

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	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. 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 13:7-14:55. 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

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	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. 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, 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. Lisogurski at 18:16-23. 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.

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	Lisogurski at 19:1-12. 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 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]. 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. The system may, in response to the external rigger, vary the light intensity, duty cycle, light source firing rate, any other suitable parameter, or any combination thereof. Lisogurski at 1:67-2:2. 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

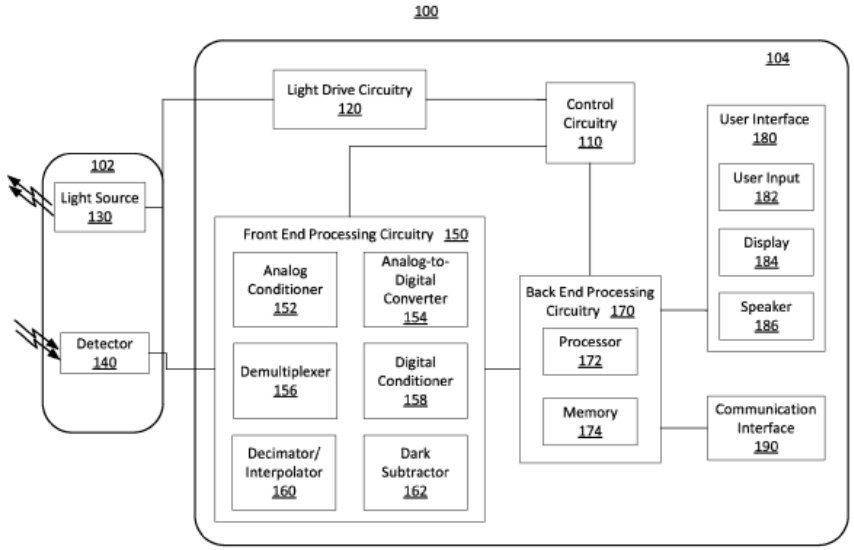
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	current provided to an emitter, high and low values of a duty cycle, high and low values of a decimation ratio (i.e., how often an emitter is switched on), any other suitable relatively distinct states, or any combination thereof. In some embodiments, “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. 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 wave lengths 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.

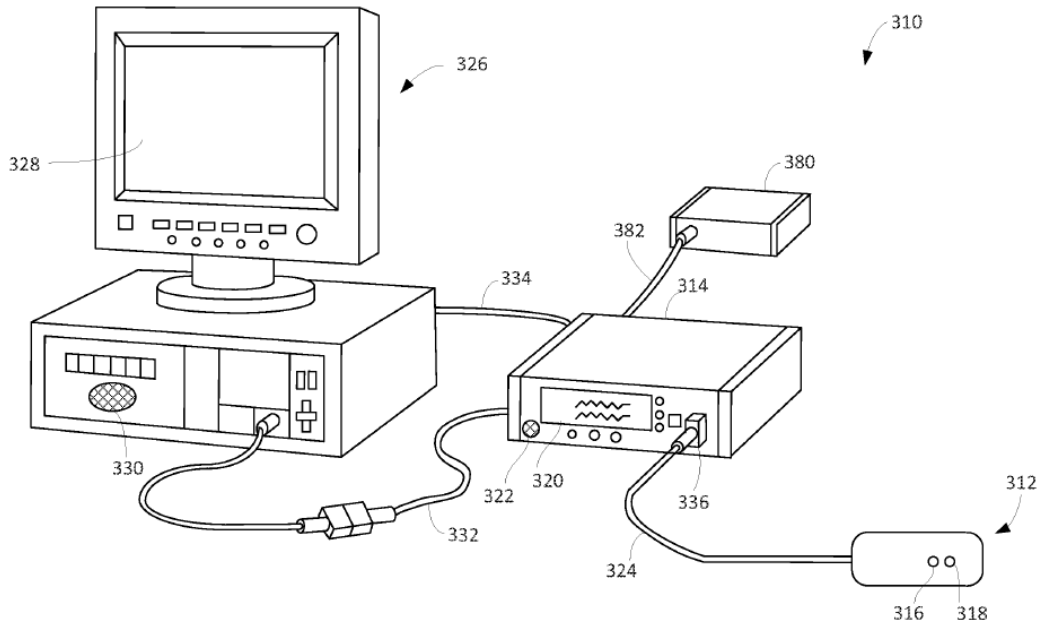
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	Lisogurski at 11:41-12:9. FIG. 2B shows an illustrative plot of detector signal 214 that may be generated by a sensor in accordance with some embodiments of the present disclosure. The peaks of detector current waveform 214 may represent current signals 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. 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. Lisogurski at 16:66-17:2. 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. In some embodiments, sampling rate modulation may be correlated with light drive signal modulation.

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	Lisogurski at 33:47-49. 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. Lisogurski at 35:16-23. 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 35:25-31. 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[f]. 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	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 spatially separated detectors.

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least one of the spatially separated detectors;	 FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 3 Lisogurski at Fig. 3. 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 oflight at the Red and IR wavelengths.

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	Lisogurski at 11:9-10. 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. 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., 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. Digital conditioner 158 may perform any suitable digital conditioning of the detector signal. The digital conditioner may include any type of digital filtering of the signal (e.g., low pass, high pass, band pass, notch,

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	or any other suitable filtering), amplifying, performing an operation on the signal, performing any other suitable digital conditioning, or any combination thereof. Decimator/interpolator 160 may decrease the number of samples in the digital detector signal. For example, decimator/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 filtering to smooth the output signal. Lisogurski at 13:6-60. 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. 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

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	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. 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. 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 19:56-64. 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 26:40-48. 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

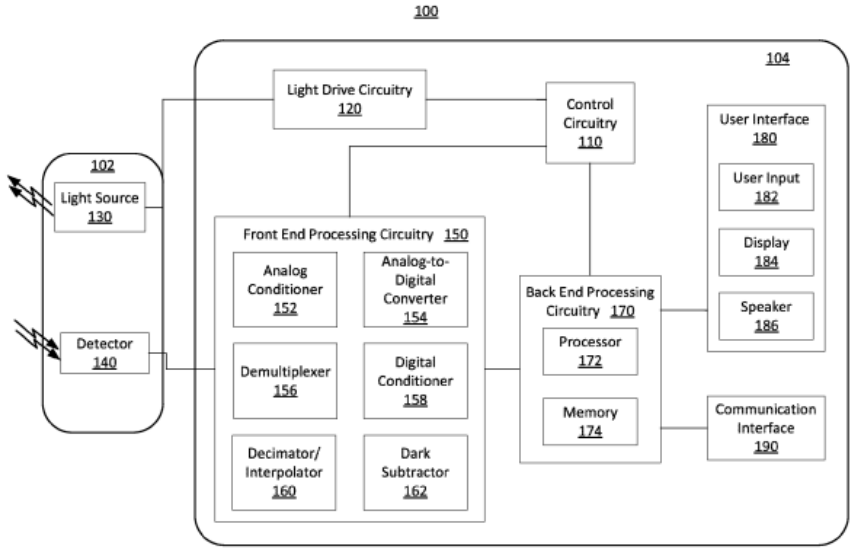
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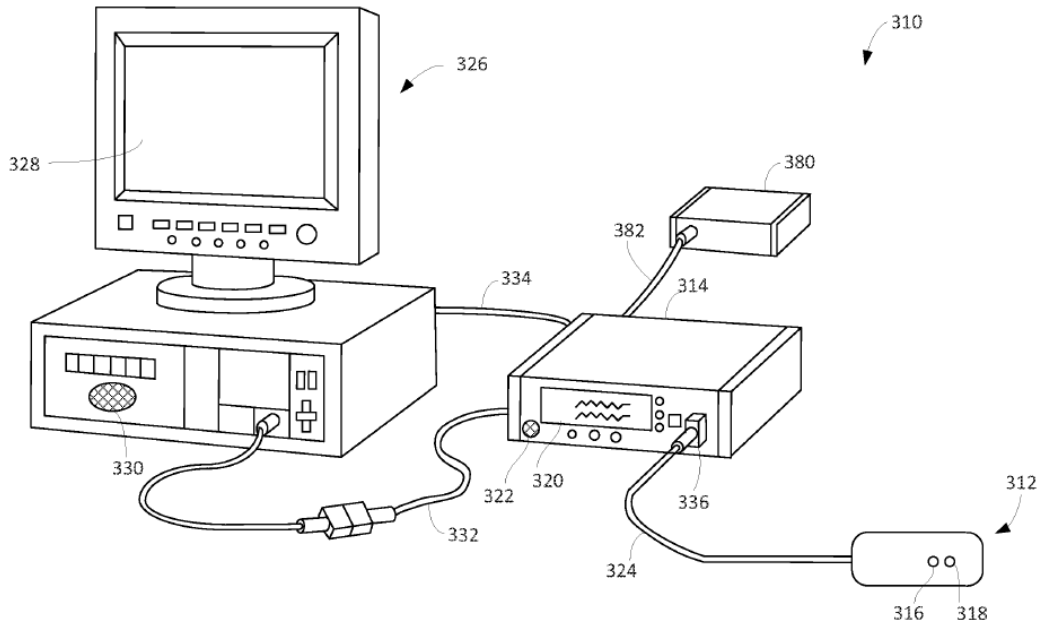
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	time resolution of identified features. For example, in a continuous non-invasive blood pressure measurement where the pulse transit time is used in calculations, increasing the sampling rate for a portion of the cardiac cycle may result in more accurate 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 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 33:49-64. 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. 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. Lisogurski at 35:10-23.

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	In step 2202, the system may receive a signal. The signal may be, for example, an attenuated photonic signal. The signal may have been detected by a detector. The detected signal may be processed by processing equipment including, for example, digitizers, filters, decimators, interpolators, other suitable processing equipment, or any combination thereof. 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. Lisogurski at 38:59-39:8. 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 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]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal,	Lisogurski discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link.

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and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	 FIG. 1 Lisogurski at Fig. 1.

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	 FIG. 3 Lisogurski at Fig. 3. In some embodiments, reducing power consumption may allow for increased battery life in portable systems or increased portability. Lisogurski at 1:16-18. 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-

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	readable media capable of storing information that can be interpreted by processor 172. This information may bedata or may take the form of computer-executable instruct tions, 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 nonremovable 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 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 embodyments, 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

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	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. Lisogurski at 14:56-16:16. 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

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	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 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

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	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 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

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	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 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.
1[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Lisogurski discloses or renders obvious wherein the output signal is indicative of the one or more of the physiological parameters. 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.

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	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 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

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	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. 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.

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	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. 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 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 13:21-30

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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 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 14:56-64 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 17:54-18:15 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

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	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. 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

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	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. 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

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	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 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

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	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. 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.

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	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 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 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the

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	time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 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;	Lisogurski discloses or renders obvious the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of semiconductor 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. 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. 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

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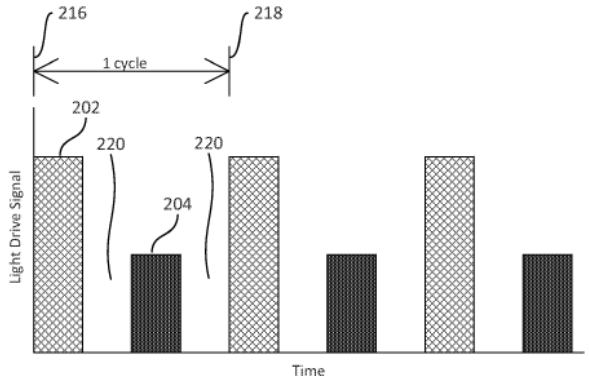
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	cycle modulation may have a period of, for example, around 1 second, while drive cycle modulation may have a period around, for example, 1.6 milliseconds. In some embodiments, conventional servo algorithms may be used in addition to any combination 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. In 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 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

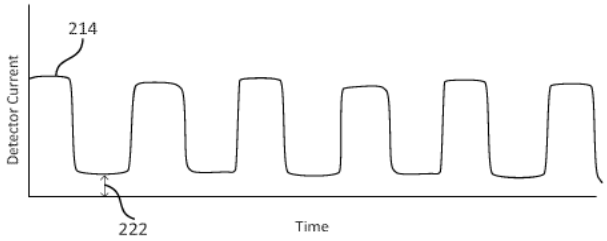
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	may be selected based on efficiency parameters and information from the first light Source may be used only to control a second light source. For example, a highly efficient first light source that is not at a wavelength of interest for physiological 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. 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. 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 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.

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	For example, light drive circuitry 120 may generate a light drive signal, which may be used to tum on and off the light source 130, based on the timing control signals. Lisogurski at 11:38-41. 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. 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. 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 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

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	wavelength, multiple LEDs of different wave lengths, any other Suitable arrangement, or any combination thereof. Lisogurski at 19:20-31. 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. 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

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	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. 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.

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	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. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 while the semiconductor sources are off,	Lisogurski discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor diodes are off.  FIG. 2A

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	Lisogurski at Fig. 2A.  FIG. 2B Lisogurski at Fig. 2B. 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. 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. Lisogurski at 8:16-23.

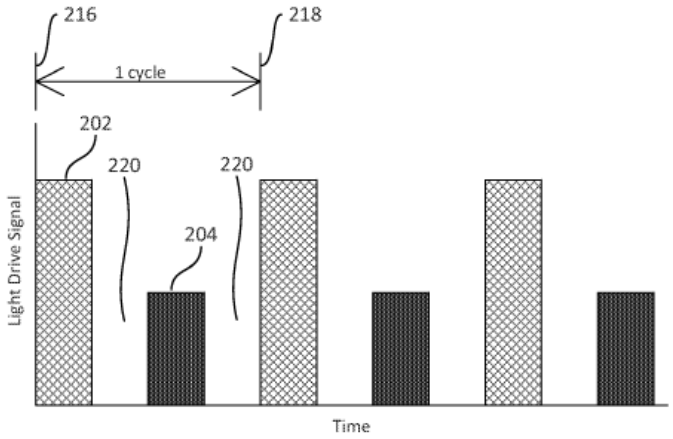
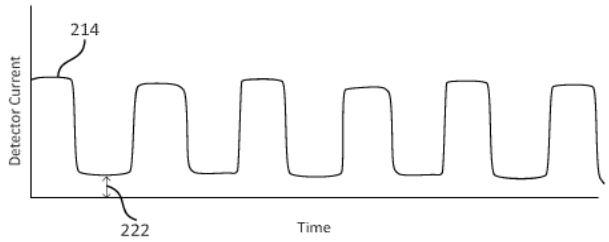
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	In some embodiments, detector 140 may be configured to detect the intensity of light at the Red and IR wavelengths. In some embodiments, an array of sensors may be used and each sensor in the array may be configured to detect an intensity of a single 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 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. Lisogurski at 11:9-20. 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 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., 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).

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	Lisogurski at 13:31-41. 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. 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 16:33-53. The system may subtract the back ground or dark level from the levels received during red “on” portion 286 and IR “on” portion 290.

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	Lisogurski at 17:8-10. 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. Lisogurski at 17:40-42. 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 semiconductor sources is on; and	Lisogurski discloses or renders obvious the detection system further configured to: generate a second signal responsive to light received while at least one of the semiconductor diodes is on.

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	 FIG. 2A Lisogurski at Fig. 2A.  FIG. 2B Lisogurski at Fig. 2B. 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

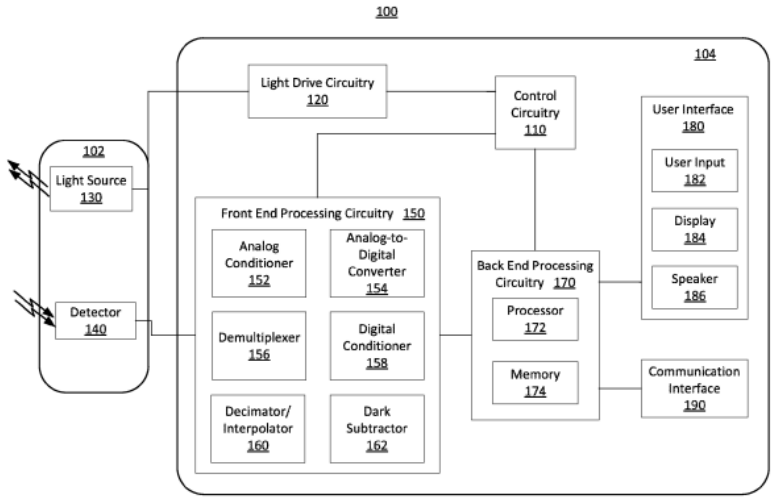
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	the ambient light detected by the detector during the "dark" period and then subtract this ambient contribution from the signals received during the first and second "on" periods. Lisogurski at 6:11-19. For example, the system may operate the first 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. Lisogurski at 8:16-23. 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. Lisogurski at 11:9-20. 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

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	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 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. 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. 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

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	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 16:33-53. 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 17:8-10. 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. Lisogurski at 17:40-42, 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

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	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 the detection system further configured to: 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. 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. 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

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	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. 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. 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 16:33-53. 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,

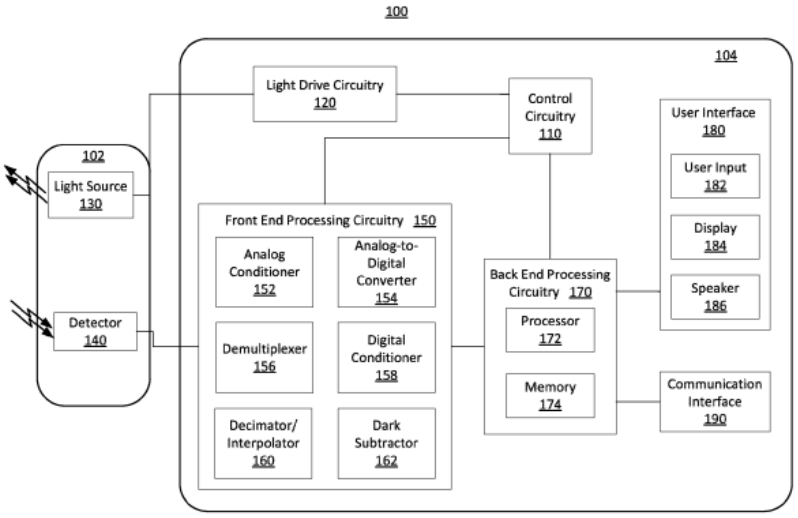
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	or any combination thereof. For example, the light source may include light source 130 of FIG. 1 or light source 316 of FIG. 3. In some embodiments, the light source may include LEDs of multiple wavelengths, for example, a red LED and an IR led. Lisogurski 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[m]. wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Lisogurski discloses or renders obvious wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.  FIG. 1

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	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. 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. 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. Lisogurski at 4:42-51. 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.

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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 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 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. 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. 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

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	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. Lisogurski at 17:17-39. 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 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. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the

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	time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 1 above. Lisogurski discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.  FIG. 1 Lisogurski at Fig. 1.

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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. 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 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 subjects 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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	System 310 may include sensor unit 312 and monitor 314. In some embodiments, sensor unit 312 may be part of anoximeter. 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 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 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. 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

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	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 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	*See* claim 2 above. Lisogurski discloses or renders obvious wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. 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

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	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 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. 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. 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,"

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	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. 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. Lisogurski at 17:43-67. In the illustrated embodiment, system 310 includes a multiparameter 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.

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	Lisogurski at 18:44-57. 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 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. 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 oflight 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. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in

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	Defendants' Invalidity 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 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lisogurski discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 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 wearable device adapted to be placed on a wrist or an ear of a user,	Lisogurski discloses or renders obvious a wearable device adapted to be placed on a wrist or an ear of a user. *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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]. including a light source comprising a driver and a plurality of semiconductor sources	Lisogurski discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths.

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that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	*See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the 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;	Lisogurski discloses or renders obvious the 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. *See* above at claim 1[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 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]. the wearable device further comprising 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 the wearable device further comprising 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. *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 Lisogurski, it would have been obvious

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	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]. 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. *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 incorporated by reference into this chart.
8[f]. 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 spatially separated detectors;	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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the	Lisogurski discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g].

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smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Lisogurski discloses or renders obvious wherein the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[i]. the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the	Lisogurski discloses or renders obvious 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. *See* above at claim 1[i].

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plurality of semiconductor sources from an initial light intensity; and	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	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. *See* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[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 the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off. See above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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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8[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Lisogurski discloses or renders obvious the detection system further configured to: increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Lisogurski discloses or renders obvious wherein the plurality of semiconductor sources comprises six light emitting diodes. *See* above 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 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 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated	See claim 8 above. Lisogurski discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above at claim 2.

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detectors are located on one or more arcs.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	See claim 9 above. Lisogurski discloses or renders obvious wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. *See* above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Lisogurski discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *See* above at claim 1[pre].

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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.
15[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Lisogurski discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Lisogurski discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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

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	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.
15[c]. the 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;	Lisogurski discloses or renders obvious the 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. *See* above at claim 1[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 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.
15[d]. the wearable device further comprising 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 the wearable device further comprising 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. *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 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.
15[e]. wherein the detection system is configured to be	Lisogurski discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. *See* above at claim 1[e].

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synchronized to the light 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 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.
15[f]. 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 spatially separated detectors;	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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone	Lisogurski discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in

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or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Defendants’ Invalidity 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.
15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Lisogurski discloses or renders obvious wherein the output signal is indicative of the one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[i]. 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; and	Lisogurski discloses or renders obvious the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of semiconductor diodes from an initial light intensity. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by

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’455 Patent	Lisogurski
	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.
15[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Lisogurski discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor diodes are off. *See* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[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 the detection system further configured to: generate a second signal responsive to light received while at least one of the semiconductor diodes is on. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal;	Lisogurski discloses or renders obvious the detection system further configured to: increase the signal-to-noise ratio by comparing the first signal and the second signal.

’455 Patent	Lisogurski
	See above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes, and	Lisogurski discloses or renders obvious wherein the plurality of semiconductor sources comprises six light emitting diodes. *See* above 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 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.
15[n]. wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and	Lisogurski discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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 Lisogurski, it would have been obvious

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’455 Patent	Lisogurski
	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.
15[o]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Lisogurski discloses or renders obvious wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. *See* above at claim 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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EXHIBIT E9

U.S. Pat. No. 11,160,455 in view of U.S. Patent No. 5,746,206 to Paul D. Mannheimer ("Mannheimer")

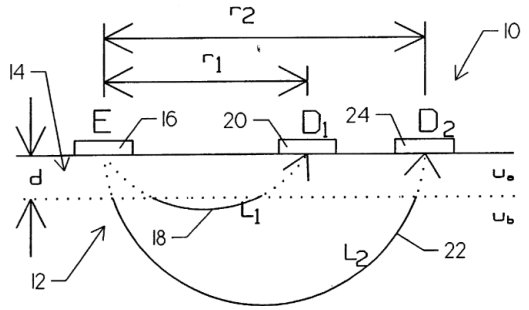
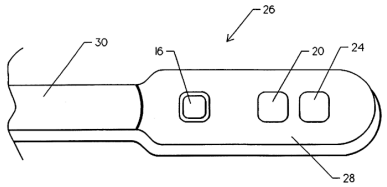
As described in detail below, Mannheimer (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 B2 (the "'455 Patent") under 35 U.S.C. §102 and/or §103, either alone in combination with the knowledge of a person of ordinary skill, and/or additional prior art references discussed in discussed in Exhibits E1-E8 and E10-E18, 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 '455 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 Mannheimer. The cited portions of Mannheimer are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Mannheimer. 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 Mannheimer "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Mannheimer 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 Mannheimer (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 Mannheimer anticipates and/or renders obvious the Asserted Claims of the '455 Patent.

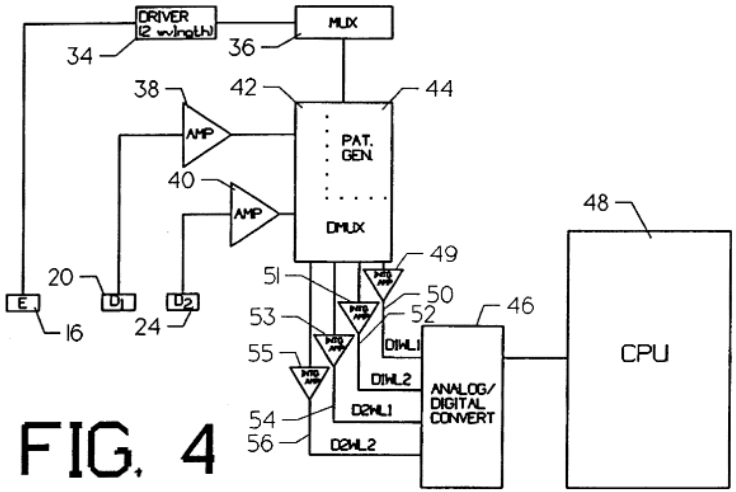
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that 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.

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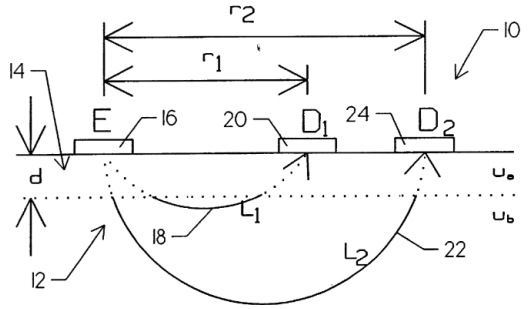
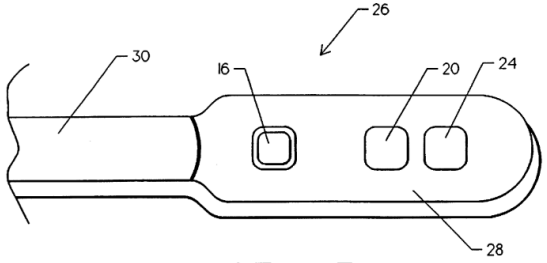
’455 Patent	Mannheimer
Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mannheimer discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. The present invention generally relates to instruments which operate on the principal of pulse oximetry and more particularly relates to instruments which non-invasively measure oxygen saturation of arterial blood in vivo. Mannheimer at 01:10-13 The present invention overcomes the disadvantages found in the prior art by providing a pulse oximetry system for the determination of arterial blood oxygen saturation level at a particular depth of tissue which readily compensates for limitations induced in the prior art systems. Specifically, the present invention allows for pulsed oximetry measurement which isolates arterial saturation levels for particular ranges of tissue layers which rejects saturation levels of the tissue above or below the tissue of interest by utilizing multiple spaced detectors and/or emitters. According to one embodiment of the invention, a sensor for use with a pulse oximeter monitor comprises a patient interface housing for coupling to a patient; at least three sensor areas for emitting electromagnetic radiation which penetrates tissue of the patient and detects that electromagnetic radiation scattered by the tissue, a spacing between a first pair of electromagnetic emitter and electromagnetic detector being different than that of a spacing between a second pair of electromagnetic emitter and electromagnetic detector; and means for calculating an arterial oxygen saturation level of the patient in response to the detected electromagnetic radiation. Mannheimer at 1:64-2:18. FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently.

’455 Patent	Mannheimer
	Mannheimer at 02:65-03:09  FIG. 1 A Mannheimer at Fig. 1A FIG. 2 is a perspective view of the preferred mode of patient interface device 26 employing the present invention. Planar surface 28 is placed into contact with the skin of the patient during monitoring and measurement. If desirable, this position may be maintained via adhesive or other mechanical means known in the art. Further, if desirable, surface 28 may have a curvature, and may be either flexible or rigid. Mannheimer at 05:63-06:03  FIG. 2 Mannheimer at Fig. 2

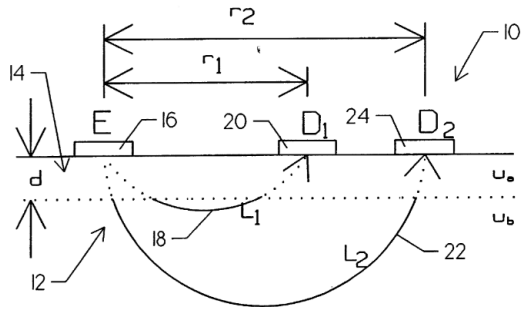
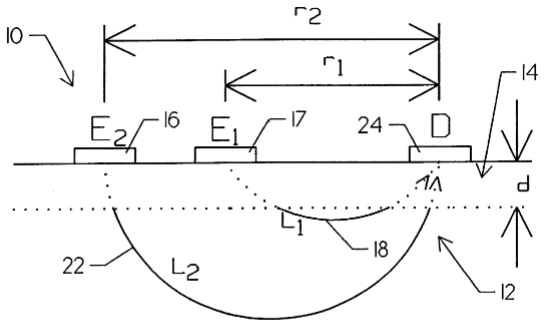
’455 Patent	Mannheimer
	FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired. As previously described, if deep tissue properties are desired, CPU 48 calculates R using equation 8 and Sp O2 using equation 11 with constants $\beta_{red},\lambda 2,\beta_{red},\lambda 1,\beta_{oxy},\lambda 1$, and $\beta_{oxy},\lambda 2$ being stored in CPU memory, having been previously determined empirically. If shallow tissue properties are desired, CPU 48 calculates R using equation 15 and Sp O2 using equation 11. According to a preferred embodiment, CPU 48 identifies and qualifies arterial pulses from the signals D1, λ1 ; D1, λ2 ; D2, λ1, D2, λ2 using any of the signal processing techniques described in U.S. Pat. Nos. 4,869,254; 5,078,136; 4,911,167; 4,934,372; 4,802,486; and 4,928,692, the disclosures of which are all incorporated herein by reference. Mannheimer at 06:17-49 The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly, the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 07:08-17 Each different emitter/detector spacing pair could be used to calculate an oxygen saturation using different pulse oximetry signal processing methodologies as disclosed, and these multiple saturation

’455 Patent	Mannheimer
	values could be processed to image the tissue layers beneath the sensor areas or to reveal other desired information regarding these tissue layers. Mannheimer at 07:52-58  FIG. 4 Mannheimer at Fig. 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[a]. a wearable device adapted to be placed on	Mannheimer discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user.

’455 Patent	Mannheimer
teeth, a wrist, or an ear of a user,	According to one embodiment of the invention, a sensor for use with a pulse oximeter monitor comprises a patient interface housing for coupling to a patient; at least three sensor areas for emitting electromagnetic radiation which penetrates tissue of the patient and detects that electromagnetic radiation scattered by the tissue, a spacing between a first pair of electromagnetic emitter and electromagnetic detector being different than that of a spacing between a second pair of electromagnetic emitter and electromagnetic detector; and means for calculating an arterial oxygen saturation level of the patient in response to the detected electromagnetic radiation. Mannheimer at 02:07-18 During the time that planar surface 28 is in position, emitter 16, detector 20, and detector 24 are in direct contact with the skin of the patient (see also FIG. 1). The spacing of emitter 16, detector 20, and detector 24 are as previously discussed. Mannheimer at 06:04-08 FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 02:65-03:09

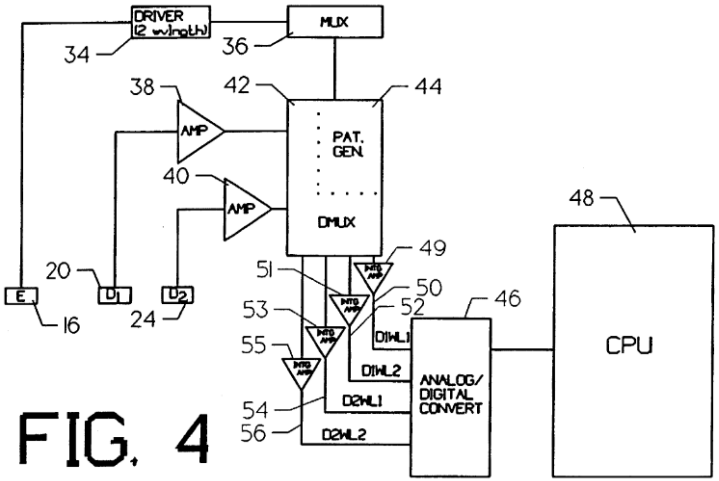
’455 Patent	Mannheimer
	 FIG. 1 A Mannheimer at Fig. 1A FIG. 2 is a perspective view of the preferred mode of patient interface device 26 employing the present invention. Planar surface 28 is placed into contact with the skin of the patient during monitoring and measurement. If desirable, this position may be maintained via adhesive or other mechanical means known in the art. Further, if desirable, surface 28 may have a curvature, and may be either flexible or rigid. Mannheimer at 05:63-06:03  FIG. 2 Mannheimer at Fig. 2

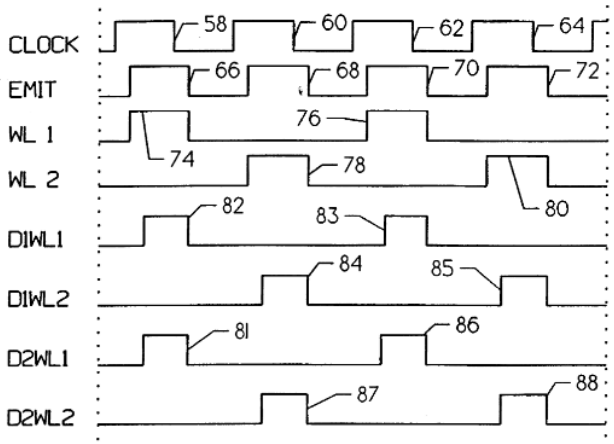
’455 Patent	Mannheimer
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	Mannheimer discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. The present invention overcomes the disadvantages found in the prior art by providing a pulse oximetry system for the determination of arterial blood oxygen saturation level at a particular depth of tissue which readily compensates for limitations induced in the prior art systems. Specifically, the present invention allows for pulsed oximetry measurement which isolates arterial saturation levels for particular ranges of tissue layers which rejects saturation levels of the tissue above or below the tissue of interest by utilizing multiple spaced detectors and/or emitters. According to one embodiment of the invention, a sensor for use with a pulse oximeter monitor comprises a patient interface housing for coupling to a patient; at least three sensor areas for emitting electromagnetic radiation which penetrates tissue of the patient and detects that electromagnetic radiation scattered by the tissue, a spacing between a first pair of electromagnetic emitter and electromagnetic detector being different than that of a spacing between a second pair of electromagnetic emitter and electromagnetic detector; and means for calculating an arterial oxygen saturation level of the patient in response to the detected electromagnetic radiation. According to two preferred embodiments, the sensor areas comprise first and second separated and spaced apart emitter areas each capable of generating light of at least two distinct wavelengths, and a detector, the first emitter area and the detector corresponding to a first pair of emitter and detector, the second emitter area and the detector corresponding to the second pair of emitter and detector; or the sensor areas comprise first and second detector areas each capable of detecting light of at least two separate wavelength values, and an emitter area capable of generating said light having the at least two separated wavelength values. Mannheimer at 01:64-02:30

’455 Patent	Mannheimer
	FIG. 1A is a schematic diagram showing the basic principles of the present invention using a single emitter and multiple detectors; FIG. 1B shows an alternative approach using multiple emitters and a single detector; Mannheimer at 02:40-45  FIG. 1 A Mannheimer at Fig. 1A  FIG. 1 B Mannheimer at Fig. 1B

’455 Patent	Mannheimer
	FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 02:65-03:09 According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 03:10-22 During the time that planar surface 28 is in position, emitter 16, detector 20, and detector 24 are in direct contact with the skin of the patient (see also FIG. 1). The spacing of emitter 16, detector 20, and detector 24 are as previously discussed. Wiring, not shown in this view, electrically couples emitter 16, detector 20, and detector 24 to the circuitry which performs the monitoring functions. Mannheimer at 06:04-11 FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as

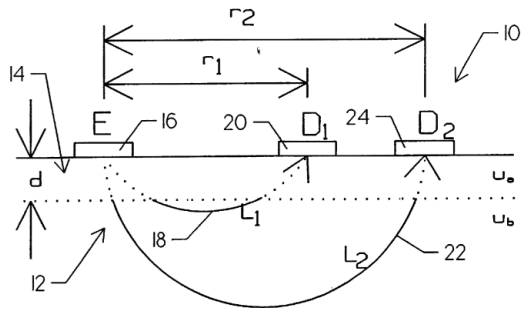
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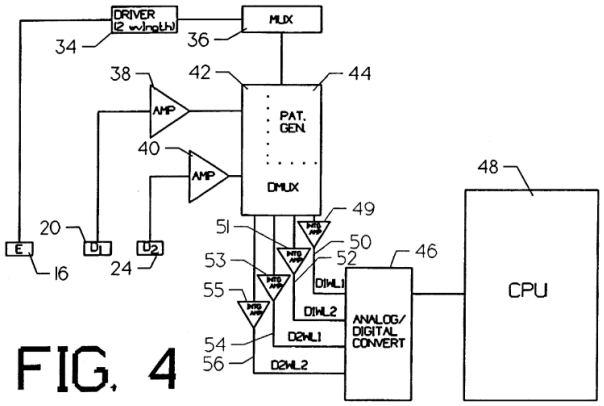
’455 Patent	Mannheimer
	to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired Mannheimer at 06:17-36  FIG. 4 Mannheimer at Fig. 4 FIG. 5 is a timing diagram for the apparatus of FIG. 4. The clock signal, containing pulses 58, 60, 62, and 64, is produced by Pattern Generator 44 (see also FIG. 4). The clock pulses are preferably produced at a rate of about 1600 hz. Each of the clock pulses triggers an output of emitter 16 as shown by pulses 66, 68, 70, and 72. The first wavelength is emitted twice corresponding to timing signals 74 and 76. Thereafter, the second wavelength is emitted twice corresponding to timing signals 78 and 80. Mannheimer at 06:66-07:07

’455 Patent	Mannheimer
	 FIG. 5 Mannheimer at Fig. 5 FIG. 6 is a graphical representation of the absorptivities of the various saturation levels of arterial blood as a function of wavelength of emitter 16. The wavelengths preferred in the instant invention are about 660 nm and about 905 nm. However, those of skill in the art will readily appreciate that the present invention may be satisfactorily practiced using other wavelengths. Mannheimer at 07:18-24 Though the invention has been primarily described by reference to an apparatus having a single emitter area 16 which emits light of at least two differing and known wavelengths, and first and second separated detector areas 20, 24, it will be appreciated that the three sensor areas could also be achieved by having a single detector area and first and second separated emitter areas, each of which emit light at first and second differing and known wavelengths, as illustrated in FIG. 1B. According to a preferred embodiment, the signals are transmitted by the emitters and detected by the detectors using standard time signal multiplex techniques, though other signal multiplex techniques could alternately be used if desired (e.g. frequency multiplex). In addition, increased resolution between differing tissue layers is achievable

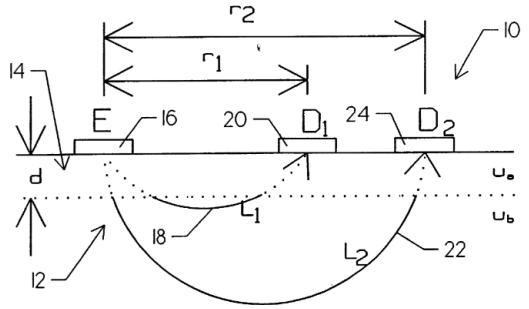
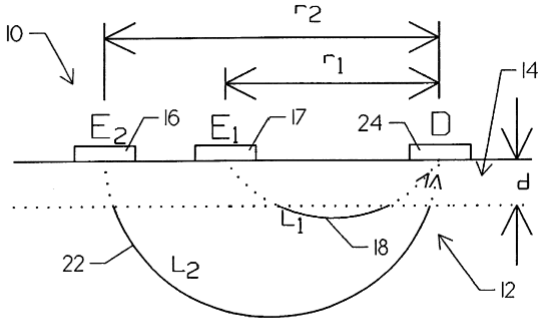
’455 Patent	Mannheimer
	if increased number of sensor areas is utilized. For example, a half dozen or more detector areas could be utilized in combination with a single emitter area, or half dozen or more dual wavelength emitter areas could be utilized in combination with a single detector area. In addition, the sensor areas could be aligned in a linear array, either straight or curved, or could be disposed in a two-dimensional array. Each different emitter/detector spacing pair could be used to calculate an oxygen saturation using different pulse oximetry signal processing methodologies as disclosed, and these multiple saturation values could be processed to image the tissue layers beneath the sensor areas or to reveal other desired information regarding these tissue layers. Mannheimer at 07:31-58 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. the 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;	Mannheimer discloses or renders obvious the 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 FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 02:65-03:09

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	 FIG. 1 A Mannheimer at Fig. 1A According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 03:10-22 FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation.

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	A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired Mannheimer at 06:17-36  FIG. 4 Mannheimer at Fig. 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. the wearable device further comprising a detection system configured to receive at least a portion	Mannheimer discloses or renders obvious the wearable device further comprising 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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of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	The present invention overcomes the disadvantages found in the prior art by providing a pulse oximetry system for the determination of arterial blood oxygen saturation level at a particular depth of tissue which readily compensates for limitations induced in the prior art systems. Specifically, the present invention allows for pulsed oximetry measurement which isolates arterial saturation levels for particular ranges of tissue layers which rejects saturation levels of the tissue above or below the tissue of interest by utilizing multiple spaced detectors and/or emitters. According to one embodiment of the invention, a sensor for use with a pulse oximeter monitor comprises a patient interface housing for coupling to a patient; at least three sensor areas for emitting electromagnetic radiation which penetrates tissue of the patient and detects that electromagnetic radiation scattered by the tissue, a spacing between a first pair of electromagnetic emitter and electromagnetic detector being different than that of a spacing between a second pair of electromagnetic emitter and electromagnetic detector; and means for calculating an arterial oxygen saturation level of the patient in response to the detected electromagnetic radiation. According to two preferred embodiments, the sensor areas comprise first and second separated and spaced apart emitter areas each capable of generating light of at least two distinct wavelengths, and a detector, the first emitter area and the detector corresponding to a first pair of emitter and detector, the second emitter area and the detector corresponding to the second pair of emitter and detector; or the sensor areas comprise first and second detector areas each capable of detecting light of at least two separate wavelength values, and an emitter area capable of generating said light having the at least two separated wavelength values. Mannheimer at 01:64-02:30 FIG. 1A is a schematic diagram showing the basic principles of the present invention using a single emitter and multiple detectors; FIG. 1B shows an alternative approach using multiple emitters and a single detector; Mannheimer at 02:40-45

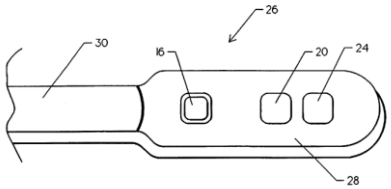
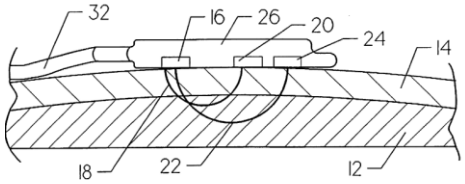
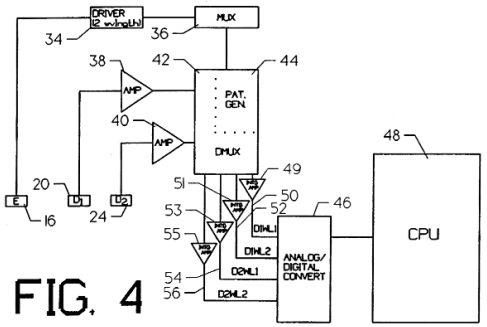
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	 FIG. 1 A Mannheimer at Fig. 1A  FIG. 1 B Mannheimer at Fig. 1B FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or

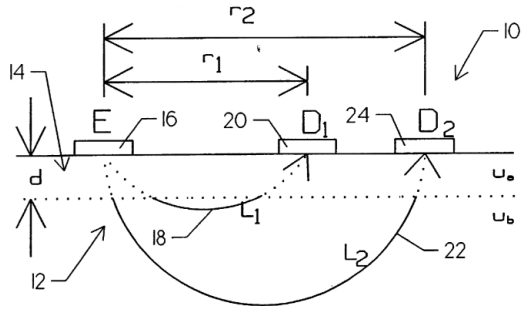
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	surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 02:65-03:09 According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 03:10-22 Detector 20 is spaced a distance of r1 from emitter 16 and detector 24 is spaced at a distance of r2. As can be seen in the drawing, both path 18 and path 22 traverse skin layer 14 twice. Furthermore, because paths 18 and 22 traverse skin layer 14 using approximately the same angle, the primary difference between paths 22 and 18 is the difference between length L2 and length L1 traversing subdermal layer 12, which is the tissue layer of interest. Therefore, it can be assumed that the difference in absorption between path L2 and path L1 is directly attributable to subdermal layer 12, the tissue layer of interest, corresponding to the different spacings r2 and r1. The path length through skin layer 12 may be represented by l and the deeper path through the subdermal tissue by L1 and L2, depending on which detector is considered. Note that multiple emitters may transmit to a single detector as discussed below in relation to FIG. 1B. Mannheimer at 03:23-40 This result differs from the conventional single detector pulse oximetry algorithm in that the skin layer signals are excluded from the measurement, regardless if the skin pulses or is non-pulsatile (e.g., vasoconstriction or exsanguination). Within the limitations of the assumptions made, as long as the upper skin layer does not create a shunt, and the deeper layer continues to pulse, this algorithm gives a result related only to the arterial blood saturation of the deeper tissue. Mannheimer at 05:01-09

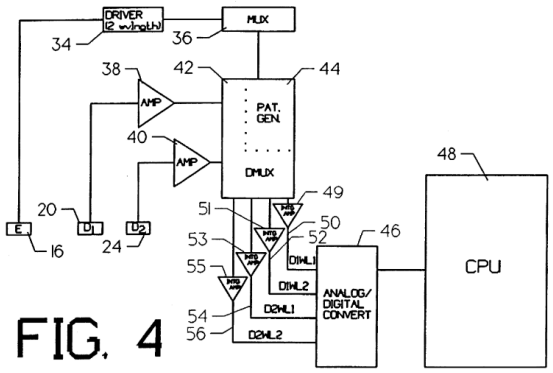
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	The separation of the first emitter/detector pair 16,20 (i.e. r1) and the second emitter/detector pair 16,24 (i.e. r2) should be larger than several times the skin thickness (i.e. r1,r2 much greater than d) so that the four occurrences of are all approximately equal, or at least have equivalent counterparts influencing the two detectors. The detector separation from the emitter should also be large enough to probe "deep" enough, the probed depth somewhat less than the separation. The two detectors should not be too far separated from one another, however, or else the assumption of equivalent skin thickness may be violated. If the detectors are too close to each other, ΔL becomes 0 and the measurement becomes unstable (see equation 9). Mannheimer at 05:10-22 FIG. 2 is a perspective view of the preferred mode of patient interface device 26 employing the present invention. Planar surface 28 is placed into contact with the skin of the patient during monitoring and measurement. If desirable, this position may be maintained via adhesive or other mechanical means known in the art. Further, if desirable, surface 28 may have a curvature, and may be either flexible or rigid. During the time that planar surface 28 is in position, emitter 16, detector 20, and detector 24 are in direct contact with the skin of the patient (see also FIG. 1). The spacing of emitter 16, detector 20, and detector 24 are as previously discussed. Wiring, not shown in this view, electrically couples emitter 16, detector 20, and detector 24 to the circuitry which performs the monitoring functions. FIG. 3 is a partially sectioned view showing patient interface device 26 in operational position. Cable 32 conducts the electrical signals to and from the monitoring circuitry as described below. All other elements are as previously described. FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital

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	Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired. Mannheimer at 05:63-6:36 The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly, the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 07:08-17 Though the invention has been primarily described by reference to an apparatus having a single emitter area 16 which emits light of at least two differing and known wavelengths, and first and second separated detector areas 20, 24, it will be appreciated that the three sensor areas could also be achieved by having a single detector area and first and second separated emitter areas, each of which emit light at first and second differing and known wavelengths, as illustrated in FIG. 1B. According to a preferred embodiment, the signals are transmitted by the emitters and detected by the detectors using standard time signal multiplex techniques, though other signal multiplex techniques could alternately be used if desired (e.g. frequency multiplex). In addition, increased resolution between differing tissue layers is achievable if increased number of sensor areas is utilized. For example, a half dozen or more detector areas could be utilized in combination with a single emitter area, or half dozen or more dual wavelength emitter areas could be utilized in combination with a single detector area. In addition, the sensor areas could be aligned in a linear array, either straight or curved, or could be disposed in a two-dimensional array. Each different emitter/detector spacing pair could be used to calculate an oxygen saturation using different pulse oximetry signal processing methodologies as disclosed, and these multiple saturation values could be processed to image the tissue layers beneath the sensor areas or to reveal other desired information regarding these tissue layers. Mannheimer at 07:31-58

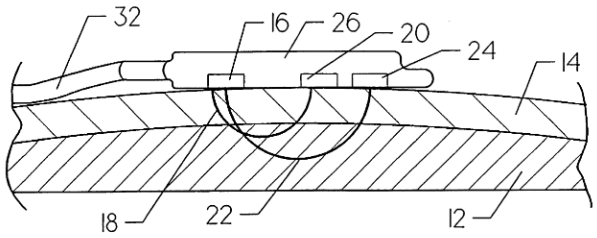
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	 FIG. 2 Mannheimer at Fig.2  FIG. 3 Mannheimer at Fig.3  FIG. 4 Mannheimer at Fig.4 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken 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

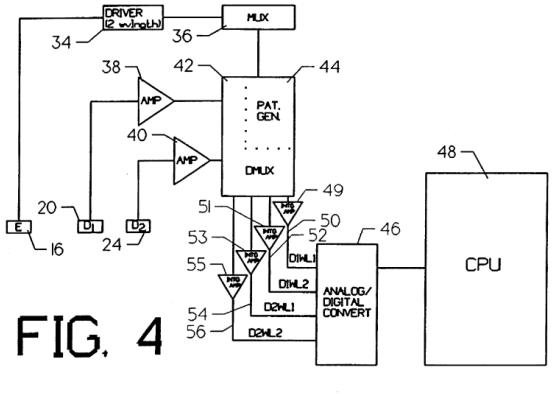
’455 Patent	Mannheimer
	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. wherein the detection system is configured to be synchronized to the light source;	Mannheimer discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 02:65-03:09  FIG. 1 A Mannheimer at Fig. 1A According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different

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	predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 03:10-22 FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired Mannheimer at 06:17-36  FIG. 4

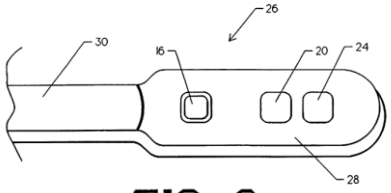
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	Mannheimer at Fig. 4 1. An apparatus comprising: a. a patient interface adapted to be coupled to a patient; b. an emitter of electromagnetic radiation coupled to said patient interface; c. a first detector coupled to said patient interface at a first distance from said emitter; d. a second detector coupled to said patient interface at a second distance from said emitter; e. means for synchronizing an oxygen saturation measurement to a predetermined portion of a cardiac cycle of said patient; and f. means coupled to said first and said second detectors and said synchronizer for computing an oxygen saturation level of arterial blood of said patient, at a predetermined tissue level of interest, with an algorithm that filters out pulsatile signal contributions from a second predetermined tissue level. Mannheimer 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. 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 spatially separated detectors;	Mannheimer 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 spatially separated detectors. The separation of the first emitter/detector pair 16,20 (i.e. r1) and the second emitter/detector pair 16,24 (i.e. r2) should be larger than several times the skin thickness (i.e. r1,r2 much greater than d) so that the four occurrences of are all approximately equal, or at least have equivalent counterparts influencing the two detectors. The detector separation from the emitter should also be large enough to probe "deep" enough, the probed depth somewhat less than the separation. The two detectors should not be too far

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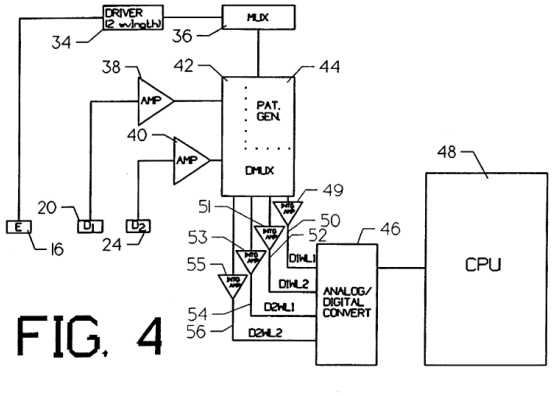
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	separated from one another, however, or else the assumption of equivalent skin thickness may be violated. If the detectors are too close to each other, ΔL becomes 0 and the measurement becomes unstable (see equation 9). Mannheimer at 05:10-22  FIG. 3 Mannheimer at Fig. 3 According to two preferred embodiments, the sensor areas comprise first and second separated and spaced apart emitter areas each capable of generating light of at least two distinct wavelengths, and a detector, the first emitter area and the detector corresponding to a first pair of emitter and detector, the second emitter area and the detector corresponding to the second pair of emitter and detector; or the sensor areas comprise first and second detector areas each capable of detecting light of at least two separate wavelength values, and an emitter area capable of generating said light having the at least two separated wavelength values. Mannheimer at 02:19-30 According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24

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	as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 03:10-22 FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired Mannheimer at 06:17-36  FIG. 4 Mannheimer at Fig. 4

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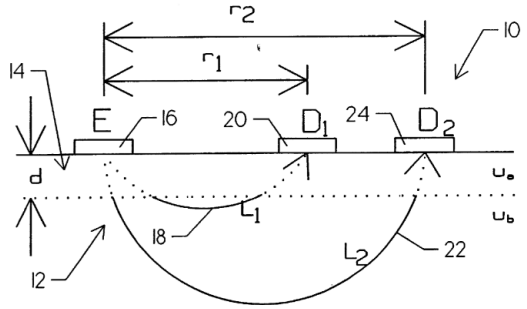
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	The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly, the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 07:08-17 Though the invention has been primarily described by reference to an apparatus having a single emitter area 16 which emits light of at least two differing and known wavelengths, and first and second separated detector areas 20, 24, it will be appreciated that the three sensor areas could also be achieved by having a single detector area and first and second separated emitter areas, each of which emit light at first and second differing and known wavelengths, as illustrated in FIG. 1B. According to a preferred embodiment, the signals are transmitted by the emitters and detected by the detectors using standard time signal multiplex techniques, though other signal multiplex techniques could alternately be used if desired (e.g. frequency multiplex). In addition, increased resolution between differing tissue layers is achievable if increased number of sensor areas is utilized. For example, a half dozen or more detector areas could be utilized in combination with a single emitter area, or half dozen or more dual wavelength emitter areas could be utilized in combination with a single detector area. In addition, the sensor areas could be aligned in a linear array, either straight or curved, or could be disposed in a two-dimensional array. Each different emitter/detector spacing pair could be used to calculate an oxygen saturation using different pulse oximetry signal processing methodologies as disclosed, and these multiple saturation values could be processed to image the tissue layers beneath the sensor areas or to reveal other desired information regarding these tissue layers. Mannheimer at 07:31-58  FIG. 2

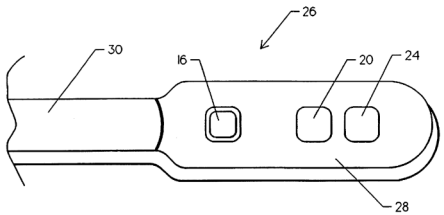
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	Mannheimer at Fig.2 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Mannheimer discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired

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	Mannheimer at 06:17-36  FIG. 4 Mannheimer at Fig. 4 As previously described, if deep tissue properties are desired, CPU 48 calculates R using equation 8 and Sp O2 using equation 11 with constants $\beta_{red},\lambda 2,\beta_{red},\lambda 1,\beta_{oxy},\lambda 1$, and $\beta_{oxy},\lambda 2$ being stored in CPU memory, having been previously determined empirically. If shallow tissue properties are desired, CPU 48 calculates R using equation 15 and Sp O2 using equation 11. According to a preferred embodiment, CPU 48 identifies and qualifies arterial pulses from the signals D1, λ1 ; D1, λ2 ; D2, λ1, D2, λ2 using any of the signal processing techniques described in U.S. Pat. Nos. 4,869,254; 5,078,136; 4,911,167; 4,934,372; 4,802,486; and 4,928,692, the disclosures of which are all incorporated herein by reference. Mannheimer at 06:37-49 The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly, the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 07:08-17

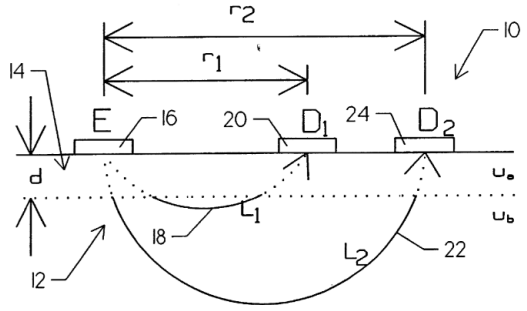
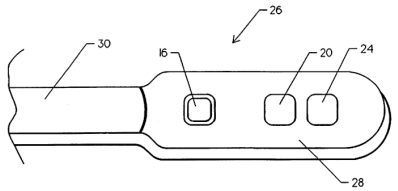
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, 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 one or more of the physiological parameters;	Mannheimer discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. The present invention generally relates to instruments which operate on the principal of pulse oximetry and more particularly relates to instruments which non-invasively measure oxygen saturation of arterial blood in vivo. Mannheimer at 01:10-13 The present invention overcomes the disadvantages found in the prior art by providing a pulse oximetry system for the determination of arterial blood oxygen saturation level at a particular depth of tissue which readily compensates for limitations induced in the prior art systems. Specifically, the present invention allows for pulsed oximetry measurement which isolates arterial saturation levels for particular ranges of tissue layers which rejects saturation levels of the tissue above or below the tissue of interest by utilizing multiple spaced detectors and/or emitters. According to one embodiment of the invention, a sensor for use with a pulse oximeter monitor comprises a patient interface housing for coupling to a patient; at least three sensor areas for emitting electromagnetic radiation which penetrates tissue of the patient and detects that electromagnetic radiation scattered by the tissue, a spacing between a first pair of electromagnetic emitter and electromagnetic detector being different than that of a spacing between a second pair of electromagnetic emitter and electromagnetic detector; and means for calculating an arterial oxygen saturation level of the patient in response to the detected electromagnetic radiation. Mannheimer at 01:64-02:18

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	FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 02:65-03:09  FIG. 1 A Mannheimer at Fig. 1A FIG. 2 is a perspective view of the preferred mode of patient interface device 26 employing the present invention. Planar surface 28 is placed into contact with the skin of the patient during monitoring and measurement. If desirable, this position may be maintained via adhesive or other mechanical means known in the art. Further, if desirable, surface 28 may have a curvature, and may be either flexible or rigid. Mannheimer at 05:63-06:03

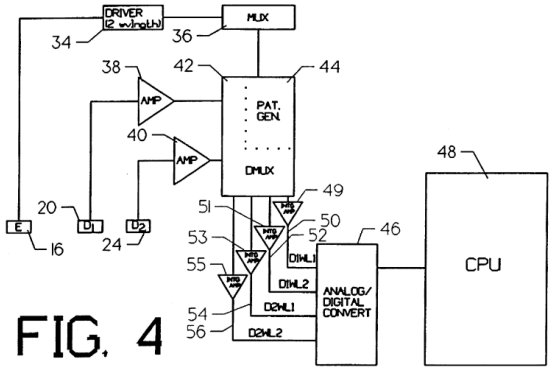
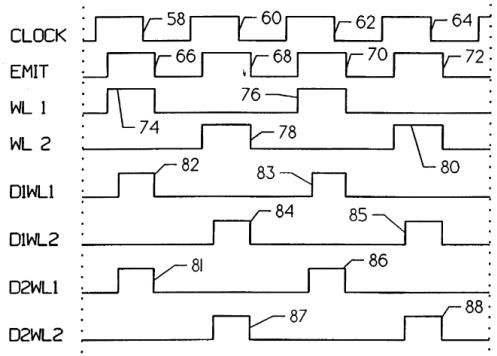
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	 FIG. 2 Mannheimer at Fig. 2 FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired. As previously described, if deep tissue properties are desired, CPU 48 calculates R using equation 8 and Sp O2 using equation 11 with constants $\beta_{red},\lambda 2,\beta_{red},\lambda 1,\beta_{oxy},\lambda 1$, and $\beta_{oxy},\lambda 2$ being stored in CPU memory, having been previously determined empirically. If shallow tissue properties are desired, CPU 48 calculates R using equation 15 and Sp O2 using equation 11. According to a preferred embodiment, CPU 48 identifies and qualifies arterial pulses from the signals D1, $\lambda 1$; D1, $\lambda 2$; D2, $\lambda 1$, D2, $\lambda 2$ using any of the signal processing techniques described in U.S. Pat. Nos. 4,869,254; 5,078,136; 4,911,167; 4,934,372; 4,802,486; and 4,928,692, the disclosures of which are all incorporated herein by reference. Mannheimer at 06:17-49

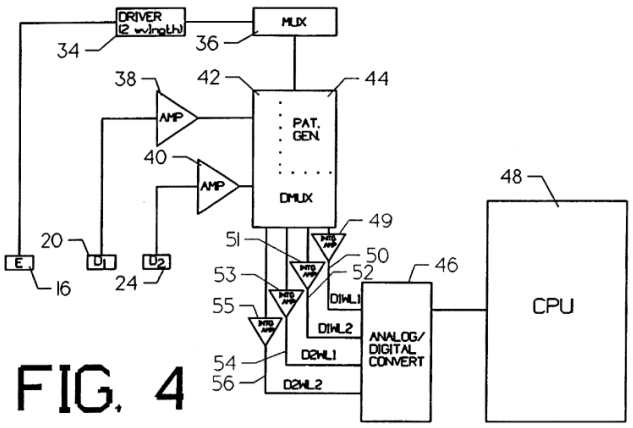
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	The signal from the first wavelength as received by detector 20 is gated to Analog/Digital converter 46 by DMUX 42 via line 50 during times 82 and 83. The signal produced by the first wavelength as received by detector 24 is gated over line 54 at times 81 and 86. Similarly, the signal from the second wavelength emission is gated over lines 52 and 54 from detectors 20 and 24 at times 84 and 85, and times 87 and 88, respectively. The received signals are converted to digital form and transferred to CPU 48 for calculation of the oxygen saturation level. Mannheimer at 07:08-17 Each different emitter/detector spacing pair could be used to calculate an oxygen saturation using different pulse oximetry signal processing methodologies as disclosed, and these multiple saturation values could be processed to image the tissue layers beneath the sensor areas or to reveal other desired information regarding these tissue layers. Mannheimer at 07:52-58 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. 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;	Mannheimer discloses or renders obvious 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. FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or

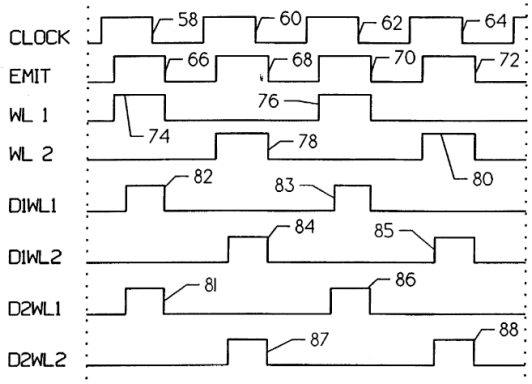
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	surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 02:65-03:09  FIG. 1 A Mannheimer at Fig. 1A FIG. 2 is a perspective view of the preferred mode of patient interface device 26 employing the present invention. Planar surface 28 is placed into contact with the skin of the patient during monitoring and measurement. If desirable, this position may be maintained via adhesive or other mechanical means known in the art. Further, if desirable, surface 28 may have a curvature, and may be either flexible or rigid. Mannheimer at 05:63-06:03  FIG. 2 Mannheimer at Fig. 2

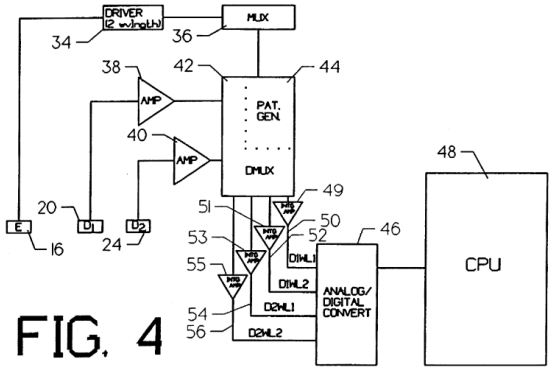
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	This result differs from the conventional single detector pulse oximetry algorithm in that the skin layer signals are excluded from the measurement, regardless if the skin pulses or is non-pulsatile (e.g., vasoconstriction or exsanguination). Within the limitations of the assumptions made, as long as the upper skin layer does not create a shunt, and the deeper layer continues to pulse, this algorithm gives a result related only to the arterial blood saturation of the deeper tissue. Mannheimer at 05:01-09 determining a blood characteristic level, at a predetermined tissue level of interest, with an algorithm that filters out pulsatile signal contributions from a second predetermined tissue level, using the intensities of the first wavelength measured at the first detector and the second detector, using the intensities of the second wavelength measured at the first detector and the second detector, and rejecting blood characteristic level of venous blood of the patient. Mannheimer at 10:07-15 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, 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 semiconductor sources are off,	Mannheimer discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off. FIG. 5 is a timing diagram for the apparatus of FIG. 4. The clock signal, containing pulses 58, 60, 62, and 64, is produced by Pattern Generator 44 (see also FIG. 4). The clock pulses are preferably produced at a rate of about 1600 hz. Each of the clock pulses triggers an output of emitter 16 as shown by pulses 66, 68, 70, and 72. The first wavelength is emitted twice corresponding to timing signals 74 and 76. Thereafter, the second wavelength is emitted twice corresponding to timing signals 78 and 80. Mannheimer at 06:66-07:07

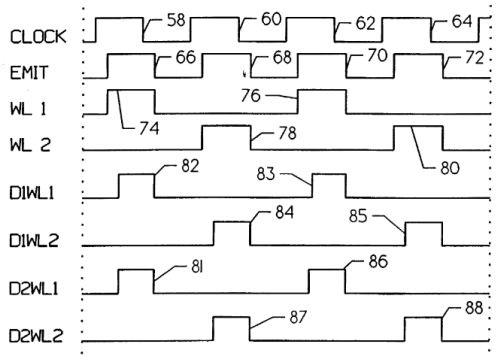
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	 FIG. 4 Mannheimer at Fig. 4  FIG. 5 Mannheimer at Fig. 5 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

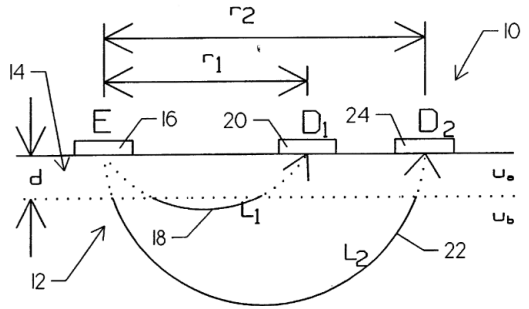
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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, 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 semiconductor sources is on; and	Mannheimer discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on; and. FIG. 5 is a timing diagram for the apparatus of FIG. 4. The clock signal, containing pulses 58, 60, 62, and 64, is produced by Pattern Generator 44 (see also FIG. 4). The clock pulses are preferably produced at a rate of about 1600 hz. Each of the clock pulses triggers an output of emitter 16 as shown by pulses 66, 68, 70, and 72. The first wavelength is emitted twice corresponding to timing signals 74 and 76. Thereafter, the second wavelength is emitted twice corresponding to timing signals 78 and 80. Mannheimer at 06:66-07:07  FIG. 4 Mannheimer at Fig. 4

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	 FIG. 5 Mannheimer at Fig. 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, 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	Mannheimer discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. This result differs from the conventional single detector pulse oximetry algorithm in that the skin layer signals are excluded from the measurement, regardless if the skin pulses or is non-pulsatile (e.g., vasoconstriction or exsanguination). Within the limitations of the assumptions made, as long as the upper

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	skin layer does not create a shunt, and the deeper layer continues to pulse, this algorithm gives a result related only to the arterial blood saturation of the deeper tissue. Mannheimer at 05:01-09 FIG. 5 is a timing diagram for the apparatus of FIG. 4. The clock signal, containing pulses 58, 60, 62, and 64, is produced by Pattern Generator 44 (see also FIG. 4). The clock pulses are preferably produced at a rate of about 1600 hz. Each of the clock pulses triggers an output of emitter 16 as shown by pulses 66, 68, 70, and 72. The first wavelength is emitted twice corresponding to timing signals 74 and 76. Thereafter, the second wavelength is emitted twice corresponding to timing signals 78 and 80. Mannheimer at 06:66-07:07  FIG. 4 Mannheimer at Fig. 4

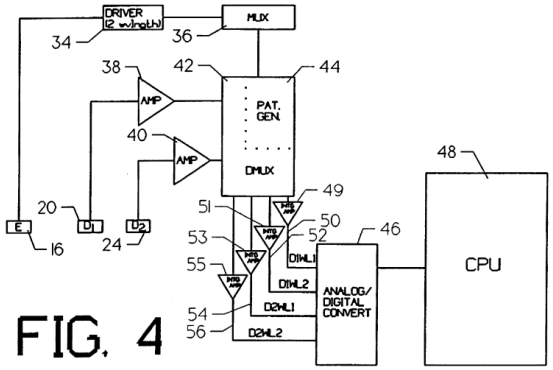
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	 FIG. 5 Mannheimer at Fig. 5 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one	Mannheimer discloses or renders obvious wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.

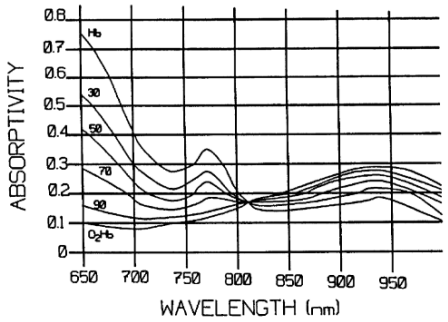
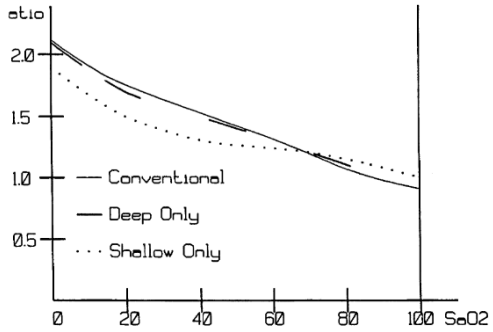
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or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Light in the visible and near infrared region of the electromagnetic spectrum has been used for the in vivo measurement of oxygen saturation levels of a patient's blood. Lewis et al. in U.S. Pat. No. 5,139,025 and Lewis et al. in International Publication (PCT) Number WO 92/21283 discuss spectrophotometric instruments whereby the oxygen saturation of blood, both venous and arterial combined, is estimated using at least three electromagnetic sensor areas. A disadvantage of such instruments is that the accuracy of the oxygen saturation calculation is limited due to such calculation's sensitivity to varying parameters of the tissue other than blood saturation, for example a change in concentration. Rall, et al, in German Patent No. DE 43 04 693 teaches the use of a plurality of light sensors with a single light detector as the best means for oximetry measurement in the particular shape of the device of the invention, primarily intended for connection to a fetus. Mannheimer at 01:15-29 FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 02:65-03:09  FIG. 1 A Mannheimer at Fig. 1A

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	According to two preferred embodiments, the sensor areas comprise first and second separated and spaced apart emitter areas each capable of generating light of at least two distinct wavelengths, and a detector, the first emitter area and the detector corresponding to a first pair of emitter and detector, the second emitter area and the detector corresponding to the second pair of emitter and detector; or the sensor areas comprise first and second detector areas each capable of detecting light of at least two separate wavelength values, and an emitter area capable of generating said light having the at least two separated wavelength values. Mannheimer at 02:19-30 FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired Mannheimer at 06:17-36

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	 FIG. 4 Mannheimer at Fig. 4 FIG. 6 is a graph of absorptivity vs. wavelength for various different oxygen saturation levels within the range of operation of the present invention; and FIG. 7 is a graph comprising calculated oxygen saturation values using the principles of the invention for deep and shallow tissue measurements, and values obtained without using the principles of the invention. Mannheimer at 06:56-65

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	 FIG. 6  FIG. 7 Mannheimer at Fig. 6 & Fig. 7 Though the invention has been primarily described by reference to an apparatus having a single emitter area 16 which emits light of at least two differing and known wavelengths, and first and second separated detector areas 20, 24, it will be appreciated that the three sensor areas could also be achieved by having a single detector area and first and second separated emitter areas, each of which emit light at first and

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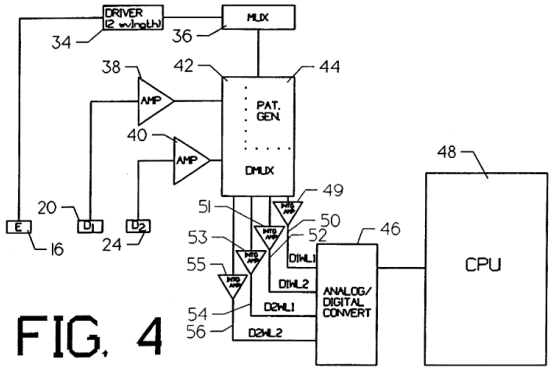
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	second differing and known wavelengths, as illustrated in FIG. 1B. According to a preferred embodiment, the signals are transmitted by the emitters and detected by the detectors using standard time signal multiplex techniques, though other signal multiplex techniques could alternately be used if desired (e.g. frequency multiplex). In addition, increased resolution between differing tissue layers is achievable if increased number of sensor areas is utilized. For example, a half dozen or more detector areas could be utilized in combination with a single emitter area, or half dozen or more dual wavelength emitter areas could be utilized in combination with a single detector area. In addition, the sensor areas could be aligned in a linear array, either straight or curved, or could be disposed in a two-dimensional array. Each different emitter/detector spacing pair could be used to calculate an oxygen saturation using different pulse oximetry signal processing methodologies as disclosed, and these multiple saturation values could be processed to image the tissue layers beneath the sensor areas or to reveal other desired information regarding these tissue layers. Mannheimer at 07:31-58 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors	See claim 1 above. Mannheimer discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. Light in the visible and near infrared region of the electromagnetic spectrum has been used for the in vivo measurement of oxygen saturation levels of a patient's blood. Lewis et al. in U.S. Pat. No. 5,139,025 and Lewis et al. in International Publication (PCT) Number WO 92/21283 discuss spectrophotometric

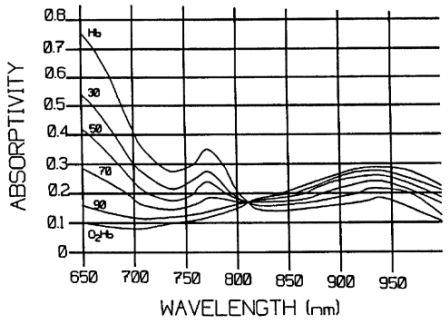
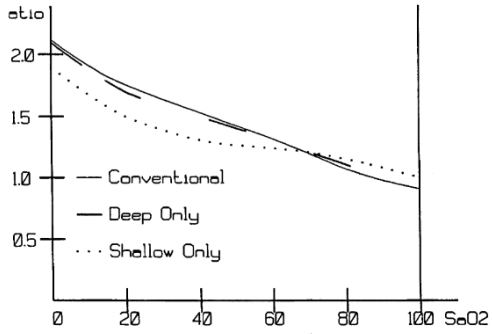
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are located on one or more arcs.	instruments whereby the oxygen saturation of blood, both venous and arterial combined, is estimated using at least three electromagnetic sensor areas. A disadvantage of such instruments is that the accuracy of the oxygen saturation calculation is limited due to such calculation's sensitivity to varying parameters of the tissue other than blood saturation, for example a change in concentration. Rall, et al, in German Patent No. DE 43 04 693 teaches the use of a plurality of light sensors with a single light detector as the best means for oximetry measurement in the particular shape of the device of the invention, primarily intended for connection to a fetus. Mannheimer at 01:15-29 According to two preferred embodiments, the sensor areas comprise first and second separated and spaced apart emitter areas each capable of generating light of at least two distinct wavelengths, and a detector, the first emitter area and the detector corresponding to a first pair of emitter and detector, the second emitter area and the detector corresponding to the second pair of emitter and detector; or the sensor areas comprise first and second detector areas each capable of detecting light of at least two separate wavelength values, and an emitter area capable of generating said light having the at least two separated wavelength values. Mannheimer at 02:19-30 According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 03:10-22 The separation of the first emitter/detector pair 16,20 (i.e. r1) and the second emitter/detector pair 16,24 (i.e. r2) should be larger than several times the skin thickness (i.e. r1,r2 much greater than d) so that the four occurrences of are all approximately equal, or at least have equivalent counterparts influencing the

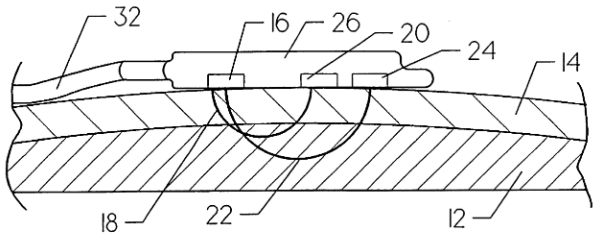
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	two detectors. The detector separation from the emitter should also be large enough to probe "deep" enough, the probed depth somewhat less than the separation. The two detectors should not be too far separated from one another, however, or else the assumption of equivalent skin thickness may be violated. If the detectors are too close to each other, ΔL becomes 0 and the measurement becomes unstable (see equation 9). Mannheimer at 05:10-22 FIG. 3 is a partially sectioned view showing patient interface device 26 in operational position. Cable 32 conducts the electrical signals to and from the monitoring circuitry as described below. All other elements are as previously described. FIG. 4 is a block diagram showing the entire monitoring and measurement system employing the present invention. According to a first preferred embodiment, multiplexer 36 and two wavelength driver 34 alternately turn on the red and infrared LED's 16 at a desired chop frequency (e.g. 1,600 hz). These red and infrared signals are detected by detectors 20 and 24 and amplified by current-to- voltage amplifiers 38 and 40. The outputs of transconductance amplifiers 38 and 40 are demultiplexed by DMUX 42 so as to generate a first and second wavelength signal for each of detectors D1 (20) and D2 (24), which generated signals are sent through integrating amplfiers 49, 51, 53 and 55 to be placed on, respectively, lines 50, 52, 54 and 56. These first and second wavelength signals are digitized by Analog/Digital Converter 46. The digitized signals are transmitted to CPU 48 for calculating arterial oxygen saturation. A preferred architectural implementation of the control electronics is disclosed in PCT/US94/03546, the disclosure of which is incorporated herein by reference. Alternate control electronics are known in the art and could be used, if desired Mannheimer at 06:12-36

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	 FIG. 4 Mannheimer at Fig. 4 FIG. 6 is a graph of absorptivity vs. wavelength for various different oxygen saturation levels within the range of operation of the present invention; and FIG. 7 is a graph comprising calculated oxygen saturation values using the principles of the invention for deep and shallow tissue measurements, and values obtained without using the principles of the invention. Mannheimer at 06:56-65

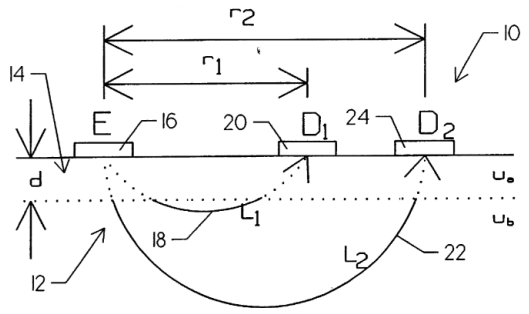
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	 FIG. 6  FIG. 7 Mannheimer at Fig. 6 & Fig. 7 Though the invention has been primarily described by reference to an apparatus having a single emitter area 16 which emits light of at least two differing and known wavelengths, and first and second separated detector areas 20, 24, it will be appreciated that the three sensor areas could also be achieved by having a single detector area and first and second separated emitter areas, each of which emit light at first and

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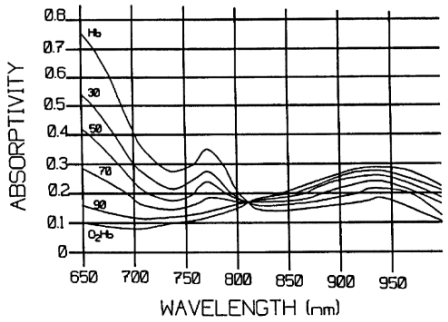
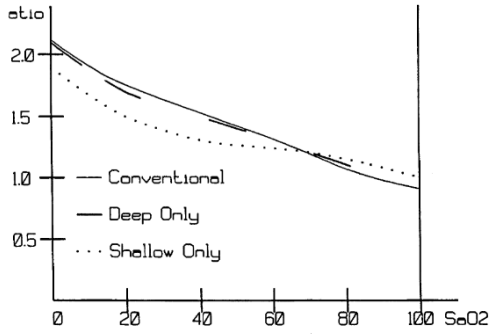
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	second differing and known wavelengths, as illustrated in FIG. 1B. According to a preferred embodiment, the signals are transmitted by the emitters and detected by the detectors using standard time signal multiplex techniques, though other signal multiplex techniques could alternately be used if desired (e.g. frequency multiplex). In addition, increased resolution between differing tissue layers is achievable if increased number of sensor areas is utilized. For example, a half dozen or more detector areas could be utilized in combination with a single emitter area, or half dozen or more dual wavelength emitter areas could be utilized in combination with a single detector area. In addition, the sensor areas could be aligned in a linear array, either straight or curved, or could be disposed in a two-dimensional array. Each different emitter/detector spacing pair could be used to calculate an oxygen saturation using different pulse oximetry signal processing methodologies as disclosed, and these multiple saturation values could be processed to image the tissue layers beneath the sensor areas or to reveal other desired information regarding these tissue layers. Mannheimer at 07:31-58  FIG. 3 Mannheimer 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of

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	Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	See claim 2 above. Mannheimer discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. The present invention overcomes the disadvantages found in the prior art by providing a pulse oximetry system for the determination of arterial blood oxygen saturation level at a particular depth of tissue which readily compensates for limitations induced in the prior art systems. Specifically, the present invention allows for pulsed oximetry measurement which isolates arterial saturation levels for particular ranges of tissue layers which rejects saturation levels of the tissue above or below the tissue of interest by utilizing multiple spaced detectors and/or emitters. Mannheimer at 01:64-02:06 FIG. 1A is a schematic diagram showing the principles of operation of the present invention. In this example, it is assumed desirable to measure the percentage of oxygen saturation within the arterial blood of patient 10 at subdermal tissue level 12 having light absorption properties ub. Interposed between the non-invasive monitoring and measurement system (not shown) and subdermal tissue level 12, is skin or surface tissue level 14 having light absorption properties ua. It is deemed desirable to measure arterial oxygen saturation in the tissue layer 12 or the tissue layer 14 independently. Mannheimer at 02:65-03:09

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	 FIG. 1 A Mannheimer at Fig. 1A According to a first preferred embodiment, emitter 16 transmits electromagnetic radiation in the visible and near infrared region at two predetermined wavelengths (e.g. 660 nm and 905 nm). Emitter 16 is shown as a single entity in this example. However, different emitters may be used for the different predetermined wavelengths, if desired. If more than one emitter is used, it is most convenient that they be co-located to simulate a single point source. LED's are a preferred type of emitter. The signals from emitter 16 travel generally along path 18 to a first detector 20 and along path 22 to a second detector 24 as shown. The length of path 18 within layer 12 (with absorption ub) is shown as L1 and the length of path 22 within layer 12 is shown as L2. Mannheimer at 03:10-22 FIG. 6 is a graph of absorptivity vs. wavelength for various different oxygen saturation levels within the range of operation of the present invention; and FIG. 7 is a graph comprising calculated oxygen saturation values using the principles of the invention for deep and shallow tissue measurements, and values obtained without using the principles of the invention. Mannheimer at 06:56-65

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	 FIG. 6  FIG. 7 Mannheimer at Fig. 6 & Fig. 7 FIG. 6 is a graphical representation of the absorptivities of the various saturation levels of arterial blood as a function of wavelength of emitter 16. The wavelengths preferred in the instant invention are about 660 nm and about 905 nm. However, those of skill in the art will readily appreciate that the present invention may be satisfactorily practiced using other wavelengths.

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	Mannheimer at 07:18-24 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mannheimer discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. The wearable device adapted to be placed on a wrist or an ear of a user,	Mannheimer discloses or renders obvious the wearable device adapted to be placed on a wrist or an ear of a user. See above at claim 1[a].

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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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Mannheimer discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. the 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;	Mannheimer discloses or renders obvious the 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. See above at claim 1[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

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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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source;	Mannheimer discloses or renders obvious the wearable device further comprising 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. 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. wherein the detection system is configured to be synchronized to the light source;	Mannheimer discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. See above at claim 1[e].

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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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. 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 spatially separated detectors;	Mannheimer 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 spatially separated detectors. See above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion	Mannheimer discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; See above at claim 1[g].

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of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Mannheimer discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[i]. the wearable device configured to increase the signal-to-noise ratio by	Mannheimer discloses or renders obvious 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.

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increasing light intensity of at least one of the plurality of semiconductor sources from an initial light intensity; and	See above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Mannheimer 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 above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Mannheimer discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. See above at claim 1[k].

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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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Mannheimer discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Mannheimer discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. See above 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

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 8 above. Mannheimer discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	See claim 9 above. Mannheimer discloses or renders obvious the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. See above at claim 1[m].

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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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mannheimer discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[a]. The wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Mannheimer discloses or renders obvious the wearable device adapted to be placed on teeth, a wrist, or an ear of a user, See above at claim 1[a]

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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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[b].including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Mannheimer discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[c]. the 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;	Mannheimer discloses or renders obvious the 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. See above at claim 1[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

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[d]. the wearable device further comprising 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,	Mannheimer discloses or renders obvious the wearable device further comprising 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,. 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[e].wherein the detection system is configured to be synchronized to the light source;	Mannheimer discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. 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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[f]. 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 spatially separated detectors;	Mannheimer discloses 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 spatially separated detectors. See above at claim 1[f] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal; wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link	Mannheimer discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link See above at claim 1[g] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Mannheimer discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[i]. 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; and	Mannheimer discloses or renders obvious 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. See above at claim 1[i] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[j]. the detection system further configured to:	Mannheimer 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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generate a first signal responsive to light received while the light emitting diodes are off,	See above at claim 1[j] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Mannheimer discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on;and See above at claim 1[k] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal;	Mannheimer discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l]

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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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes,	Mannheimer discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, See above 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[n]. wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Mannheimer discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[o]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Mannheimer discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. See above at claim 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 Mannheimer, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mannheimer, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT E10

U.S. Pat. No. 11,160,455 in view of U.S. Patent Publication No. 2003/0208113 to James R Mault ("Mault")

As described in detail below, Mault (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 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 E1-E9 and E11-E18, 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 '455 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 Mault. The cited portions of Mault are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Mault. 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 Mault "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Mault 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 Mault (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 Mault anticipates and/or renders obvious the Asserted Claims of the '455 Patent.

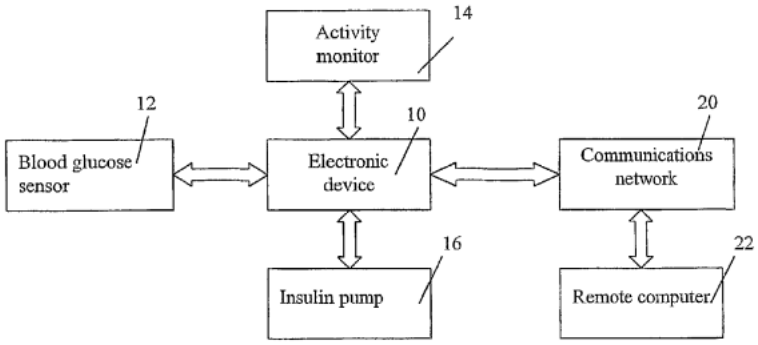
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that 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.

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Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mault discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. Embodiments of the present invention provide methods of blood glucose management systems that allow a person to view projected future levels of blood glucose, so as to assist the person to keep blood glucose levels within a predetermined range, such as a medically advisable healthy range. Systems are provided by which a person can view future projections of blood glucose levels in based on actions or planned actions, receive advance warnings of possible excursions of blood glucose from the predetermined range, and receive advice on diet, exercise, behavior modification, or medical treatments that can help the person prevent the blood glucose level excursions into unhealthy ranges. Mault at [0013] In one embodiment, the system comprises a portable computing device such as a personal digital assistant (PDA), having a software program (such as a calorie management program or other health maintenance program) having a glycemic modeling capability, such as a glycemic response algorithm. The term PDA will be used for convenience to refer to a portable computing device. The software program can be adapted to receive blood glucose measurements of the person. Blood glucose levels can be determined by any convenient technique for comparison with the glycemic response predictions of the software program. The software program can be advantageously modified from the program described in U.S. Provisional Application 60/240,185 to James R. Mault and others, so as to have a glycemic response algorithm, to record blood glucose levels, and to access a component response database by which the blood glucose response of a person to a meal can be determined by identifying meal components and determining the glycemic response of the person to the components. Diet logging methods are described in more detail later. Mault at [0014] The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the

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	person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] A system for controlling a blood glucose level of a person comprises: a blood glucose sensor, providing data correlated with the blood glucose level of the person; a computing device, having a display; a software program, running on the computing device, adapted to receive data from the blood glucose sensor, further adapted to receive food consumption data from the person, and further having an algorithm so as to display a blood glucose projection on the display. Mault at [0037] A system for assisting a person to maintain a blood glucose level between predetermined limits comprises an electronic device, for example a portable computing device such as a PDA, comprising a display, a clock, a memory, and a processor; and a software program executable by the processor of the electronic device, adapted to receive nutritional data of food consumed by the person, to calculate the blood glucose level for the person using the nutritional data and a glycemic response model for the person, and further adapted to present the blood glucose level to the person on the display of the electronic device. The program can receive diet log data from the person, for example food identities, then correlate the food identities with nutritional data using a database. The software program can be further adapted to receive time data related to the time of consumption of food (including beverages, nutraceuticals, and other consumables) by the person, and to receive data relating to planned consumption of food. Blood glucose levels can be calculated for a plurality of times, and presented as a table or graph. An activity monitor, in communication with the electronic device, can providing a signal correlated with a physical activity level of the person. An insulin delivery system, adapted to deliver insulin into the person by injection,

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	infusion, aerosol, nasally, orally, using an implant, or any other method, can be in communication with the electronic device, so that the software program can initiate operation of the insulin delivery system, for example in response to projected blood glucose levels. A glucose sensor, in communication with the electronic device, can provide a signal correlated with the blood glucose level of the person. The glucose sensor can comprise at least one microneedle adapted to draw interstitial fluid from the person to a fluorescence sensor, so that the fluorescence sensor provides a fluorescence signal correlated with glucose concentration in the interstitial fluid; an analog-to-digital converter, providing a digital representation of the fluorescence signal; and a transmitter, adapted to transmit the digital representation of the fluorescence signal to an electronic device. The electronic device can comprises a wireless receiver, and the blood glucose sensor can comprise a wireless transmitter which transmits the digital representation of the fluorescence signal to the wireless receiver of the electronic device. The glucose sensor can comprises a fiber optically coupled to a fluorescence sensor in contact with lymph fluid, with interstitial fluid, or blood. Mault at [0042] FIG. 1 shows a schematic of 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]

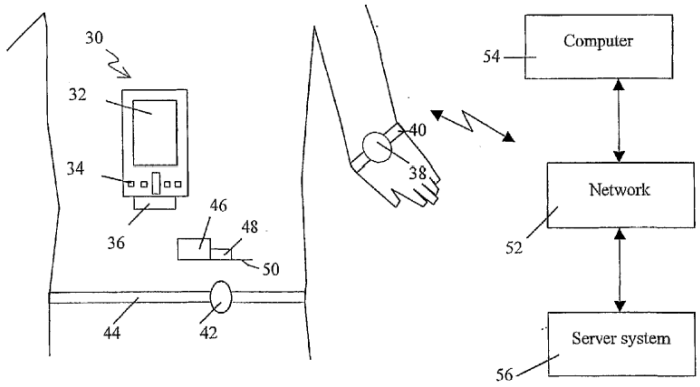
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	 Figure 1 Mault at Fig. 1 FIG. 1 shows a schematic of a system embodiment comprising an electronic device 10, a blood glucose sensor 12, a physical activity monitor 14, an insulin pump 16, a communications network 20, and a remote computer system 22. Mault at [0069] Electronic 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. The electronic device 10 can be a PDA such as a Palm Pilot. The electronic device can be a portable electronic device or system carried by the person, or a device or system combining multiple functionalities, such as: a personal digital assistant (PDA); an electronic book (e-book); a portable computer; any portable Internet access device; a wireless phone; a wristwatch, adapted to record data, for example to monitor physiological properties, or act as a diet log (it may also act as a wireless internet access device, or be otherwise adapted); a headset, providing for example visual and audio communication to the person, and recording audio and/or visual information; a body mounted activity monitor (for example pedometer) adapted to record data; any portable electronic device with data logging capabilities, for example an electronic organizer; or some combination of the above or other devices.

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	Mault at [0070] Sensor 12 can be carried by the person and provides blood glucose measurements at intervals. For example, sensor 12 can uses ion flow to draw glucose molecules out of the blood into a gel disk containing the enzyme glucose oxidase, generating hydrogen peroxide, which is detected and a numerical value displayed. This technique is used by GlucoWatch developed by Cygnus (Redwood City, Calif.). The sensor can then transmit the numerical value of blood glucose to the PDA 10, for example using a wireless method. Alternatively, sensor 12 may use spectroscopic detection of a glucose oxidase reaction. Sensor 12 may also use in-vivo spectroscopy techniques to measure blood glucose, for example as described in U.S. Pat. Nos. 6,067,463 (Jeng), 6,049,727 (Crothal), 5,660,163 (Schulman), and others. For example, IR absorption or reflection properties of skin or tissues may be determined, for example using a finger, toe, wrist, skin membrane, earlobe, nose, cheek, retina, or other body part. A blood analysis sensor may be built in to a module which plugs in to the PDA. For example, using a non-invasive spectroscopic technique, the PDA/module combination may be placed against part of the body to obtain a blood glucose reading. The sensor may also be placed under the skin, with wireless communication, such as using the Bluetooth protocol, to the PDA. The sensor may be powered by internal batteries, by light using a photoelectric effect, by temperature gradients using a thermoelectric effect, by radiation (e.g. from AM radio stations, electric mains, or radiated by the PDA or other portable device), and may be either continuously powered or only powered at times a reading is required. The sensor may record data to a memory card which plugs into the PDA. Mault at [0073] In one embodiment, the glucose sensor transmits the blood glucose level data to the PDA using a wireless communication protocol such as Bluetooth (Ericsson Components AB). Communication methods between sensor 12 and PDA 10 might include Bluetooth, IR transmission, IEEE 802.11(b), wireless Ethernet, optical methods, acoustic methods, or other wireless methods, or using a cable connection, electrical interface, or manual entry of data into the PDA using any input mechanism, such as keys, a stylus, voice recognition, and the like. The PDA may request a blood glucose reading from the sensor. Mault at [0074]

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	FIG. 2 shows a system embodiment, comprising portable computing device 30 having a display 32, data entry mechanism 34, and wireless transceiver 36; a wrist-mounted glucose sensor 38 having a strap 40; activity monitor 42 supported by the person's body using belt 44; insulin storage and dispensing device 46 comprising a subcutaneous needle 50 and delivery system 48 such as a pump. The 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. 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. The wrist mounted sensor 40 and activity monitor 42 can transmit data to the portable computing device 30 through a wireless method. The device 30 can be carried in a pocket of the person's clothes, or on a belt clip, or other convenient method. Mault at [0079] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Mault discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and

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	improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020]  Figure 2 Mault at Figs. 2 FIG. 2 shows a system embodiment, comprising portable computing device 30 having a display 32, data entry mechanism 34, and wireless transceiver 36; a wrist-mounted glucose sensor 38 having a strap 40; activity monitor 42 supported by the person's body using belt 44; insulin storage and dispensing device 46 comprising a subcutaneous needle 50 and delivery system 48 such as a pump. The 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. 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. The wrist mounted sensor 40 and activity monitor 42 can transmit data to the portable computing device 30 through a wireless method. The device 30 can be carried in a pocket of the person's clothes, or on a belt clip, or other convenient method. Mault at [0079]

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	Functionalities of system elements can be combined. For example a wrist mounted device can combine the functionality of a glucose sensor and a portable computer. An earring-like device could combine the functionality of a glucose sensor and a device to give audible feedback to the person, perhaps as an extension of the PDA, and in for example Bluetooth wireless communication with it. The PDA may have a plug in module which analyzes blood. Other combinations are possible. Mault at [0080] . In one embodiment, interstitial fluid is drawn out of the dermis of the skin into an analysis means. Fluid can be drawn out of the skin through one or more inlet microneedles, and returned to the dermis through one or more outlet microneedles, so as to provide a flow of interstitial fluid through the module. The fluid can flow through an array of microspheres, such as silica or polymer microspheres, the surfaces of which have a molecular species which fluoresces in the presence of glucose. Alternatively, the fluid may flow through a capillary or microcapillary having an inside surface lined with a fluorescence film sensitive to the concentration of glucose in the fluid. The fluorescence is detected as a measure of glucose concentration, using a detector and excitation radiation source (which can be located within the housing) possibly in comparison with a reference region not exposed to interstitial fluid flow. IR radiation may also be waveguided along capillaries, or scattered by microspheres, so as to spectroscopically detect glucose. In other embodiments, the analysis module uses the detection methods developed by Cygnus for the GlucoWatch, as discussed above. The module may alternatively draw blood or lymph fluid into the housing for analysis, for example using a micromechanical pump. The analysis module may alternatively perform non-invasive analysis of blood glucose, for example by clipping to an ear lobe or other skin flap and transmitting near-IR radiation through the skin flap. An analysis module with a fluorescence sensing region may be optically accessed by an external device having an excitation radiation source and a fluorescence detector, for example a fluorescence sensor can be contained within a transparent housing and embedded in the skin. Mault at [0094] The wrist-mounted device is adapted to monitor the blood glucose level of the wearer, for example using the methods and apparatus as described in U.S. Pat. Nos. 6,144,869 to Berner et al., 6,023,629 to Tamada,

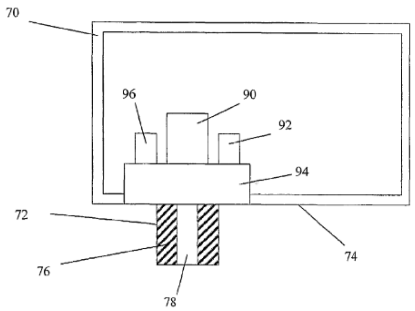
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	5,989,409 to Kurnik et al., and 5,954,685 to Tierney, the contents of which are incorporated by reference. The wrist-mounted device is provided with a mechanism for drawing interstitial fluid out of the dermis into a medium, such as a gel or porous matrix, within the main housing, and a means for performing a test for blood glucose level using the fluid within the medium, for example the glucose oxidase reaction described in U.S. Pat. No. 5,108,819, herein incorporated by reference. Interstitial fluid can be withdrawn from the dermis using pressure, suction, capillary action, ion flow, peristalsis, osmotic flow, dialysis, heat treatment, abrasion, or other appropriate method. Analysis of the fluid for glucose concentration may use any convenient technique known in the art or described elsewhere in this specification. Mault at [0102] The display capability of the PDA is used in diet logging, diet planning, and glycemic response modeling, and a software program running on the PDA can be adapted to use data received from the wrist-mounted device. Also, data can be entered into the PDA and transmitted to the wrist-mounted device for use in glycemic response prediction. A PDA may communicate in a similar manner with other devices adapted to monitor blood glucose levels or otherwise be carried by the person, such as earrings, finger mounted devices, and other skin mounted monitors. Mault at [0103] Physiological Monitoring A PDA can also be used to monitor the physiological state of the person. It may communicate or otherwise receive data from physiological sensors or monitors carried by the person. It may also receive data from other physiological sensors or medical diagnostic equipment, for example devices located at a gym, doctors office, shopping mall, retail space, etc. The following methods or devices may be used: monitoring body fat proportion, for example using bioimpedance; monitoring skin resistance; monitoring blood component levels, for example glucose, oxygenation levels, carbonyl groups, ethanol, etc.; monitoring insulin, glucagon, or other hunger-related blood component levels, or other body products related to weight and metabolism, for example lactate, glycogen levels, epinephrine, norepinephrine, and thyroid hormone; monitoring levels of compounds related to long-term average blood glucose levels, for example glycohemoglobin levels in the blood; monitoring blood pressure; monitoring blood pH, carbonate ions, and ketone bodies in the blood (ketone body levels are related to

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	fat metabolism, and monitoring is useful in a diet or exercise program); monitoring leptin levels, relating to satiety and obesity in humans; monitoring levels of uncoupling proteins (UCP1, UCP2), UCP regulating compounds, and analogs, which relate to metabolism; monitoring gastrointestinal hormones and hormone regulators, (for example cholecystokinin, gastrin, etc.), Mault by [0200 & 0201] As part of a physiological monitoring system, a person may use one or more of the following methods: wearing a wristwatch-like device containing sensors; embedding or implanting sensors in the body; wearing patches on the skin; detecting color changes of elements in contact with the body; extracting and analyzing blood, for example using an automated device; wearing belt-mounted devices; wearing sensors mounted on a band circling some part of the body, wearing an earring or other body-piercing element adapted so as to monitor for example the blood; carrying a skin-mounted or belt-mounted sensor with the form and electrical connections of a non-volatile memory card (or “flash card”), such as manufactured by Sony, SanDisk, and others, which may also monitor physical activity; carrying microphones for example so as to monitor cardio-vascular noises; having electrodes contacting the skin, for example for bioimpedance analysis; and drawing blood and carrying out various analytical techniques, for example using enzymes. Mault at [0204] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. including a light source comprising a driver and a plurality of semiconductor	Mault discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths.

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sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085]

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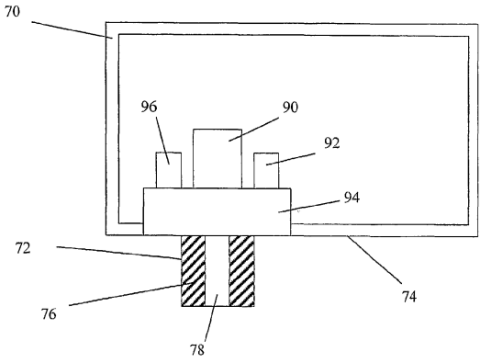
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	 Figure 5 Mault at Fig. 5 In one embodiment, interstitial fluid is drawn out of the dermis of the skin into an analysis means. Fluid can be drawn out of the skin through one or more inlet microneedles, and returned to the dermis through one or more outlet microneedles, so as to provide a flow of interstitial fluid through the module. The fluid can flow through an array of microspheres, such as silica or polymer microspheres, the surfaces of which have a molecular species which fluoresces in the presence of glucose. Alternatively, the fluid may flow through a capillary or microcapillary having an inside surface lined with a fluorescence film sensitive to the concentration of glucose in the fluid. The fluorescence is detected as a measure of glucose concentration, using a detector and excitation radiation source (which can be located within the housing) possibly in comparison with a reference region not exposed to interstitial fluid flow. IR radiation may also be waveguided along capillaries, or scattered by microspheres, so as to spectroscopically detect glucose. In other embodiments, the analysis module uses the detection methods developed by Cygnus for the GlucoWatch, as discussed above. The module may alternatively draw blood or lymph fluid into the housing for analysis, for example using a micromechanical pump. The analysis module may alternatively perform non-invasive analysis of blood glucose, for example by clipping to an ear lobe or other skin flap and transmitting near-IR radiation through the skin flap. An analysis module with a fluorescence sensing region may be optically accessed by an external device having an excitation radiation source and a fluorescence detector, for example a fluorescence sensor can be contained within a transparent housing and embedded in the skin. Mault at [0094]

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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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. the 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;	Mault discloses or renders obvious the 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 The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] In one embodiment, interstitial fluid is drawn out of the dermis of the skin into an analysis means. Fluid can be drawn out of the skin through one or more inlet microneedles, and returned to the dermis through one or more outlet microneedles, so as to provide a flow of interstitial fluid through the module. The fluid can flow through an array of microspheres, such as silica or polymer microspheres, the surfaces of which have a molecular species which fluoresces in the presence of glucose. Alternatively, the fluid may flow through a capillary or microcapillary having an inside surface lined with a fluorescence film sensitive to the concentration of glucose in the fluid. The fluorescence is detected as a measure of glucose concentration, using a detector and excitation radiation source (which can be located within the housing)

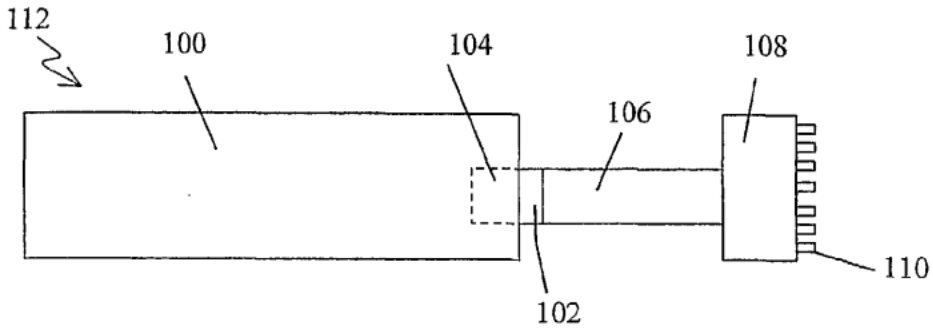
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	possibly in comparison with a reference region not exposed to interstitial fluid flow. IR radiation may also be waveguided along capillaries, or scattered by microspheres, so as to spectroscopically detect glucose. In other embodiments, the analysis module uses the detection methods developed by Cygnus for the GlucoWatch, as discussed above. The module may alternatively draw blood or lymph fluid into the housing for analysis, for example using a micromechanical pump. The analysis module may alternatively perform non-invasive analysis of blood glucose, for example by clipping to an ear lobe or other skin flap and transmitting near-IR radiation through the skin flap. An analysis module with a fluorescence sensing region may be optically accessed by an external device having an excitation radiation source and a fluorescence detector, for example a fluorescence sensor can be contained within a transparent housing and embedded in the skin. Mault at [0094] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. the wearable device further comprising 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,	Mault discloses or renders obvious the wearable device further comprising 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 person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and

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	improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085]  Figure 5 Mault at Fig. 5

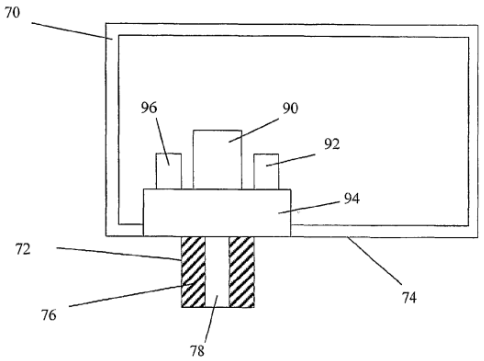
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	Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] In other embodiments, one or more optical fibers are used instead of or in addition to microneedles. The fibers have a length sufficient to penetrate the epidermis. A fluorescence sensing chemistry region is incorporated into the end of the fiber, so as to respond to the analyte of interest, such as glucose. For example, the end of the fiber may be a fluorophore-doped polymer permeable to the analyte of interest. Excitation radiation is passed down the fiber, so as to excite the fluorescent end of the fiber, and fluorescence is returned along the fiber to a detector. Optical filters can be used in addition to detectors. Mault at [0088] FIG. 6 shows a microneedle module adapted to act as an accessory to a PDA. A microneedle array 110 is formed on one surface of the microneedle module 108, which is connected to an analysis module 106, the analysis module being connected to an interface 102 which plugs into a slot 104 within the housing 100 of PDA 112. At intervals, possibly alerted by the PDA, the person places the microneedle array against the skin allowing interstitial fluid to flow into the module. Analysis is performed within the analysis module, using any appropriate method. In one embodiment, the interstitial fluid is drawn into a gel layer, where it is analyzed for blood glucose using the conventional glucose oxidase reaction, or another analytical technique. Infrared and Raman spectroscopy can also be used for noninvasive analysis of blood glucose levels. A module may be placed against the skin to detect the IR signature of glucose of fluid beneath the skin, or a spectroscopic mechanism can be included into the analysis module described above so as to detect levels of glucose within the interstitial fluid extracted from the skin. Mault at [0089]

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	 Figure 6 Mault at Fig. 6 The PDA may be used to monitor environmental conditions, such as those in the following list. Appropriate sensors may be part of the PDA, carried with the person by some other method, or otherwise be appropriately located for transmission of useful information to the PDA. The following methods may be useful, either individually or in combination: recording ambient temperature; monitoring radiation levels; monitoring smoke or particulate levels; monitoring atmospheric pollution levels for example ozone, nitrogen oxides, chemical solvents; monitoring noise levels; recording body cooling rates, wind-chill, etc. for example from skin temperature; monitoring light levels; monitoring UV levels; determining location (from GPS or other positioning method); cosmic ray levels (for example for aviation employees); monitoring odor levels; monitoring water pollution; receiving data over a communications network such as the Internet concerning environmental conditions (for example air pollution, pollen count, etc.); manual entry of data from diverse sources, for example readings from sensors, data from publications (newspapers, web-sites, etc.); and monitoring altitude. Mault at [0204]

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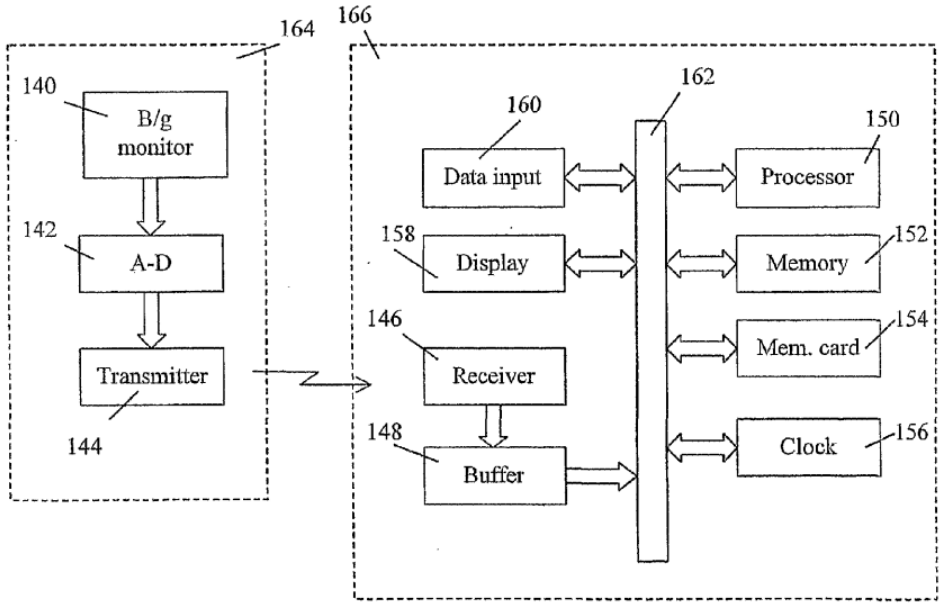
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, 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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. wherein the detection system is configured to be synchronized to the light source;	Mault discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used.

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	Mault at [0085]  Figure 5 Mault at Fig. 5 Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] In other embodiments, one or more optical fibers are used instead of or in addition to microneedles. The fibers have a length sufficient to penetrate the epidermis. A fluorescence sensing chemistry region is incorporated into the end of the fiber, so as to respond to the analyte of interest, such as glucose. For example, the end of the fiber may be a fluorophore-doped polymer permeable to the analyte of interest. Excitation radiation is passed down the fiber, so as to excite the fluorescent end of the fiber, and fluorescence is returned along the fiber to a detector. Optical filters can be used in addition to detectors. Mault at [0088] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

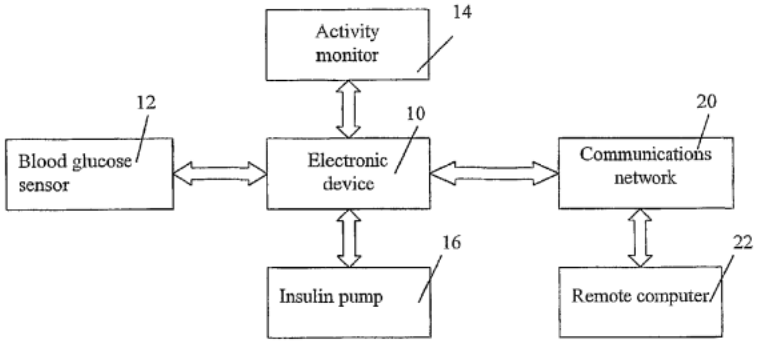
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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. 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 spatially separated detectors;	Mault 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 spatially separated detectors. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 7B shows a schematic of a possible embodiment of a system blood glucose monitoring system, an analysis module 164 comprising a blood glucose sensor 140 providing an electrical glucose signal correlated with blood glucose levels, an analog-to-digital converter 142 providing a digital representation of the glucose signal, and a wireless transmitter 144 transmitting the digital representation of the glucose signal to other devices in communication with the analysis module. A portable computing device 166 which can communicate with the analysis module comprises a wireless receiver 146, a data buffer 148, a processor 150, a memory 152, a memory module (e.g. memory card) interface 154, a clock 156, a display 158, and a bus 162. Mault at [0093]

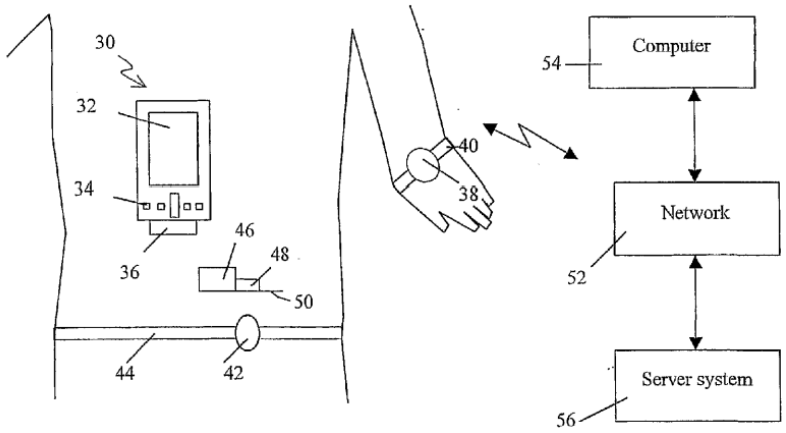
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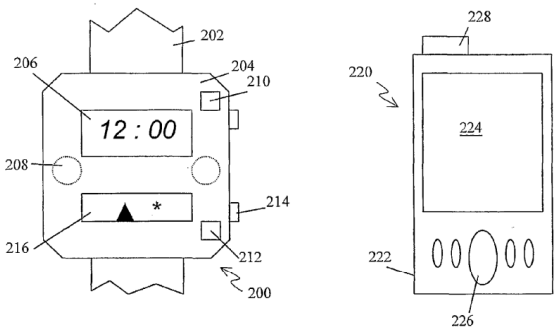
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	 Figure 7B Mault at Fig. 7B In one embodiment, interstitial fluid is drawn out of the dermis of the skin into an analysis means. Fluid can be drawn out of the skin through one or more inlet microneedles, and returned to the dermis through one or more outlet microneedles, so as to provide a flow of interstitial fluid through the module. The fluid can flow through an array of microspheres, such as silica or polymer microspheres, the surfaces of which have a molecular species which fluoresces in the presence of glucose. Alternatively, the fluid may flow through a capillary or microcapillary having an inside surface lined with a fluorescence film sensitive to the concentration of glucose in the fluid. The fluorescence is detected as a measure of glucose concentration, using a detector and excitation radiation source (which can be located within the housing) possibly in comparison with a reference region not exposed to interstitial fluid flow. IR radiation may also be waveguided along capillaries, or scattered by microspheres, so as to

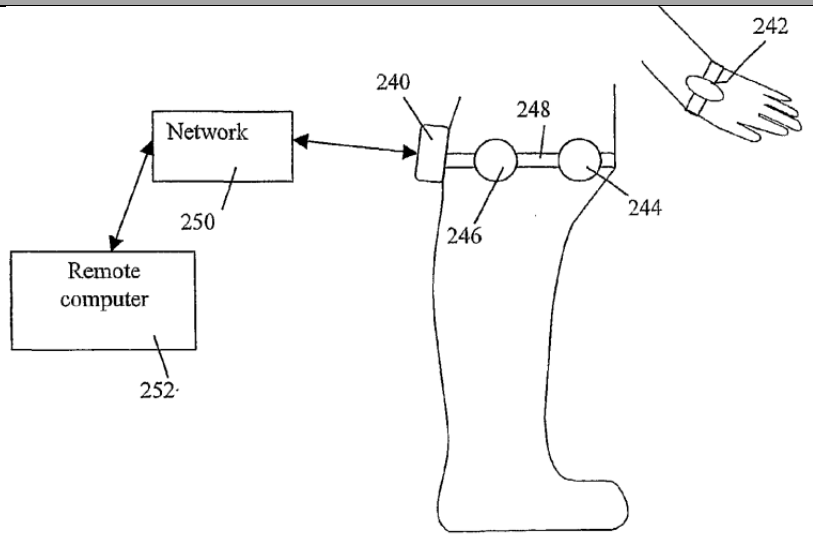
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	spectroscopically detect glucose. In other embodiments, the analysis module uses the detection methods developed by Cygnus for the GlucoWatch, as discussed above. The module may alternatively draw blood or lymph fluid into the housing for analysis, for example using a micromechanical pump. The analysis module may alternatively perform non-invasive analysis of blood glucose, for example by clipping to an ear lobe or other skin flap and transmitting near-IR radiation through the skin flap. An analysis module with a fluorescence sensing region may be optically accessed by an external device having an excitation radiation source and a fluorescence detector, for example a fluorescence sensor can be contained within a transparent housing and embedded in the skin. Mault at [0094] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at	Mault discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. In one embodiment, the system comprises a portable computing device such as a personal digital assistant (PDA), having a software program (such as a calorie management program or other health maintenance program) having a glycemic modeling capability, such as a glycemic response algorithm. The term PDA will be used for convenience to refer to a portable computing device. The software program can be adapted to receive blood glucose measurements of the person. Blood glucose levels can be determined by any convenient technique for comparison with the glycemic response predictions of the software program. The software program can be advantageously modified from the program described in U.S.

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least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Provisional Application 60/240,185 to James R. Mault and others, so as to have a glycemic response algorithm, to record blood glucose levels, and to access a component response database by which the blood glucose response of a person to a meal can be determined by identifying meal components and determining the glycemic response of the person to the components. Diet logging methods are described in more detail later. Mault at [0014] A system for assisting a person to maintain a blood glucose level between predetermined limits comprises an electronic device, for example a portable computing device such as a PDA, comprising a display, a clock, a memory, and a processor; and a software program executable by the processor of the electronic device, adapted to receive nutritional data of food consumed by the person, to calculate the blood glucose level for the person using the nutritional data and a glycemic response model for the person, and further adapted to present the blood glucose level to the person on the display of the electronic device. The program can receive diet log data from the person, for example food identities, then correlate the food identities with nutritional data using a database. The software program can be further adapted to receive time data related to the time of consumption of food (including beverages, nutraceuticals, and other consumables) by the person, and to receive data relating to planned consumption of food. Blood glucose levels can be calculated for a plurality of times, and presented as a table or graph. An activity monitor, in communication with the electronic device, can providing a signal correlated with a physical activity level of the person. An insulin delivery system, adapted to deliver insulin into the person by injection, infusion, aerosol, nasally, orally, using an implant, or any other method, can be in communication with the electronic device, so that the software program can initiate operation of the insulin delivery system, for example in response to projected blood glucose levels. A glucose sensor, in communication with the electronic device, can provide a signal correlated with the blood glucose level of the person. The glucose sensor can comprise at least one microneedle adapted to draw interstitial fluid from the person to a fluorescence sensor, so that the fluorescence sensor provides a fluorescence signal correlated with glucose concentration in the interstitial fluid; an analog-to-digital converter, providing a digital representation of the fluorescence signal; and a transmitter, adapted to transmit the digital representation of the fluorescence signal to an electronic device. The electronic device can comprises a wireless receiver, and the blood glucose sensor can comprise a wireless transmitter which transmits the digital representation of the fluorescence signal to the wireless receiver of the electronic device. The glucose

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	sensor can comprises a fiber optically coupled to a fluorescence sensor in contact with lymph fluid, with interstitial fluid, or blood. Mault at [0042] FIG. 1 shows a schematic of 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]  Figure 1 Mault at Fig. 1. Remote computer system 22 may be a remote server, physicians computer, home computer, or other computer system accessible over the communications network 20. The 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, allowing examination by a dietician, physician, other specialist, or by the person themselves using the PDA or any computer. Feedback, generated by a specialist or computer expert system, may be transmitted to the PDA from the remote computer over the communications network. In an emergency situation, the PDA may send out a request for medical

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	assistance. A global positioning system (GPS) may also be added to the PDA, to facilitate medical rescue in an emergency. Mault at [0077]  Figure 2 Mault at Fig. 2. FIG. 2 shows a system embodiment, comprising portable computing device 30 having a display 32, data entry mechanism 34, and wireless transceiver 36; a wrist-mounted glucose sensor 38 having a strap 40; activity monitor 42 supported by the person's body using belt 44; insulin storage and dispensing device 46 comprising a subcutaneous needle 50 and delivery system 48 such as a pump. The 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. 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. The wrist mounted sensor 40 and activity monitor 42 can transmit data

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	to the portable computing device 30 through a wireless method. The device 30 can be carried in a pocket of the person's clothes, or on a belt clip, or other convenient method. Mault at [0079]  Figure 8 Mault at Fig. 8. FIG. 8 shows a wrist-mounted device 200 having a strap 202; housing 204; display 206; electrodes on the rear surface 208 for interstitial fluid extraction, with corresponding fluid analysis functionality within the housing; a barcode scanner 210; an IR port 212, for communication with a PDA or other device; and a graphics display 216. Buttons such as 214 are provided for setting the time, mode changes, and the like. The IR port allows communication with PDA 220. The PDA 220 has housing 222, a display 224, data entry mechanism 226, and an IR port 228. Other wireless communication methods, such as the Bluetooth protocol, or a cable link, can be used between the wrist mounted device and the PDA. Mault at [0101]

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	 Figure 9 Mault at Fig. 9. Communication between the PDA and the remote computer system 252 can be using a wireless connection to a communications network 250, such as the Internet, so that the data collected by the PDA can be transmitted for example to a web site accessible by a physician. In other embodiments, all portable system elements are carried on a belt, and the belt provides communication between system elements for example using integrated cables. A battery can also be carried by or built into the belt. Mault at [0105] The electronic device 240 is used as a diet log and to store blood glucose readings. The device provides dietary feedback to the mother based on a measured and modeled (or estimated) glycemic response. The device also collects data from physiological sensors monitoring the health of the baby and/or mother. An audible alert can sound if projected or actual blood glucose levels deviate from a predetermined range. Mault at [0106]

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	The PDA may also be used to keep a diet log for the person over an extended period of time, for example one month, during which blood glucose readings are made at appropriate intervals, for example every half-hour, perhaps more frequently just after a meal. The glycemic response of the person can then be calculated from the blood glucose readings and the recorded diet log using multi-parameter fits. The response to different meals will overlap in the blood glucose response over time, but using data fitting techniques, the responses to different meals may be resolved, particularly if the same meal is consumed on several different days. The response to a meal may then be broken down into the response to individual components, particularly if the same component occurs in different meals. The fitting of the overall glycemic response data to modeled responses to individual meals, and then possibly to responses due to meal components, is an example of a multi-parameter fit to the glycemic response data. Mault at [0129] Data may be received by the PDA using any convenient method, for example wireless communication (for example Bluetooth), IR beams, wires, cables, electrical interfaces, data storage media transfer, voice entry, manual entry (for example using keys or stylus), etc. Sensors may be part of the PDA, in which case signals would be received by connections contained within the housing of the PDA. Data may be received in continuously, in real time, or at periodic intervals. The PDA may prompt a sensor to send data. Mault at [0199] A PDA can also be used to monitor the physiological state of the person. It may communicate or otherwise receive data from physiological sensors or monitors carried by the person. It may also receive data from other physiological sensors or medical diagnostic equipment, for example devices located at a gym, doctors office, shopping mall, retail space, etc. The following methods or devices may be used: monitoring body fat proportion, for example using bioimpedance; monitoring skin resistance; monitoring blood component levels, for example glucose, oxygenation levels, carbonyl groups, ethanol, etc.; monitoring insulin, glucagon, or other hunger-related blood component levels, or other body products related to weight and metabolism, for example lactate, glycogen levels, epinephrine, norepinephrine, and thyroid hormone; monitoring levels of compounds related to long-term average blood glucose levels, for

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	example glycohemoglobin levels in the blood; monitoring blood pressure; monitoring blood pH, carbonate ions, and ketone bodies in the blood (ketone body levels are related to fat metabolism, and monitoring is useful in a diet or exercise program); monitoring leptin levels, relating to satiety and obesity in humans; monitoring levels of uncoupling proteins (UCP1, UCP2), UCP regulating compounds, and analogs, which relate to metabolism; monitoring gastrointestinal hormones and hormone regulators, (for example cholecystokinin, gastrin, etc.), and antibody/antagonist levels, which relate to digestion efficiency; monitoring the blood for disease-related components, for example liver enzymes, which relate to liver disease; monitoring the blood for products of protein metabolism, such as nitrogen-containing compounds for example urea (as protein metabolism is generally unwelcome in for example weight control programs as it leads to muscle loss and a decrease in resting metabolic rate); monitoring the blood for pathogens for example bacteria, viruses, protazoans, and/or antibodies to them; monitoring the blood for parasites, for example merozoites (malaria); monitoring the blood for viruses (and/or antibodies) related to obesity, for example adenoviruses such as Ad-36; monitoring vitamin, mineral, and electrolyte levels; monitoring pulse rate; monitoring respiratory volume, for example using abdominal expansion, acoustic monitoring, or a spirometer; monitoring for respiration abnormalities, for an awake or asleep person, for example monitoring sleep apnea; monitoring exhaled air for evidence of lung infection or disease; monitoring hydrogen levels in exhaled air, which relates to digestion efficiency; performing respiratory analysis, for example for oxygen consumption, or exhalation of carbon dioxide, ketones, aldehydes, nitric oxide, ammonia, other nitrogen-containing compounds, peroxides, sulfur-containing compounds, esters, or other volatile organic compounds, which may be symptomatic of diabetes, liver misfunction, kidney misfunction, etc.; respiratory monitoring of acetone to indicate the onset of fat burning in a diet and/or exercise program, or to indicate diabetic symptoms; respiratory monitoring of nitric oxide (NO) as indicator of inflammatory airway diseases (for example asthma), for example as described in U.S. Pat. No. 6,010,459; respiratory monitoring of isotopically labeled gases, for example due to the metabolism of labeled compounds, for example as in U.S. Pat. No. 5,962,335; monitoring brain activity (brain waves), and using the physiological effects of thinking to control devices (for example U.S. Pat. No. 6,024,700); monitoring the heart, using for example using electrocardiograms, acoustic monitoring, etc., also forming correlations between data sets, filtering, signal processing, etc.; monitoring body temperature; monitoring skin temperature, this may decrease at the extremities in some physiological conditions; monitoring physiological indications of eating, for example blood glucose, body temperature, swallowing, etc. which may assist diet logging; monitoring posture, for example using ultrasonic transducers which determine distances between each other, which can also be used to monitor

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	physical activity; monitoring time awake, or time asleep; monitoring time engaged in a specific activity (occupational or recreational), for example driving, operating equipment, walking, running, other exercise, typing, etc., using one or more physiological states; measuring body weight, for example using scales in communication with the PDA, or entering data into the PDA; monitoring skin pallor (for surface blood flow estimation, this reduces in hypoglycemic state); receiving data from other analytical or testing devices; monitoring response to electrostimulation, particularly at the extremities (this reduces in hypoglycemia); recording emotion (for example heartbeat, facial muscle state, stress hormone level); monitoring hormone levels in the blood; monitoring perspiration level; performing perspiration analysis; transmitting physiologic data to a physician, nutritionist, dietician, fitness consultant, or other professional, using for example a wireless Internet connection, for example transmitting data at periodic intervals or on demand from the PDA to a database on a remote (i.e. not carried by the person) computer which may be accessed by authorized persons; performing urine analysis (for example for quantifying nitrogen metabolism, estimating protein intake, etc.); monitoring metabolic rate, for example using an indirect calorimeter; monitoring bone density, for example using ultrasonic transducers mounted on the skin using an adhesive clip and/or acoustic impedance matching gel (the person may be prompted to take calcium supplements if bone density falls below a certain level); searching for tumor markers; detecting gene sequences; and monitoring pupil dilation. Further, hydration level can be monitored. For example, the current Handspring Visor, or similar device, may be provided with a frame plugging into the Springboard slot, with four electrodes projecting from the frame, and appropriate electronic circuitry provided for bioimpedance analysis of the person's body. Bioimpedance data may be used to determine body fat content, and can also be used to monitor short-term hydration level changes, over time periods during which body fat proportion would not be expected to change. Dehydration is known to sometimes stimulate the appetite. Mault 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 Mault, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, 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 one or more of the physiological parameters;	Mault discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] Physiological Monitoring A PDA can also be used to monitor the physiological state of the person. It may communicate or otherwise receive data from physiological sensors or monitors carried by the person. It may also receive data from other physiological sensors or medical diagnostic equipment, for example devices located at a gym, doctors office, shopping mall, retail space, etc. The following methods or devices may be used: monitoring body fat proportion, for example using bioimpedance; monitoring skin resistance; monitoring blood component levels, for example glucose, oxygenation levels, carbonyl groups, ethanol, etc.; monitoring insulin, glucagon, or other hunger-related blood component levels, or other body products related to weight and metabolism, for example lactate, glycogen levels, epinephrine, norepinephrine, and thyroid hormone; monitoring levels of compounds related to long-term average blood glucose levels, for example glycohemoglobin levels in the blood; monitoring blood pressure; monitoring blood pH, carbonate ions, and ketone bodies in the blood (ketone body levels are related to fat metabolism, and monitoring is useful in a diet or exercise program); monitoring leptin levels, relating to satiety and obesity in humans; monitoring levels of uncoupling proteins (UCP1, UCP2), UCP

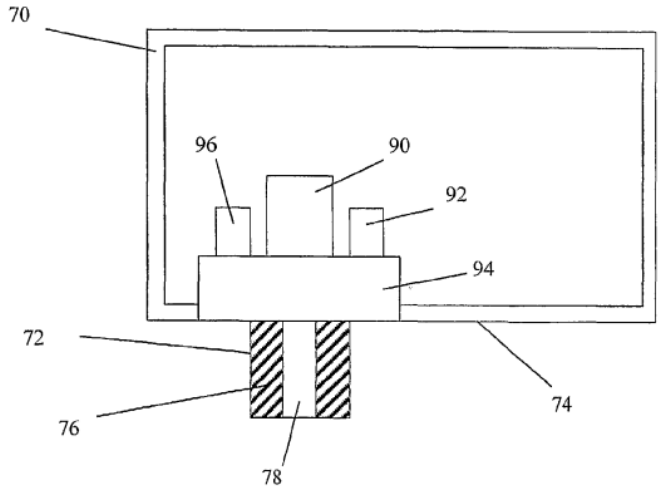
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	regulating compounds, and analogs, which relate to metabolism; monitoring gastrointestinal hormones and hormone regulators, (for example cholecystokinin, gastrin, etc.), Mault by [0200 & 0201] One of ordinary skill would find this limitation disclosed 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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. 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;	Mault discloses or renders obvious 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. As part of a physiological monitoring system, a person may use one or more of the following methods: wearing a wristwatch-like device containing sensors; embedding or implanting sensors in the body; wearing patches on the skin; detecting color changes of elements in contact with the body; extracting and analyzing blood, for example using an automated device; wearing belt-mounted devices; wearing sensors mounted on a band circling some part of the body, wearing an earring or other body-piercing element adapted so as to monitor for example the blood; carrying a skin-mounted or belt-mounted sensor with the form and electrical connections of a non-volatile memory card (or “flash card”), such as manufactured by Sony, SanDisk, and others, which may also monitor physical activity; carrying microphones for example so as to monitor cardio-vascular noises; having electrodes contacting the skin, for example for bioimpedance analysis; and drawing blood and carrying out various analytical techniques, for example using enzymes. Mault at [0204] The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-

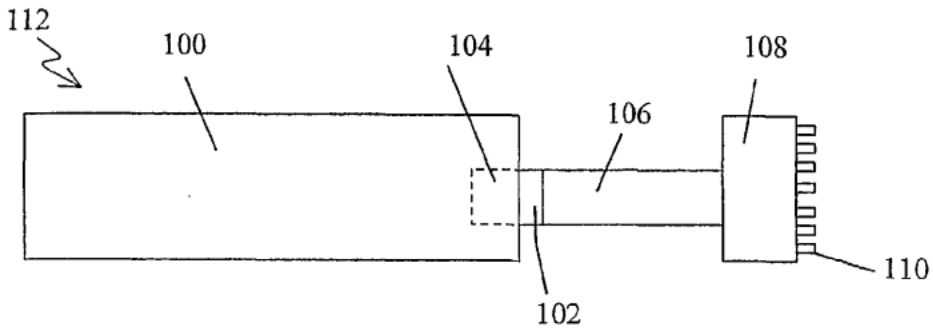
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	IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] In one embodiment, interstitial fluid is drawn out of the dermis of the skin into an analysis means. Fluid can be drawn out of the skin through one or more inlet microneedles, and returned to the dermis through one or more outlet microneedles, so as to provide a flow of interstitial fluid through the module. The fluid can flow through an array of microspheres, such as silica or polymer microspheres, the surfaces of which have a molecular species which fluoresces in the presence of glucose. Alternatively, the fluid may flow through a capillary or microcapillary having an inside surface lined with a fluorescence film sensitive to the concentration of glucose in the fluid. The fluorescence is detected as a measure of glucose concentration, using a detector and excitation radiation source (which can be located within the housing) possibly in comparison with a reference region not exposed to interstitial fluid flow. IR radiation may also be waveguided along capillaries, or scattered by microspheres, so as to spectroscopically detect glucose. In other embodiments, the analysis module uses the detection methods developed by Cygnus for the GlucoWatch, as discussed above. The module may alternatively draw blood or lymph fluid into the housing for analysis, for example using a micromechanical pump. The analysis module may alternatively perform non-invasive analysis of blood glucose, for example by clipping to an ear lobe or other skin flap and transmitting near-IR radiation through the skin flap. An analysis module with a fluorescence sensing region may be optically accessed by an external device having an excitation radiation source and a fluorescence detector, for example a fluorescence sensor can be contained within a transparent housing and embedded in the skin. Mault at [0094] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

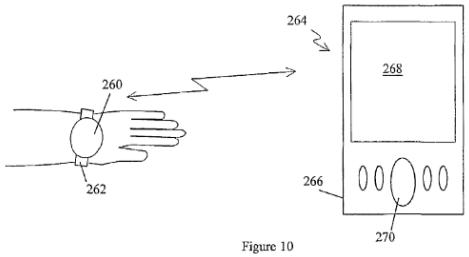
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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, 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 semiconductor sources are off,	Mault discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085]

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	Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] In other embodiments, one or more optical fibers are used instead of or in addition to microneedles. The fibers have a length sufficient to penetrate the epidermis. A fluorescence sensing chemistry region is incorporated into the end of the fiber, so as to respond to the analyte of interest, such as glucose. For example, the end of the fiber may be a fluorophore-doped polymer permeable to the analyte of interest. Excitation radiation is passed down the fiber, so as to excite the fluorescent end of the fiber, and fluorescence is returned along the fiber to a detector. Optical filters can be used in addition to detectors. Mault at [0088]

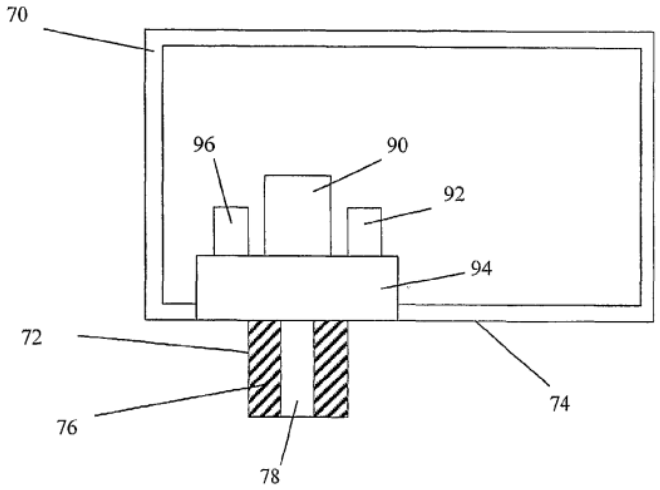
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	 Figure 5 Mault at Fig. 5 FIG. 6 shows a microneedle module adapted to act as an accessory to a PDA. A microneedle array 110 is formed on one surface of the microneedle module 108, which is connected to an analysis module 106, the analysis module being connected to an interface 102 which plugs into a slot 104 within the housing 100 of PDA 112. At intervals, possibly alerted by the PDA, the person places the microneedle array against the skin allowing interstitial fluid to flow into the module. Analysis is performed within the analysis module, using any appropriate method. In one embodiment, the interstitial fluid is drawn into a gel layer, where it is analyzed for blood glucose using the conventional glucose oxidase reaction, or another analytical technique. Infrared and Raman spectroscopy can also be used for noninvasive analysis of blood glucose levels. A module may be placed against the skin to detect the IR signature of glucose of fluid beneath the skin, or a spectroscopic mechanism can be included into the analysis module described above so as to detect levels of glucose within the interstitial fluid extracted from the skin.

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	Mault at [0089]  Figure 6 Mault at Fig. 6 FIG. 10 shows a blood glucose monitoring system 260, in the form of a watch, supported on a monitored subject using a strap 262, providing data to a PDA 264 in possession of the caregiver. The PDA 264 has housing 266, display 268, and data entry means in the form of a keypad 270. 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. Wireless data transmission can be used, such as Bluetooth (Ericsson) or IR transmission. Electrical connections may be used at intervals, or data read off a display of the wrist-mounted device. The PDA has a software program, such as a calorie management program, having a glycemic response algorithm for the subject. The software program can be adapted for diet logging and glycemic response modeling for a plurality of subjects. Monitoring device 260 can further be any wearable, portable, or implanted analysis device. The caregiver records meals consumed by the subject, estimates activity levels (or receives data from a physical activity monitor worn by the subject), and is alerted to possible or actual blood glucose excursions from a safe range. The caregiver can control diet,

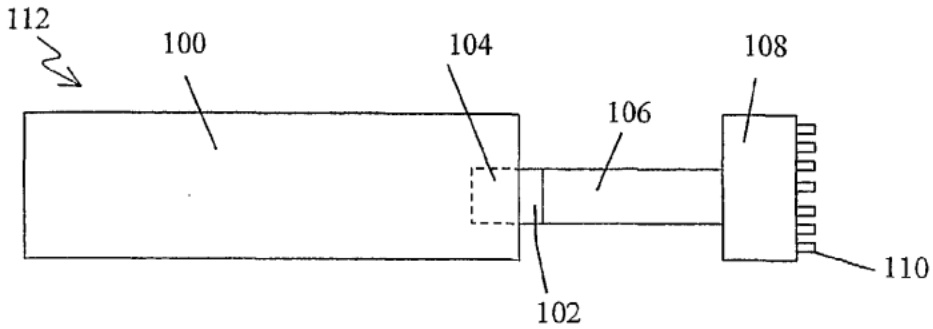
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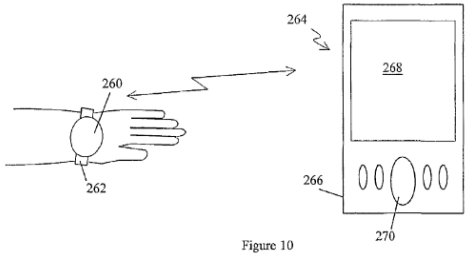
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	exercise, insulin administration, or other subject treatment or condition so as to maintain a healthy status of the subject. Mault at [0109]  Figure 10 Mault at Fig. 10 One of ordinary skill would find this limitation disclosed either expressly or 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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, 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 semiconductor sources is on; and	Mault discloses or renders obvious the detection system further configured to: generate a second signal responsive to light received while at least one of the semiconductor sources is on; and. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be

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	chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085] Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] In other embodiments, one or more optical fibers are used instead of or in addition to microneedles. The fibers have a length sufficient to penetrate the epidermis. A fluorescence sensing chemistry region is incorporated into the end of the fiber, so as to respond to the analyte of interest, such as glucose. For example, the end of the fiber may be a fluorophore-doped polymer permeable to the analyte of interest. Excitation radiation is passed down the fiber, so as to excite the fluorescent end of the fiber, and fluorescence is returned along the fiber to a detector. Optical filters can be used in addition to detectors.

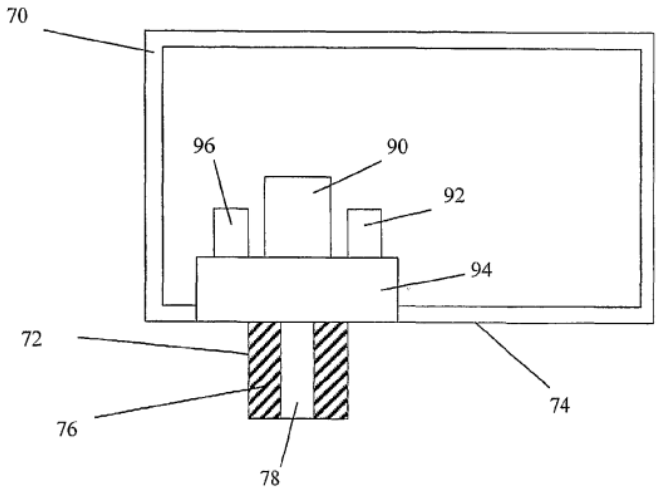
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	Mault at [0088]  Figure 5 Mault at Fig. 5 FIG. 6 shows a microneedle module adapted to act as an accessory to a PDA. A microneedle array 110 is formed on one surface of the microneedle module 108, which is connected to an analysis module 106, the analysis module being connected to an interface 102 which plugs into a slot 104 within the housing 100 of PDA 112. At intervals, possibly alerted by the PDA, the person places the microneedle array against the skin allowing interstitial fluid to flow into the module. Analysis is performed within the analysis module, using any appropriate method. In one embodiment, the interstitial fluid is drawn into a gel layer, where it is analyzed for blood glucose using the conventional glucose oxidase reaction, or another analytical technique. Infrared and Raman spectroscopy can also be used for noninvasive analysis of blood glucose levels. A module may be placed against the skin to detect the IR signature of glucose

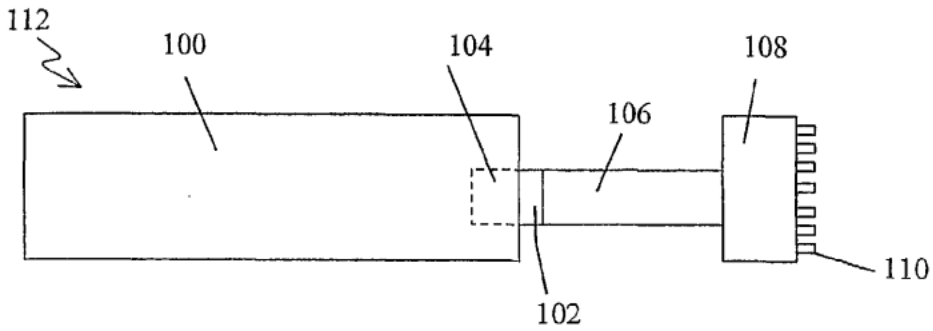
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	of fluid beneath the skin, or a spectroscopic mechanism can be included into the analysis module described above so as to detect levels of glucose within the interstitial fluid extracted from the skin. Mault at [0089]  Figure 6 Mault at Fig. 6 FIG. 10 shows a blood glucose monitoring system 260, in the form of a watch, supported on a monitored subject using a strap 262, providing data to a PDA 264 in possession of the caregiver. The PDA 264 has housing 266, display 268, and data entry means in the form of a keypad 270. 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. Wireless data transmission can be used, such as Bluetooth (Ericsson) or IR transmission. Electrical connections may be used at intervals, or data read off a display of the wrist-mounted device. The PDA has a software program, such as a calorie management program, having a glycemic response algorithm for the subject. The software program can be adapted for diet logging and glycemic response modeling for a plurality of subjects. Monitoring device 260 can further be any

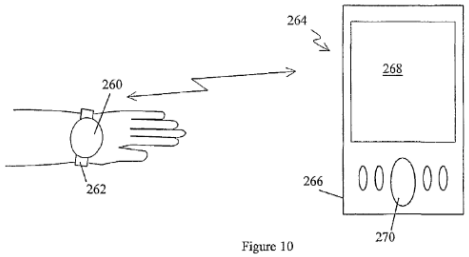
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	wearable, portable, or implanted analysis device. The caregiver records meals consumed by the subject, estimates activity levels (or receives data from a physical activity monitor worn by the subject), and is alerted to possible or actual blood glucose excursions from a safe range. The caregiver can control diet, exercise, insulin administration, or other subject treatment or condition so as to maintain a healthy status of the subject. Mault at [0109]  Figure 10 Mault at Fig. 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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, 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	Mault discloses the detection system further configured to: increase the signal-to-noise ratio by comparing the first signal and the second signal. The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single

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	device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] FIG. 5 shows a microneedle 72 with a hollow center 78 in fluid communication with fluorescent matrix 94. Matrix 94, for example a fluorophore doped polymer or sol-gel, is excited by light emitting diode 90. Photodetector 96 detects fluorescent radiation from a sensing region of the matrix, which is affected by the presence of analyte in the interstitial fluid drawn from the skin. A reference photodiode 92 is used to provide a reference signal from an reference region of fluorescent matrix, into which the analyte does not enter. For example, a semi-permeable membrane can be used to prevent glucose molecules from entering reference regions of the matrix. A number of microneedles such as 72 can pass fluid to a fluorescent matrix. The sensor housing contains at least one fluorescent matrix. In other embodiments, a plurality of separate analyte and reference matrix regions can be used. Mault at [0085] Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] In other embodiments, one or more optical fibers are used instead of or in addition to microneedles. The fibers have a length sufficient to penetrate the epidermis. A fluorescence sensing chemistry region is incorporated into the end of the fiber, so as to respond to the analyte of interest, such as glucose. For example, the end of the fiber may be a fluorophore-doped polymer permeable to the analyte of interest.

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	Excitation radiation is passed down the fiber, so as to excite the fluorescent end of the fiber, and fluorescence is returned along the fiber to a detector. Optical filters can be used in addition to detectors. Mault at [0088]  Figure 5 Mault at Fig. 5 FIG. 6 shows a microneedle module adapted to act as an accessory to a PDA. A microneedle array 110 is formed on one surface of the microneedle module 108, which is connected to an analysis module 106, the analysis module being connected to an interface 102 which plugs into a slot 104 within the housing 100 of PDA 112. At intervals, possibly alerted by the PDA, the person places the microneedle array against the skin allowing interstitial fluid to flow into the module. Analysis is performed within the analysis module, using any appropriate method. In one embodiment, the interstitial fluid is drawn into a gel layer, where it is analyzed for blood glucose using the conventional glucose oxidase reaction, or

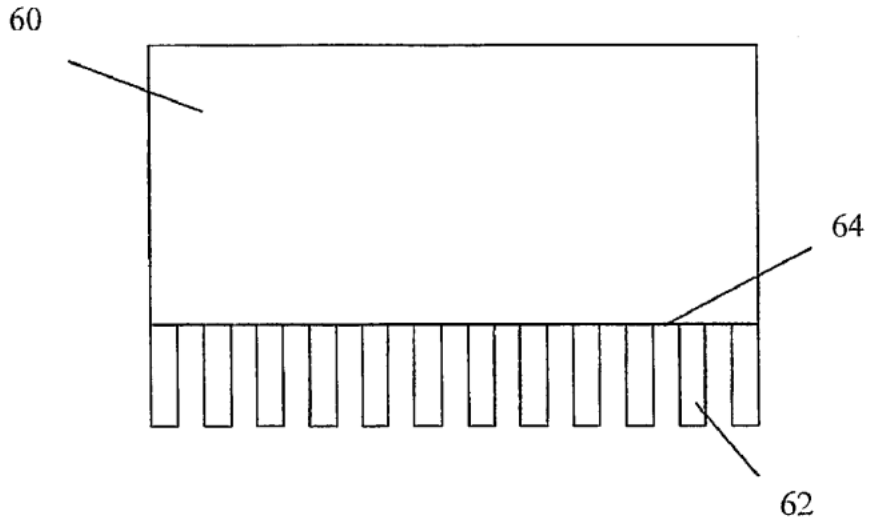
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	another analytical technique. Infrared and Raman spectroscopy can also be used for noninvasive analysis of blood glucose levels. A module may be placed against the skin to detect the IR signature of glucose of fluid beneath the skin, or a spectroscopic mechanism can be included into the analysis module described above so as to detect levels of glucose within the interstitial fluid extracted from the skin. Mault at [0089]  Figure 6 Mault at Fig. 6 FIG. 10 shows a blood glucose monitoring system 260, in the form of a watch, supported on a monitored subject using a strap 262, providing data to a PDA 264 in possession of the caregiver. The PDA 264 has housing 266, display 268, and data entry means in the form of a keypad 270. 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. Wireless data transmission can be used, such as Bluetooth (Ericsson) or IR transmission. Electrical connections may be used at intervals, or data read off a display of the wrist-mounted device. The PDA has a software program, such as a calorie management program, having a

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	glycemic response algorithm for the subject. The software program can be adapted for diet logging and glycemic response modeling for a plurality of subjects. Monitoring device 260 can further be any wearable, portable, or implanted analysis device. The caregiver records meals consumed by the subject, estimates activity levels (or receives data from a physical activity monitor worn by the subject), and is alerted to possible or actual blood glucose excursions from a safe range. The caregiver can control diet, exercise, insulin administration, or other subject treatment or condition so as to maintain a healthy status of the subject. Mault at [0109]  Figure 10 Mault at Fig. 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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one	Mault discloses or renders obvious wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.

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or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 1 above. Mault discloses or renders obvious the system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. Glucose Sensor FIG. 3 shows a blood glucose sensor housing 60 having a plurality of microneedles 62 projecting from a surface 64 of the housing 60. The microneedles 62 are hollow, and are of a length such that they penetrate through the outer layer of the skin of the person (through the epidermis), so that they are in

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	contact with interstitial fluid below the outer layer of the epidermis. To reduce discomfort, the microneedles can be a length which does not penetrate the dermis. Mault at [0081 & 0082] A person holds the housing 60 to their skin, so that the surface 64 lies closely against the skin, such that a plurality of microneedles 62 puncture the skin surface. Interstitial fluid is drawn up through the microneedles 62 into the housing 60. A variety of techniques can be used to extract interstitial fluid from the skin, including iontophoresis, other electrical methods, ultrasonic methods, capillary action, thermal irradiation, and suction. The housing may contain a plunger, be deformable, or provide another mechanism for generating negative pressure within the microneedles so as to draw interstitial fluid out of the skin. The housing may also be strapped to the body of a person, or otherwise held against the skin. Mault at [0083]  Figure 3

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	Mault at Fig. 3 Excitation radiation, for example from a light emitting diode, may be passed along the hollow center of a microneedle. A fluorescent matrix may be supported by the end of the microneedle, or line the wall surface of a microneedle, so as to be in contact with interstitial fluid, allowing fluorescent detection of analytes in the fluid. Mault at [0087] In other embodiments, one or more optical fibers are used instead of or in addition to microneedles. The fibers have a length sufficient to penetrate the epidermis. A fluorescence sensing chemistry region is incorporated into the end of the fiber, so as to respond to the analyte of interest, such as glucose. For example, the end of the fiber may be a fluorophore-doped polymer permeable to the analyte of interest. Excitation radiation is passed down the fiber, so as to excite the fluorescent end of the fiber, and fluorescence is returned along the fiber to a detector. Optical filters can be used in addition to detectors. Mault at [0088] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of	See claim 2 above. Mault discloses or renders obvious the system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.

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oxy-hemoglobin and deoxy-hemoglobin.	The person carries a portable computing device, such as a PDA, which receives blood glucose levels from a blood glucose sensor. The blood glucose sensor may be a device clipped on to the earlobe of the person, using at least one semiconductor laser or light emitting diode to emit wavelengths in the near-IR. These wavelengths are transmitted through or reflected by blood-containing tissue, and then detected by a near-IR detector. A number of emissive devices may be used, or electrical modulation of a single device may be used to obtain multiple wavelength emission. For example, two wavelengths may be chosen, one absorbed and one not absorbed by blood glucose, the absorption ratio then being used to compute the blood glucose level of the person. Other blood glucose sensors are known in the art, and improved sensor systems are discussed below. The blood glucose data can be transmitted from the sensor to the PDA using the Bluetooth wireless protocol. Mault at [0020] Physiological Monitoring A PDA can also be used to monitor the physiological state of the person. It may communicate or otherwise receive data from physiological sensors or monitors carried by the person. It may also receive data from other physiological sensors or medical diagnostic equipment, for example devices located at a gym, doctors office, shopping mall, retail space, etc. The following methods or devices may be used: monitoring body fat proportion, for example using bioimpedance; monitoring skin resistance; monitoring blood component levels, for example glucose, oxygenation levels, carbonyl groups, ethanol, etc.; monitoring insulin, glucagon, or other hunger-related blood component levels, or other body products related to weight and metabolism, for example lactate, glycogen levels, epinephrine, norepinephrine, and thyroid hormone; monitoring levels of compounds related to long-term average blood glucose levels, for example glycohemoglobin levels in the blood; monitoring blood pressure; monitoring blood pH, carbonate ions, and ketone bodies in the blood (ketone body levels are related to fat metabolism, and monitoring is useful in a diet or exercise program); monitoring leptin levels, relating to satiety and obesity in humans; monitoring levels of uncoupling proteins (UCP1, UCP2), UCP regulating compounds, and analogs, which relate to metabolism; monitoring gastrointestinal hormones and hormone regulators, (for example cholecystokinin, gastrin, etc.), Mault by [0200 & 0201]

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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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mault discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a wearable device adapted to be placed on a wrist or an ear of a user,	Mault discloses or renders obvious a wearable device adapted to be placed on a wrist or an ear of a user, See above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Mault discloses or renders obvious, the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. the wearable device comprising one or more lenses configured to receive at least a portion of the output optfical light and to deliver a lens output light to tissue;	Mault discloses or renders obvious the 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. See above at claim 1[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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. the wearable device further comprising a detection system configured to receive at least a portion	Mault discloses or renders obvious the wearable device further comprising 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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of the lens output light reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. wherein the detection system is configured to be synchronized to the light source;	Mault discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. 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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. 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 spatially separated detectors;	Mault 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 spatially separated detectors. See above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Mault discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; See above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Mault discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[i]. 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; and	Mault discloses or renders obvious 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. See above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Mault 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 above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[k]. generate a second signal responsive to light received while at least one of	Mault 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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the light emitting diodes is on, and	See above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Mault discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Mault discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. See above 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

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	incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 8 above. Mault discloses or renders obvious the system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	See claim 9 above Mault discloses or renders obvious the system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. See above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Mault discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Mault discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, See above at claim 1[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[b].including a light source comprising a driver and a plurality of semiconductor sources that	Mault discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths.

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are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	See above at claim 1[b] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[c]. the 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;	Mault discloses or renders obvious the 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. See above at claim 1[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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[d]. the wearable device further comprising 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,	Mault discloses or renders obvious the wearable device further comprising 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, 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

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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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[e]. wherein the detection system is configured to be synchronized to the light source;	Mault discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. 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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[f]. 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 spatially separated detectors;	Mault 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 spatially separated detectors. See above at claim 1[f] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless	Mault discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to

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transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	the light source. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link See above at claim 1[g] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Mault discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[i]. the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the plurality of	Mault discloses or renders obvious 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.

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semiconductor sources from an initial light intensity; and	See above at claim 1[i] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Mault 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 above at claim 1[j] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Mault discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on; and. See above at claim 1[k] One of ordinary skill would find this limitation disclosed either expressly 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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal;	Mault discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes,	Mault discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, See above 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 Mault, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[n]. wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Mault discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[o]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Mault discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. See above at claim 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 Mault, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Mault, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT E11

U.S. Pat. No. 11,160,455 in view of
US Patent Publication No. 2011/0082711 to Jeroen Poeze et al. ("Poeze")

As described in detail below, Poeze (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 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 E1-E10 and E12-E18, 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 '455 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 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 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 '455 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.

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Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants’ do not take a position on whether the preamble is limiting. Poeze discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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] FIGS. 1A-1B, 2A-2B, and 3A-3B illustrate three primary embodiments of the personal health organizer. First, FIGS. 1A and 1B depict a dedicated portable personal health organizer device that is configured to receive data from a health data collection device Such as a glucometer. In an embodiment, the personal health organizer is configured to analyze data from the collection device, manage the collected data, and use the collected data to assist the patient in man aging his or her personal healthcare. For example, the col lected data can be used to schedule reminders for the patient to visit his or her physician or pharmacist. Second, FIGS. 2A and 2B depict ageneral purpose computing device configured to execute a personal health organizer Software module, with the computing device further configured to receive data from a health data collection device Such as a glucometer. The general purpose computing device can be a mobile computing device with its own operating system and software, and has installed upon it the personal health organizer Software mod ule configured to perform tasks that are substantially similar to those performed by the dedicated personal health organizer depicted in FIGS. 1A and 1B. Finally, FIGS. 3A and 3B depict a device that integrates a personal health organizer software module with a health data collection device module, with the collection device module coupled with hardware to perform tasks of health data collection Such as those per formed by a glucometer or other patient monitoring device described above. Each of these primary embodiments will be described in further detail below.

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	Poeze at [0028] In the embodiment depicted in FIG. 1B, the health data collection device 112 includes a finger clip sensor 116 connected to a monitor 118 via a cable. Moreover, the monitor 118 can advantageously includes electronic processing, sig nal processing, and data storage devices capable of receiving signal data from the sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Alternatively, in an embodiment, the personal health organizer 110 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the personal health organizer 110, and in that embodiment the personal health organizer 110 includes components and devices for processing the signal data from the sensor 116. The monitor 118 can also include other compo nents, such as a speaker, a power button, removable storage or memory (e.g., a flash card slot), an AC or DC power port, and one or more network interfaces, such as a universal serial bus (USB) interface, an Ethernet port, or a wireless port. These interfaces and ports can be used by the monitor 118 in one embodiment to communicate with the sensor 116 via a com munication link 104, which may include various types of communication protocols and links as described above with respect to the communication link 114. For example, the monitor 118 can include a display that can indicate a mea Surement for glucose, for example, in mg/dL. Other analytes and forms of display can also appear on the monitor 118. In addition, although a single sensor with a single monitor 118 is shown, different combinations of sensors and device pairings can be implemented. For example, multiple sensors can be provided for a plurality of differing patient types or measurement sites or even patient fingers. The sensor 116 can also connect to the monitor 118 wirelessly. Alterna tively, the sensor 116 and the monitor 118 can be integrated into a single unit. A skilled artisan would appreciate that many other monitoring device configurations can be used as well. Poeze at [0031]-[0033] As shown in FIG.2B, the general computing device 126 can be coupled with the health data collection device 112, with the monitor 118 and sensor 116 as described above. In the embodiments shown in FIGS.

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	1A, 1B, 2A, and 2B, the communication and/or I/O interfaces of the health data col lection device 112 can be used to connect to personal health organizer 110 or 126. For example, the USB interface could be used to connect the monitor 118 to a USB port of the personal health organizer 110 or 126. As another example, the wireless port of the health data collection device 112 could be used to communicate with the personal health organizer via a wireless link, such as an RF or infrared link or a Bluetooth R. link. A skilled artisan will appreciate that a variety of other configurations and communication mechanisms are possible. For example, in an embodiment, general purpose computer device 126 includes a sensorport that allows for a sensor such as the sensor 116 to be connected directly to the general purpose computer device 126, and in that embodiment the general purpose computer device 126 includes components and devices for processing the signal data from the sensor 116. In another embodiment, the sensor 116 can be connected wirelessly to the general purpose computer device 126 through one or more known wireless connection protocols such as Bluetooth R. A skilled artisan will also appreciate that connecting the monitor 118 to the personal health organizer can allow the personal health organizer to collect, store, or analyze the output measurement values produced by the monitor 118. Integrated Device with Personal Health Organizer and Health Data Collection Modules FIG. 3A depicts another embodiment with a per sonal health organizer software module 132 executed on a computing device 130 that is integrated with a health data collection device module 134. In an embodiment, the health data collection device module 134 is configured to collect physiological data Such as glucose reading and other physiological parameters. In an embodiment, the health data col lection device module 134 includes components and devices for processing the signal data from the sensor 116. As shown in FIG. 3B, the integrated device 130 can include a monitor display and a sensor 116. The monitor display can provide for display for both the personal health organizer software mod ule 132 and the health data collection device module 134. In an embodiment, the sensor 116 can be further integrated into the integrated device 130. In another embodiment, the wire connecting the sensor 116 to the integrated device 130 can be retractable or detachable so that the sensor 116 can be housed within the integrated device 130 or elsewhere when the sensor 116 is not in use. In the detachable embodiment, the inte grated device 130 includes a sensor port that allows for the sensor 116 to be connected directly to the integrated device 130 through one or more known connection/communication protocols including USB and Ethernet. The sensor 116 can also connect wirelessly to the integrated device 130. Poeze at [0035]-[0036]

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	FIG. 4 illustrates in more detail components of an example personal health organizer 110, general computing device 126 (with a personal health organizer module 132) or integrated device 130 in accordance with various embodi ments (hereinafter referred to as “personal health organizer”). In an embodiment, the components are divided into required components and optional components. In FIG. 4, the required components are illustrated in blocks with continuous lines while the optional components are illustrated in blocks with dotted lines. As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the follow ing 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 [0039]-[0040] The personal health organizer in an embodiment includes one or more of: a media decoder/encoder/player 218 for playing back music and media, a phone 226, a built-in video/still capability camera 214, a barcode interface 220, a magnetic compass/accelerometer 216, a sensorinterface 224, a glucose strip reader 222, a biometric identification module (such as a retinal, vein pattern, or finger-print Scanner) 246. and an audio component 244. The media player 218 can play back media Such as music and video via a media center software displayed on the display 206. The camera 214 can Support a document scanner that allows user to input docu ments and forms from healthcare providers or insurance com panies. In an embodiment, 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 com puting network) or stored on the personal

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	health organizer device. The scanner can also enable the user to fill out a medical form and send the completed form to a healthcare provider or an insurance company. User can also photograph or scan the bar code of prescriptions and food packaging to obtain information on drug and nutrition. Poeze at [0048] The medical data analysis module 326, by way of example, can be used to receive medical or physiological data from the health data collection device 112 and/or the sensor 116. For example, the medical data analysis module 326 can be used to receive the measurement outputs from the monitor 118 in FIGS. 1B and 2B. As another example, the medical data analysis module 326 can be used to receive data from the sensor 116 in FIG. 3B. The medical data analysis module 326 can then analyze the data received from the sensor 116 to determine reading data and/or measurement values similar to those determined by the monitor 118. Poeze at [0059] In an embodiment, the medical data analysis module 326 works with the medical data display module 344 to provide visualization of health data tracking or trending. In an embodiment, the medical data display module 344 displays trended data for a user in a variety of graphical formats, for example, when rotated in a horizontal position. The trended data can contain continuous or spot readings of measureable parameters or user input for activity flags, as discussed above. 0067. A skilled artisan would appreciate that the medical data analysis module 326 could be associated with different types of programs or applications installed by the user that can interface with the medical data analysis module 326. The functions described herein can also be performed by the medical data analysis module 326 alone, one or more Sub modules, and/or one or more separate modules/programs on the personal health organizer. Poeze at [0066] In another embodiment, the network computing support module 302 can be configured to provide reminders to the user if the personal health organizer is not with the user. For example, the user can call the personal health organizer via phone or send an email or text message with a particular question regarding appointment times, medication intake schedule, etc. In an embodiment, the personal health orga nizer or a data server with Synchronized medical data records within a remote computing network (e.g. cloud computing network) provides answers to the particular questions sent.

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	Poeze at [0073] In other embodiments, sensors and/or devices mea Suring physiological parameters such as Glucose, PR, CO. SpO2, Cholesterol, LDL, HDL, SpHb, Hemoglobin A1C, SpHet, SpMet, oxygen content, bilirubin, etc. can be con nected to the personal health organizer device. In an embodi ment, the interface 208 includes a universal interface that is adapted to connect to various kinds of home used medical equipment such as blood pressure measuring devices, body temperature thermometers, etc. In other embodiments, the personal health device connects these external health data collection devices through one or more wired or wireless connections as discussed above in conjunction with the inter face 208 shown in FIG. 4. Poeze at [0086] In an embodiment, the medical information and education module 328 includes one or more of the following Sub-modules. First, it can include a gestational diabetes Sub module that allows for the integration of information and settings specific to the term of pregnancy and the user's con cerns. The gestational diabetes Sub-module can show pictures of the fetus in each stage of development, and can further be synchronized with the user's calendar and week by week progression. The Sub-module can also assist with monitoring timers, medication reminders, and prenatal timers etc. Sec ond, the medical information and education module 328 can include a “Personal Nurse Educator’ sub-module. The sub module can be paid for by an insurance company to provide a 24-hour nurse on call service, with the service specifically allowed to access the user's medical information stored within a remote computing network (e.g. cloud computing network), including data stored on the personal health orga nizer device. The sub-module enables the user to chat with, send text messages to, email, or phone (including video con ference) the on-call nurse with specific questions. Poeze at [0088] FIG. 7 illustrates an example of a health data col lection device 112. In the depicted embodiment, the monitor ing device 118 includes a finger clip sensor 116 connected to a monitor 118 via a cable 452. In the embodiment shown, the monitor 118 includes a display 456, control buttons 454 and a power button. Moreover, the monitor 118 can advanta geously include electronic processing, signal processing, and data storage devices capable of receiving signal data from said sensor 116, processing the signal data to

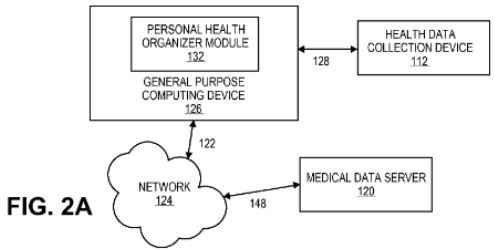
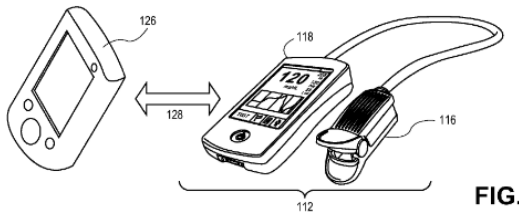
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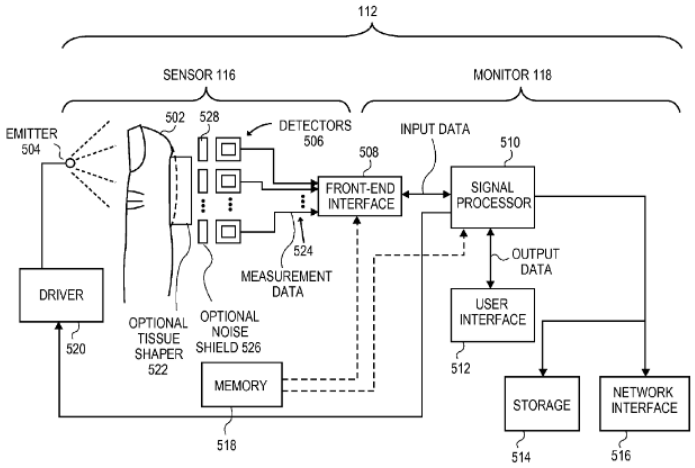
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	determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and display ing the measurement values, trends of the measurement val ues, combinations of measurement values, and the like. The cable 452 connecting the sensor 116 and the monitor 118 can be implemented using one or more wires, optical fiber, flex circuits, or the like. In some embodiments, the cable 452 can employ twisted pairs of conductors in order to minimize or reduce cross-talk of data transmitted from the sensor 116 to the monitor 118. Various lengths of the cable 452 can be employed to allow for separation between the sensor 116 and the monitor 118. The cable 452 can be fitted with a connector (male or female) on either end of the cable 452 so that the sensor 116 and the monitor 118 can be con nected and disconnected from each other. Alternatively, the sensor 116 and the monitor 118 can be coupled together via a wireless communication link, such as an infrared link, radio frequency channel, or any other wireless communication pro tocol and channel. The monitor 118 can be attached to the patient. For example, the monitor 118 can include a belt clip or straps that facilitate attachment to a patient's belt, arm, leg, or the like. The monitor 118 can also include a fitting, slot, magnet, Snap-click connector (e.g., connectors manufactured by LEMO S.A. of Switzerland), or other connecting mechanism to allow the cable 452 and sensor 116 to be attached to the monitor 118. The monitor 118 can also include other compo nents, such as a speaker, power button, removable storage or memory (e.g., a flash card slot), an AC or DC power port, and one or more network interfaces, such as a universal serial bus interface or an Ethernet port. For example, the monitor 118 can include a display 456 that can indicate a measurement for glucose, for example, in mg/dL. Other analytes and forms of display can also appear on the monitor 118. In addition, although a single sensor 116 with a single monitor 118 is shown, different combinations of sen sors and device pairings can be implemented. For example, multiple sensors can be provided for a plurality of differing patient types or measurement sites or even patient fingers. Poeze at [0093]-[0097] The data collection device 112 can include a sensor 116 (or multiple sensors) that is coupled to a processing device or physiological monitor 118. In an embodiment, the sensor 116 and the monitor 118

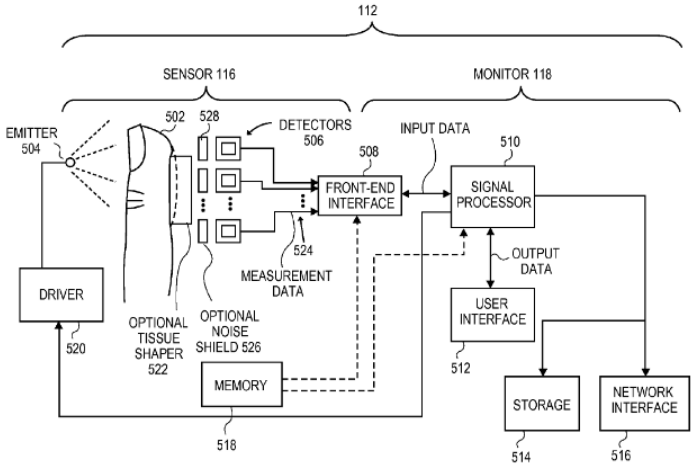
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	are integrated together into a single unit. In another embodiment, the sensor 116 and the monitor 118 are separate from each other and communicate one with another in any suitable manner. Such as via a wired or wireless connection. The sensor 116 and monitor 118 can be attachable and detachable from each other for the conve nience of the user or caregiver, for ease of storage, sterility issues, or the like. The sensor 116 and the monitor 118 will now be further described. Poeze at [0105] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is respon sive 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 pro cessor 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 [120] A computer readable medium having a computer executable personal health organizer module for analyzing and integrating medical data, the personal health organizer module comprising: a medical data input module configured to receive physiological reading data from a health data collection device or derive reading data from signal received from a Sensor, an electronic medical data integration module configured to send the physiological reading data to a remote entity via a network; a medical data analysis module configured to analyze the reading databased on medical data stored in a storage of a general purpose computing device and update the medical databased on the result of the analysis; and a network computing Support module configured to syn chronize medical data stored at the remote entity with the medical data that is stored in the storage of the general purpose computing device,

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	wherein the personal health organizer module is executable on the general purpose computing device. Poeze at claims 24 The computer readable medium of claim 24 wherein the general purpose computing device is a mobile computing device. Poeze at claim 39 The computer readable medium of claim 39 wherein the mobile computing device is the iPhone manufactured by Apple Incorporated. Poeze at claim 40. 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

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	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 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 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Poeze discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. 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.

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	Poeze at [0101]  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[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an	Poeze discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of 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

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output optical light having a plurality of optical wavelengths;	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] In some embodiments, the emitter 504 is used as a point optical source, and thus, the one or more optical sources of the emitter 504 can be located within a close distance to each other, such as within about a 2 mm to about 4 mm. The emitters 504 can be arranged in an array, such as is described in U.S. Publication No. 2006/0211924, filed Sep. 21, 2006, titled "Multiple Wavelength Sensor Emitters, the disclosure of which is hereby incorporated by reference in its entirety. In particular, the emitters 504 can be arranged at least in part as described in paragraphs 0061 through O068 of the afore mentioned publication, which paragraphs are hereby incor porated specifically by reference. Other relative spatial rela tionships can be used to arrange the emitters 504. For analytes like glucose, currently available non invasive techniques often attempt to employ light near the water absorbance minima at or about 1600 nm. Typically, these devices and methods employ a single wavelength or single band of wavelengths at or about 1600 nm. However, to date, these techniques have been unable to adequately con sistently measure analytes like glucose based on spectros copy. 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 wave lengths between about 1600 nm to about 1700 nm. In particu lar, the emitter 504 can emit optical radiation at or about 1610 nm, about 1640 nm, and about 1665 nm. In some circum stances, 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. 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

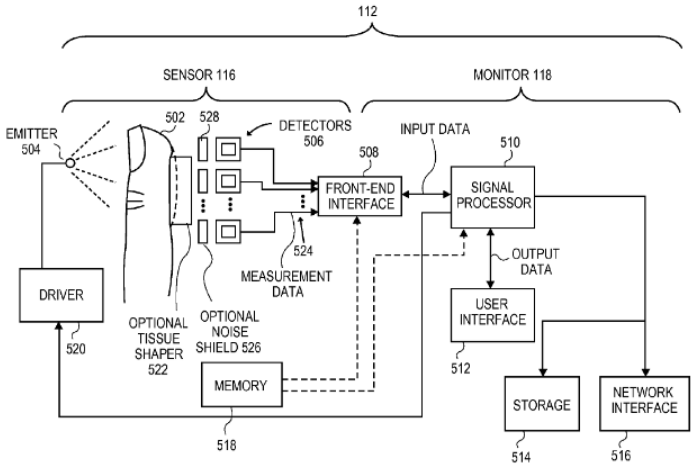
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	advantageously used to compensate or confirm the contribution of protein, water, and other non-hemoglobin species exhibited in measurements for analytes like glucose conducted between about 1600 nm and about 1700 nm. Of course, other wavelengths and combinations of wavelengths can be used to measure analytes and/or to distinguish other types of tissue, fluids, tissue properties, fluid properties, com binations of the same or the like. Poeze at [0107]-[0110] The emitter 504 can also use super luminescent LEDs (SLEDs) or side-emitting LEDs. In some embodi ments, 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 transmitat 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 effec tively 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 (SpO), 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. 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 [0114]-[0115]

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	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. 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 detec tor signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. 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 perspec tive 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 dimen sional matrix of spacing, or any other spacing scheme in order to provide an appropriate variation in path lengths. Poeze at [0117]-[0119] 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]

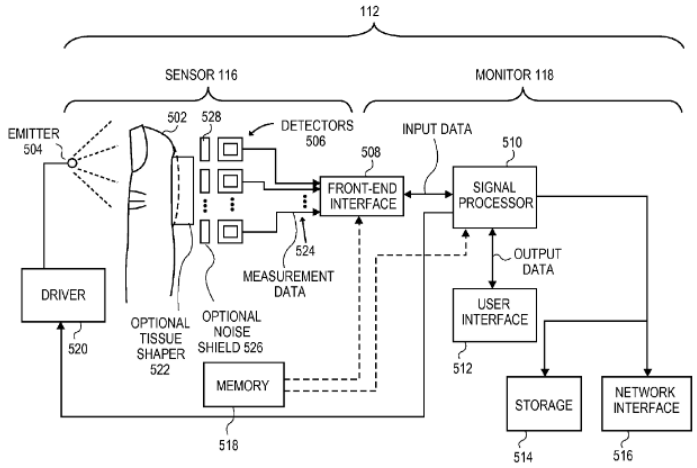
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	Due to the different responses of analytes to the different wavelengths, certain embodiments of the data collection device 112 can advantageously use the measurements at these different wavelengths to improve the accuracy of measurements. For example, 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[c]. the 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;	Poeze discloses or renders obvious the 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. 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.

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	Poeze at [0101] 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] 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. The emitter 504 can also use super luminescent LEDs (SLEDs) or side-emitting LEDs. In some embodi ments, 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 transmitat 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 effec tively 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 (SpO), 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

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	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. 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 [0113]- [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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1[d]. the wearable device further comprising 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 the wearable device further comprising 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 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 cam era. Another embodiment includes an

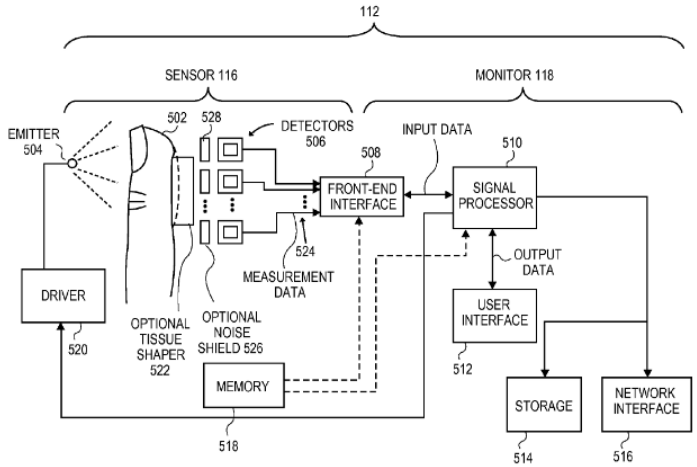
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	additional rear Sub CCD or CMOS camera placed behind an LCD or OLED screen so the user could be prompted for finger print or palm identification. In addition, a CCD or CMOS camera can be embedded in the sensor to take picture of the user's finger print. In addition to or in place of external biometric identi fication, 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 health care personnel is using the device for multiple patients). Once a patient's fingerprint is recognized, the device automatically brings up the patient's file. Poeze at [0092] 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 con ductive 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 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, combina tions of the same, or the like. In an embodiment, the emitter 504 includes sets of optical sources that are capable of emit ting visible and near-infrared optical radiation.

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	Poeze at [0106] 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 perspec tive 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 dimen sional 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 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 inter face 508 can include one or more integrated circuits that are on the same circuit board as the detectors 506. Other configu rations can also be used. Poeze at [0121] 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. In some embodiments, a programmable gain ampli fier (PGA) can be used in combination with a transimped ance-based front-end interface 508. For example, the output of a transimpedance-based front-end interface 508 can be output to a PGA that is coupled with an ADC in the monitor 118. A PGA can be useful in order to provide another level of amplification and control of the stream of signals from the detectors 506. Alternatively, the PGA and ADC components can be integrated with the transimpedance-based front-end interface 508 in the Sensor 116. Poeze at [0123]-[0124]

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	As shown in FIG. 8, the monitor 118 can include the signal processor 510 and a user interface. Such as a display 512. The monitor 109 can also include optional outputs alone or in combination with the display 512. Such as a storage device 514 and a network interface 516. In an embodiment, the signal processor 510 includes processing logic that deter mines measurements for desired analytes, such as glucose, based on the signals received from the detectors 506. The signal processor 510 can be implemented using one or more microprocessors or Subprocessors (e.g., cores), digital signal processors, application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), combinations of the same, and the like. Poeze at [0126] Although not shown in the depicted embodiment, the data collection device 112 can include various other com ponents or can be configured in different ways. For example, the sensor 116 can have both the emitter 504 and detectors 506 on the same side of the measurement site 502 and use reflectance to measure analytes. The data collection device 112 can also include a sensor that measures the power of light emitted from the emitter 504. Poeze at [0130]. 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]

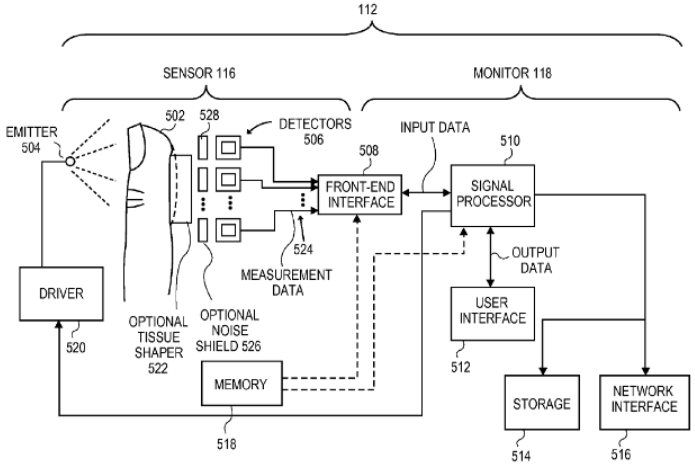
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	 FIG. 8 Poeze at Fig. 8 The data collection device 112 can measure a range of approximately about 2 nA to about 100 nA full scale. The data collection device 112 can also include sensor front-ends that are capable of processing and amplifying current 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 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 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[e]. wherein the detection system is configured to be synchronized to the light source;	Poeze discloses or renders obvious, wherein 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 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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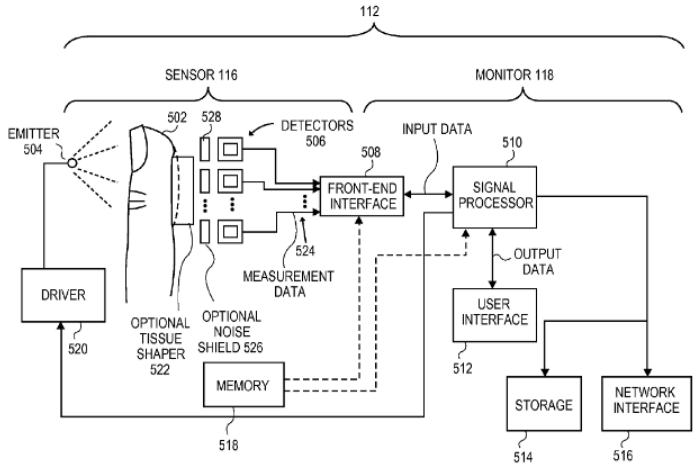
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	The driver 520 can be synchronized with other parts of the sensor 116 and can minimize or reduce jitter in the timing of pulses of optical radiation emitted from the emitter 504. In some embodiments, the driver 520 is capable of driving the emitter 504 to emit optical radiation in a pattern that varies by less than about 10 parts-per-million. Poeze at [0117] The front-end interface 508 can be implemented using one or more amplifiers, such as transimpedance ampli fiers, that are coupled to one or more analog to digital con verters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end inter face 508 can employ single-ended circuitry, differential cir cuitry, 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] The signal processor 510 can provide various sig nals 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 avoidaliasing, 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] 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

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	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 art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.

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1[f]. 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 spatially separated 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 spatially separated 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 on various factors including space desired for components, desired noise reductions or limits, desired heat reductions or limits, and the like. Poeze at [0120]

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	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.

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1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Poeze discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; 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] FIGS. 1A-1B, 2A-2B, and 3A-3B illustrate three primary embodiments of the personal health organizer. First, FIGS. 1A and 1B depict a dedicated portable personal health organizer device that is configured to receive data from a health data collection device Such as a glucometer. In an embodiment, the personal health organizer is configured to analyze data from the collection device, manage the collected data, and use the collected data to assist the patient in man aging his or her personal healthcare. For example, the col lected data can be used to schedule reminders for the patient to visit his or her physician or pharmacist. Second, FIGS. 2A and 2B depict ageneral purpose computing device configured to execute a personal health organizer Software module, with the computing device further configured to receive data from a health data collection device Such as a glucometer. The general purpose computing device can be a mobile computing device with its own operating system and software, and has installed upon it the personal health organizer Software mod ule configured to perform tasks that are substantially similar to

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	those performed by the dedicated personal health organizer depicted in FIGS. 1A and 1B. Finally, FIGS. 3A and 3B depict a device that integrates a personal health organizer software module with a health data collection device module, with the collection device module coupled with hardware to perform tasks of health data collection Such as those per formed by a glucometer or other patient monitoring device described above. Each of these primary embodiments will be described in further detail below. Poeze at [0028] FIG. 1A shows a personal health organizer 110 as a device configured for analyzing data collected by a health data collection device 112. As shown in FIG. 1A, the personal health organizer 110 can be connected to the health data collection device 112 via a communications link 114. The communications link 114 can be a wired or wireless connection adapted to transfer data between the two devices. Examples of wired connections include USB, serial, and parallel and examples of wireless connections include Bluetooth®, Wi-Fi, WiMAX, Wireless USB, and ZIGBEE. In various embodiments, the health data collection device 112 is configured to collect physiological data from a patient invasively or non-invasively. The health data collection device 112 can be a glucometer, a pulse oximeter, monitor devices that measure total hemoglobin, SpO2, methemoglobin, carboxyhemoglobin, and the like. Example portable non-invasive monitoring devices are disclosed in co-pending U.S. patent application Ser. No. 12/534,827, filed Aug. 3, 2009, assigned to Masimo Labs of Irvine, Calif., the Assignee of the present application, the disclosure of which is incorporated herein by reference. Poeze at [0029] The personal health organizer 110 can comprise a computing system configured to perform functional tasks of various embodiments of the invention. For example, in an embodiment, the personal health organizer 110 accesses data collected by the health data collection device 112 or stored at a medical data server 120 connected via a network 124, which can include a LAN, WAN, or the Internet. The medical data server 120 and the personal health organizer 110 can be connected to the network via communications links 146 and 148, respectively, and the communications links can include wired or wireless connections. The medical data server 120 can be a conventional, preexisting data system operated by an entity such as a hospital or an insurance company. Poeze at [0030]

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	In the embodiment depicted in FIG. 1B, the health data collection device 112 includes a finger clip sensor 116 connected to a monitor 118 via a cable. Moreover, the monitor 118 can advantageously includes electronic processing, signal processing, and data storage devices capable of receiving signal data from the sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Alternatively, in an embodiment, the personal health organizer 110 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the personal health organizer 110, and in that embodiment the personal health organizer 110 includes components and devices for processing the signal data from the sensor 116. Poeze at [0031] The monitor 118 can also include other components, such as a speaker, a power button, removable storage or memory (e.g., a flash card slot), an AC or DC power port, and one or more network interfaces, such as a universal serial bus (USB) interface, an Ethernet port, or a wireless port. These interfaces and ports can be used by the monitor 118 in one embodiment to communicate with the sensor 116 via a communication link 104, which may include various types of communication protocols and links as described above with respect to the communication link 114. For example, the monitor 118 can include a display that can indicate a measurement for glucose, for example, in mg/dL. Other analytes and forms of display can also appear on the monitor 118. Poeze at [0032] In addition, although a single sensor with a single monitor 118 is shown, different combinations of sensors and device pairings can be implemented. For example, multiple sensors can be provided for a plurality of differing patient types or measurement sites or even patient fingers. The sensor 116 can also connect to the monitor 118 wirelessly. Alterna tively, the sensor 116 and the monitor 118 can be integrated into a single unit. A skilled artisan would appreciate that many other monitoring device configurations can be used as well. Poeze at [0033]

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	As shown in FIG.2B, the general computing device 126 can be coupled with the health data collection device 112, with the monitor 118 and sensor 116 as described above. In the embodiments shown in FIGS. 1A, 1B, 2A, and 2B, the communication and/or I/O interfaces of the health data col lection device 112 can be used to connect to personal health organizer 110 or 126. For example, the USB interface could be used to connect the monitor 118 to a USB port of the personal health organizer 110 or 126. As another example, the wireless port of the health data collection device 112 could be used to communicate with the personal health organizer via a wireless link, such as an RF or infrared link or a Bluetooth R. link. A skilled artisan will appreciate that a variety of other configurations and communication mechanisms are possible. For example, in an embodiment, general purpose computer device 126 includes a sensorport that allows for a sensor such as the sensor 116 to be connected directly to the general purpose computer device 126, and in that embodiment the general purpose computer device 126 includes components and devices for processing the signal data from the sensor 116. In another embodiment, the sensor 116 can be connected wirelessly to the general purpose computer device 126 through one or more known wireless connection protocols such as Bluetooth R. A skilled artisan will also appreciate that connecting the monitor 118 to the personal health organizer can allow the personal health organizer to collect, store, or analyze the output measurement values produced by the monitor 118. Integrated Device with Personal Health Organizer and Health Data Collection Modules Poeze at [0035] FIG. 3A depicts another embodiment with a personal health organizer software module 132 executed on a computing device 130 that is integrated with a health data collection device module 134. In an embodiment, the health data collection device module 134 is configured to collect physiological data such as glucose reading and other physiological parameters. In an embodiment, the health data collection device module 134 includes components and devices for processing the signal data from the sensor 116. As shown in FIG. 3B, the integrated device 130 can include a monitor display and a sensor 116. The monitor display can provide for display for both the personal health organizer software module 132 and the health data collection device module 134. In an embodiment, the sensor 116 can be further integrated into the integrated device 130. In another embodiment, the wire connecting the sensor 116 to the integrated device 130 can be retractable or detachable so that the sensor 116 can be housed within the integrated device 130 or elsewhere when the sensor 116 is not in use. In the detachable embodiment, the integrated device 130 includes a sensor port that allows for the sensor 116 to be connected directly to the integrated device 130 through one or more known connection/communication protocols including USB and Ethernet. The sensor 116 can also connect wirelessly to the integrated device 130.

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	Poeze at [0036] In one or more embodiments, the personal health organizer 110, 126 or 130 can be covered by a water-proof case (e.g. a case that can withstand water pressure up to 300M in depth). In an embodiment, the sensor 116 is either detached from the personal health organizer device or integrated into the personal health organizer within the water-proof case. The case can allow, for example, divers to use the personal health organizer under water. Poeze at [0037] Although a single personal health organizer is depicted in FIGS. 1A-3B, many different personal health organizers, monitoring devices, or sensors that operate as described above can be provided. In addition, multiple distinct healthcare entities and systems can communicate with a personal health organizer and its associated monitoring device and/or sensor. This can include corporate two-way interaction of data hubs such as Google Health, Microsoft Health Vault, and hubs maintained by WellPoint or other insurers. One skilled in the art will appreciate that any number of patients or healthcare professionals can be provided access to the personal health organizer 110, 126, or 130 or the data server 120. Poeze at [0038] FIG. 4 illustrates in more detail components of an example personal health organizer 110, general computing device 126 (with a personal health organizer module 132) or integrated device 130 in accordance with various embodi ments (hereinafter referred to as “personal health organizer”). In an embodiment, the components are divided into required components and optional components. In FIG. 4, the required components are illustrated in blocks with continuous lines while the optional components are illustrated in blocks with dotted lines. Poeze at [0039] The personal health organizer in an embodiment includes one or more of: a media decoder/encoder/player 218 for playing back music and media, a phone 226, a built-in video/still capability camera 214, a barcode interface 220, a magnetic compass/accelerometer 216, a sensorinterface

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	224, a glucose strip reader 222, a biometric identification module (such as a retinal, vein pattern, or finger-print Scanner) 246. and an audio component 244. The media player 218 can play back media Such as music and video via a media center software displayed on the display 206. The camera 214 can Support a document scanner that allows user to input docu ments and forms from healthcare providers or insurance com panies. In an embodiment, 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 com puting network) or stored on the personal health organizer device. The scanner can also enable the user to fill out a medical form and send the completed form to a healthcare provider or an insurance company. User can also photograph or scan the bar code of prescriptions and food packaging to obtain information on drug and nutrition. Poeze at [0048] The medical data analysis module 326, by way of example, can be used to receive medical or physiological data from the health data collection device 112 and/or the sensor 116. For example, the medical data analysis module 326 can be used to receive the measurement outputs from the monitor 118 in FIGS. 1B and 2B. As another example, the medical data analysis module 326 can be used to receive data from the sensor 116 in FIG. 3B. The medical data analysis module 326 can then analyze the data received from the sensor 116 to determine reading data and/or measurement values similar to those determined by the monitor 118. Poeze at [0059] In another embodiment, the network computing support module 302 can be configured to provide reminders to the user if the personal health organizer is not with the user. For example, the user can call the personal health organizer via phone or send an email or text message with a particular question regarding appointment times, medication intake schedule, etc. In an embodiment, the personal health orga nizer or a data server with Synchronized medical data records within a remote computing network (e.g. cloud computing network) provides answers to the particular questions sent. Poeze at [0073] In an embodiment, the medical information and education module 328 includes one or more of the following Sub-modules. First, it can include a gestational diabetes Sub module that allows for the

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	integration of information and settings specific to the term of pregnancy and the user's con cerns. The gestational diabetes Sub-module can show pictures of the fetus in each stage of development, and can further be synchronized with the user's calendar and week by week progression. The Sub-module can also assist with monitoring timers, medication reminders, and prenatal timers etc. Sec ond, the medical information and education module 328 can include a “Personal Nurse Educator’ sub-module. The sub module can be paid for by an insurance company to provide a 24-hour nurse on call service, with the service specifically allowed to access the user's medical information stored within a remote computing network (e.g. cloud computing network), including data stored on the personal health orga nizer device. The sub-module enables the user to chat with, send text messages to, email, or phone (including video con ference) the on-call nurse with specific questions. Poeze at [0088] FIG. 7 illustrates an example of a health data col lection device 112. In the depicted embodiment, the monitor ing device 118 includes a finger clip sensor 116 connected to a monitor 118 via a cable 452. In the embodiment shown, the monitor 118 includes a display 456, control buttons 454 and a power button. Moreover, the monitor 118 can advanta geously include electronic processing, signal processing, and data storage devices capable of receiving signal data from said sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and display ing the measurement values, trends of the measurement val ues, combinations of measurement values, and the like. The cable 452 connecting the sensor 116 and the monitor 118 can be implemented using one or more wires, optical fiber, flex circuits, or the like. In some embodiments, the cable 452 can employ twisted pairs of conductors in order to minimize or reduce cross-talk of data transmitted from the sensor 116 to the monitor 118. Various lengths of the cable 452 can be employed to allow for separation between the sensor 116 and the monitor 118. The cable 452 can be fitted with a connector (male or female) on either end of the cable 452 so that the sensor 116 and the monitor 118 can be con nected and disconnected from each other. Alternatively, the sensor 116 and the monitor 118 can be coupled together via a wireless communication link, such as an infrared link, radio frequency channel, or any other wireless communication pro tocol and channel. The monitor 118 can be attached to the patient. For example, the monitor 118 can include a belt clip or straps that facilitate attachment to a patient's belt, arm, leg, or the like. The monitor 118 can also include

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	a fitting, slot, magnet, Snap-click connector (e.g., connectors manufactured by LEMO S.A. of Switzerland), or other connecting mechanism to allow the cable 452 and sensor 116 to be attached to the monitor 118. The monitor 118 can also include other compo nents, such as a speaker, power button, removable storage or memory (e.g., a flash card slot), an AC or DC power port, and one or more network interfaces, such as a universal serial bus interface or an Ethernet port. For example, the monitor 118 can include a display 456 that can indicate a measurement for glucose, for example, in mg/dL. Other analytes and forms of display can also appear on the monitor 118. In addition, although a single sensor 116 with a single monitor 118 is shown, different combinations of sen sors and device pairings can be implemented. For example, multiple sensors can be provided for a plurality of differing patient types or measurement sites or even patient fingers. Poeze at [0093]-[0097] The data collection device 112 can include a sensor 116 (or multiple sensors) that is coupled to a processing device or physiological monitor 118. In an embodiment, the sensor 116 and the monitor 118 are integrated together into a single unit. In another embodiment, the sensor 116 and the monitor 118 are separate from each other and communicate one with another in any suitable manner. Such as via a wired or wireless connection. The sensor 116 and monitor 118 can be attachable and detachable from each other for the conve nience of the user or caregiver, for ease of storage, sterility issues, or the like. The sensor 116 and the monitor 118 will now be further described. Poeze at [0105] 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 pen etrate 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 front-end interface 508 provides an interface that adapts the output of the detectors 506, which is respon sive 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 pro cessor 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 ampli fiers, that are coupled to one or more analog to digital con verters (ADCs) (which can be in the monitor 118), such as a sigma-delta ADC. A transimpedance-based front-end inter face 508 can employ single-ended circuitry, differential cir cuitry, 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. 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. In some embodiments, a programmable gain amplifier (PGA) can be used in combination with a transimped ance-based front-end interface 508. For example, the output of a transimpedance-based front-end interface 508 can be output to a PGA that is coupled with an ADC in the monitor 118. A PGA can be useful in order to provide another level of amplification and control of the stream of signals from the detectors 506. Alternatively, the PGA and ADC components can be integrated with the transimpedance-based front-end interface 508 in the Sensor 116.

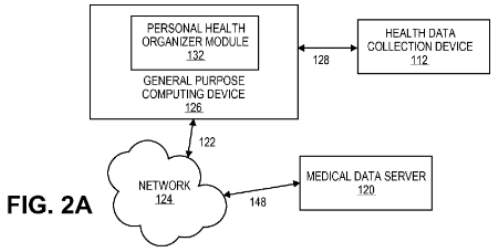
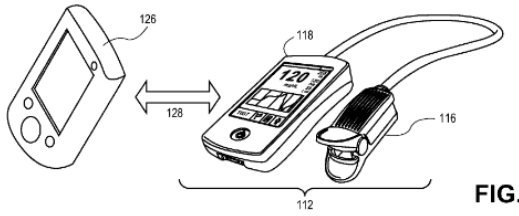
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	In another embodiment, the front-end interface 508 can be implemented using Switched-capacitor circuits. A switched-capacitor-based front-end interface 508 can be use ful for, in certain embodiments, its resistor-free design and analog averaging properties. In addition, a Switched-capaci tor-based front-end interface 508 can be useful because it can provide a digital signal to the signal processor 510 in the monitor 118. As shown in FIG. 8, the monitor 118 can include the signal processor 510 and a user interface. Such as a display 512. The monitor 109 can also include optional outputs alone or in combination with the display 512. Such as a storage device 514 and a network interface 516. In an embodiment, the signal processor 510 includes processing logic that deter mines measurements for desired analytes, such as glucose, based on the signals received from the detectors 506. The signal processor 510 can be implemented using one or more microprocessors or Subprocessors (e.g., cores), digital signal processors, application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), combinations of the same, and the like. The signal processor 510 can provide various sig nals 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 avoidaliasing, 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. The user interface 112 can provide an output, e.g., on a display, for presentation to a user of the data collection device 112. The user interface 112 can be implemented as a touch-screen display, an LCD display, an organic LED dis play, or the like. In addition, the user interface 112 can be manipulated to allow for measurement on the non-dominant side of patient. For example, the user interface 112 can include a flip Screen, a screen that can be moved from one side to another on the monitor 118, or can include an ability to reorient its display indicia responsive to user input or device orientation. In alternative embodiments, the data collection device 112 can be provided without a user interface 112 and can simply provide an output signal to a separate display or system.

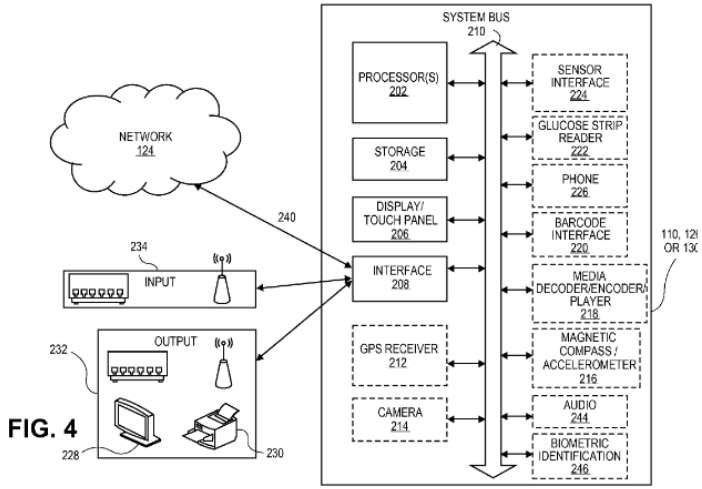
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	A storage device 514 and a network interface 516 represent other optional output connections that can be included in the monitor 118. The storage device 514 can include any computer-readable medium, Such as a memory device, hard disk storage, EEPROM, flash drive, or the like. The various software and/or firmware applications can be stored in the storage device 514, which can be executed by the signal processor 510 or another processor of the monitor 118. The network interface 516 can be a serial bus port (RS-232/ RS-485), a Universal Serial Bus (USB) port, an Ethernet port, a wireless interface (e.g., Wi-Fi such as any 802.1X interface, including an internal wireless card), or other Suitable com munication device(s) that allows the monitor 118 to commu nicate and share data with other devices. The monitor 118 can also include various other components not shown, Such as a microprocessor, graphics processor, or controller to output the user interface 112, to control data communications, to compute data trending, or to perform other operations. Poeze at [0122]-[0129] A computer readable medium having a computer executable personal health organizer module for analyzing and integrating medical data, the personal health organizer module comprising: a medical data input module configured to receive physiological reading data from a health data collection device or derive reading data from signal received from a Sensor, an electronic medical data integration module configured to send the physiological reading data to a remote entity via a network; a medical data analysis module configured to analyze the reading databased on medical data stored in a storage of a general purpose computing device and update the medical databased on the result of the analysis; and a network computing Support module configured to syn chronize medical data stored at the remote entity with the medical data that is stored in the storage of the general purpose computing device, wherein the personal health organizer module is executable on the general purpose computing device. Poeze at claims 24

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	The computer readable medium of claim 24 wherein the general purpose computing device is a mobile computing device. Poeze at claim 39 The computer readable medium of claim 39 wherein the mobile computing device is the iPhone manufactured by Apple Incorporated. Poeze at claim 40. 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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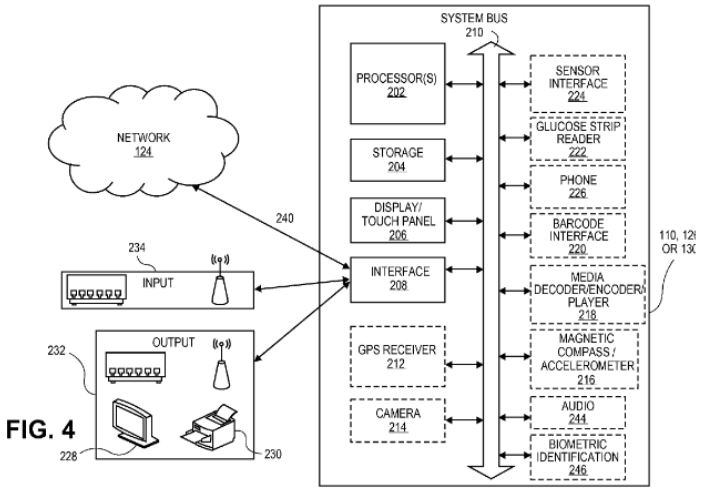
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	 FIG. 2A  FIG. 2B Poeze at Fig. 2A & 2B As illustrated in FIG. 4, various embodiments of the personal health organizer include one or more of the following components: one or more computer processor(s) 202, a storage 204, a display/touch panel 206, 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]

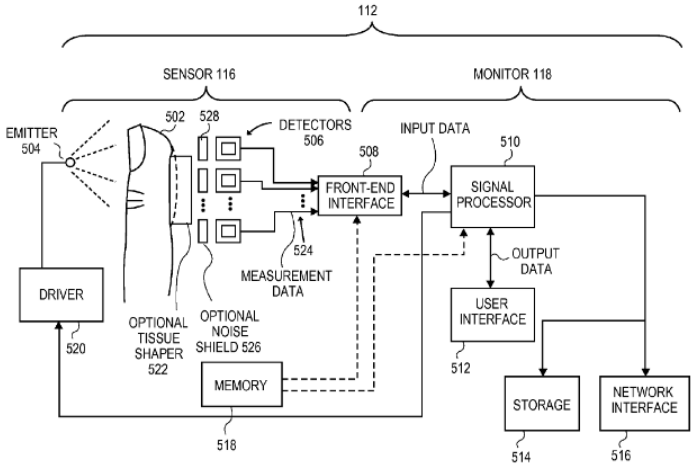
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	 FIG. 4 Poeze at Fig. 4 In addition to analyzing reading data and providing the user with reminders, alerts, and other feedback to improve the user's health, the personal health organizer in an embodiment includes the electronic medical data record 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]

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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[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Poeze discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. In the embodiment depicted in FIG. 1B, the health data collection device 112 includes a finger clip sensor 116 connected to a monitor 118 via a cable. Moreover, the monitor 118 can advantageously includes electronic processing, sig nal processing, and data storage devices capable of receiving signal data from the sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Alternatively, in an embodiment, the personal health organizer 110 includes a sensor port that allows for a sensor such as the sensor 116 to be connected directly to the personal health organizer 110, and in that embodiment the personal health organizer 110 includes components and devices for processing the signal data from the sensor 116. Poeze at [0031] FIG. 3A depicts another embodiment with a per sonal health organizer software module 132 executed on a computing device 130 that is integrated with a health data collection device module 134. In an embodiment, the health data collection device module 134 is configured to collect physiological data Such as glucose reading and other physiological parameters. In an embodiment, the health data col lection device module 134 includes components and devices for processing the signal data from the sensor 116. As shown in FIG. 3B, the integrated device 130 can include a monitor display and a sensor 116. The monitor display can provide for display for both the personal health organizer software mod ule 132 and the health data collection device module 134. In an embodiment, the sensor 116 can be further integrated into the integrated device 130. In another embodiment, the wire connecting the sensor 116 to the integrated device 130 can be retractable or detachable so that the sensor 116 can be housed

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	within the integrated device 130 or elsewhere when the sensor 116 is not in use. In the detachable embodiment, the inte grated device 130 includes a sensor port that allows for the sensor 116 to be connected directly to the integrated device 130 through one or more known connection/communication protocols including USB and Ethernet. The sensor 116 can also connect wirelessly to the integrated device 130. Poeze at [0036] In an embodiment, the medical data analysis mod ule 326 works with the medical data display module 344 to provide visualization of health data tracking or trending. In an embodiment, the medical data display module 344 displays trended data for a user in a variety of graphical formats, for example, when rotated in a horizontal position. The trended data can contain continuous or spot readings of measureable parameters or user input for activity flags, as discussed above. Poeze at [0066] In other embodiments, sensors and/or devices mea Suring physiological parameters such as Glucose, PR, CO. SpO2, Cholesterol, LDL, HDL, SpHb, Hemoglobin A1C, SpHet, SpMet, oxygen content, bilirubin, etc. can be con nected to the personal health organizer device. In an embodi ment, the interface 208 includes a universal interface that is adapted to connect to various kinds of home used medical equipment such as blood pressure measuring devices, body temperature thermometers, etc. In other embodiments, the personal health device connects these external health data collection devices through one or more wired or wireless connections as discussed above in conjunction with the inter face 208 shown in FIG. 4. Poeze at [0086] FIG. 7 illustrates an example of a health data col lection device 112. In the depicted embodiment, the monitoring device 118 includes a finger clip sensor 116 connected to a monitor 118 via a cable 452. In the embodiment shown, the monitor 118 includes a display 456, control buttons 454 and a power button. Moreover, the monitor 118 can advanta geously include electronic processing, signal processing, and data storage devices capable of receiving signal data from said sensor 116, processing the signal data to determine one or more output measurement values indicative of one or more physiological parameters

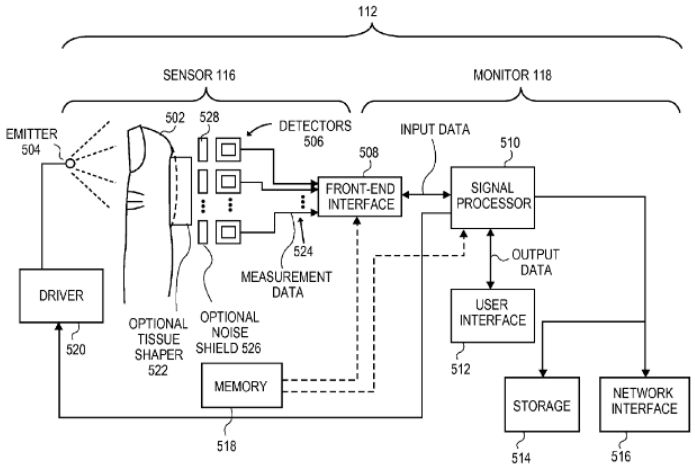
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	of a monitored patient, and displaying the measurement values, trends of the measurement values, combinations of measurement values, and the like. Poeze at [0093] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is respon sive 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]. 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] 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

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	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 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.

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	Poeze at [0098]  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[i]. the wearable device configured to increase the signal-to-noise ratio by increasing light intensity of at least one of the	Poeze discloses or renders obvious 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. 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

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semiconductor sources from an initial light intensity;	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 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] 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

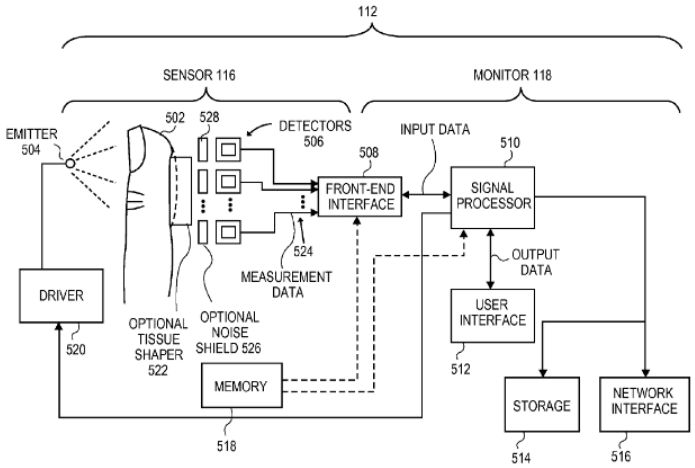
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	emitting LEDs. Alternatively, the emitter 504 can use other types of sources of optical radiation, such as a laser diode, to emit near-infrared light into the measurement site 502. Poeze at [0114]  **FIG. 8** Poeze at Fig. 8 In contrast, the emitter 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 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

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	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] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 semiconductor sources are off,	Poeze discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off. 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 con ductive 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 to light can be used instead.

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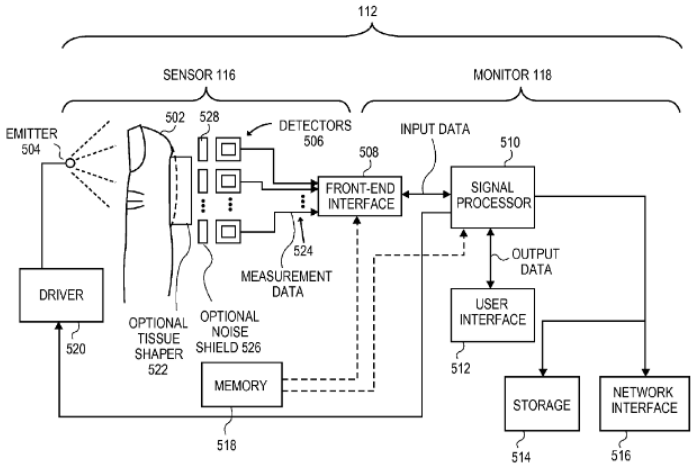
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	Poeze at [0103] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is respon sive to desired physiological parameters. For example, the front-end interface 508 can adapt a signal 524 received from one or more of the detectors 506 into a form that can be processed by the monitor 118, for example, by a signal pro cessor 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 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 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

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	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 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.

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1[k]. generate a second signal responsive to light received while at least one of the semiconductor sources is on; and	Poeze discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on; and. 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 con ductive 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 to light can be used instead. Poeze at [0103] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is respon sive 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 pro cessor 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 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

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	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 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]

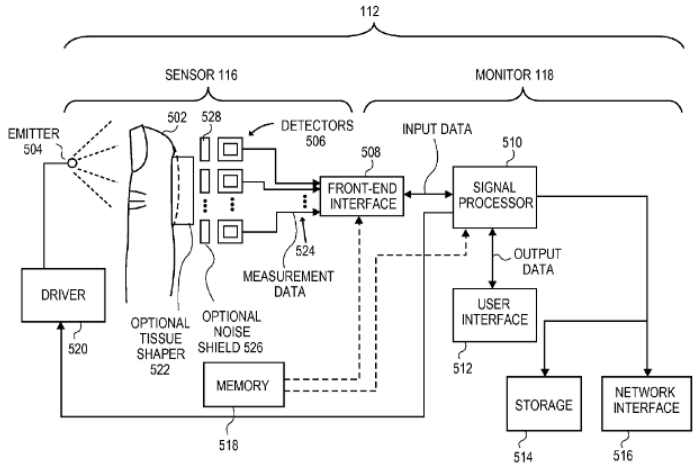
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	 **FIG. 8** Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art 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 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

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	electrically grounded. In an embodiment where the noise shield 526 includes con ductive 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 to light can be used instead. Poeze at [0103] The front-end interface 508 provides an interface that adapts the output of the detectors 506, which is respon sive 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 pro cessor 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 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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	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]

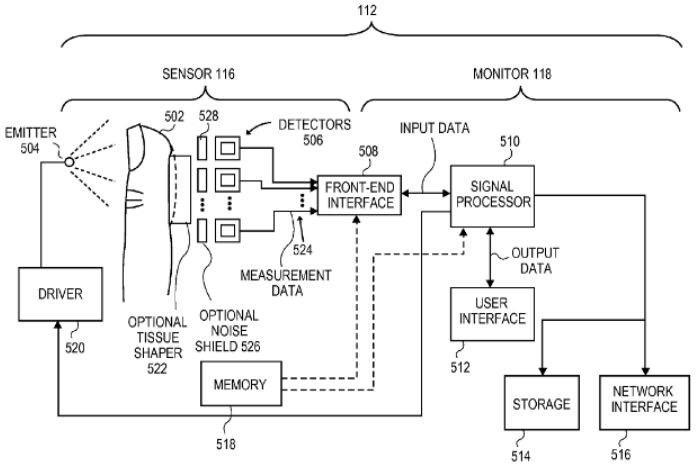
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	 **FIG. 8** Poeze at Fig. 8 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art 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 plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths	Poeze discloses or renders obvious wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. In some embodiments, the measurement site 502 is located somewhere along a non-dominant arm or a non-domi nant hand, e.g., a right-handed person's left arm or left hand. In one embodiment, the data collection device 112 can rec ognize a user's or patient's non-dominant arm/hand by com paring the two arms/hands according to various types of physiological data/measurements. For example, in some patients, the non-dominant arm or hand can have less muscu lature and higher fat content, which can result in less water content in that tissue of the patient. Tissue having less water content can provide less

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comprise near infrared or visible wavelengths.	interference with the particular wavelengths that are absorbed in a useful manner by blood analytes like glucose. Accordingly, in some embodiments, the data collection device 112 can be used on a person's non dominant hand or arm. Poeze at [0104] In some embodiments, the emitter 504 is used as a point optical source, and thus, the one or more optical sources of the emitter 504 can be located within a close distance to each other, such as within about a 2 mm to about 4 mm. The emitters 504 can be arranged in an array, such as is described in U.S. Publication No. 2006/0211924, filed Sep. 21, 2006, titled “Multiple Wavelength Sensor Emitters, the disclosure of which is hereby incorporated by reference in its entirety. In particular, the emitters 504 can be arranged at least in part as described in paragraphs 0061 through O068 of the afore mentioned publication, which paragraphs are hereby incor porated specifically by reference. Other relative spatial rela tionships can be used to arrange the emitters 504. For analytes like glucose, currently available non invasive techniques often attempt to employ light near the water absorbance minima at or about 1600 nm. Typically, these devices and methods employ a single wavelength or single band of wavelengths at or about 1600 nm. However, to date, these techniques have been unable to adequately con sistently measure analytes like glucose based on spectros copy. Poeze at [0107]-[0108] 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, com binations of the same or the like. For example, the emitter 504 can emit optical radia tion across other spectra for other analytes. In particular, the emitter 504 can employ light wavelengths to measure various blood analytes or

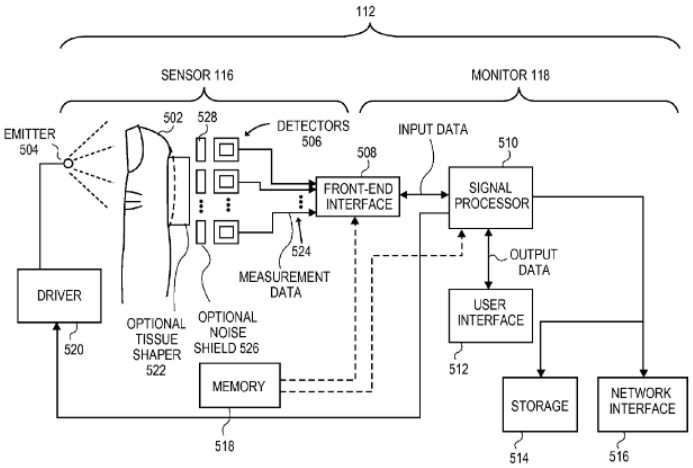
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	percentages (e.g., Saturation) thereof. For example, in an embodiment, the emitter 504 can emit optical radiation in the form of pulses at wavelengths about 905 nm, about 1050 nm, about 1200 nm, about 1300 nm, about 1330 nm, about 1610 nm, about 1640 nm, and about 1665 nm. In another embodiment, the emitter 504 can emit optical radia tion ranging from about 860 nm to about 950 nm, about 950 nm to about 1100 nm, about 1100nm 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. Due to the different responses of analytes to the different wavelengths, certain embodiments of the data col lection device 112 can advantageously use the measurements at these different wavelengths to 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 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. The emitter 504 can also use super luminescent LEDs (SLEDs) or side-emitting LEDs. In some embodi ments, 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 transmitat 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 effec tively 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 (SpO), 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.

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	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. 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 pen etrate 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 [0110]-[0116]. 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 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] 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

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	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]  **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 2	
2. The system of claim 1, wherein the plurality of semiconductor sources	See claim 1 above.

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comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	Poeze discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. 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, combina tions 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. In some embodiments, the emitter 504 is used as a point optical source, and thus, the one or more optical sources of the emitter 504 can be located within a close distance to each other, such as within about a 2 mm to about 4 mm. The emitters 504 can be arranged in an array, such as is described in U.S. Publication No. 2006/0211924, filed Sep. 21, 2006, titled “Multiple Wavelength Sensor Emitters, the disclosure of which is hereby incorporated by reference in its entirety. In particular, the emitters 504 can be arranged at least in part as described in paragraphs 0061 through O068 of the afore mentioned publication, which paragraphs are hereby incor porated specifically by reference. Other relative spatial relationships can be used to arrange the emitters 504. Poeze at [0106]-[0107]. 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

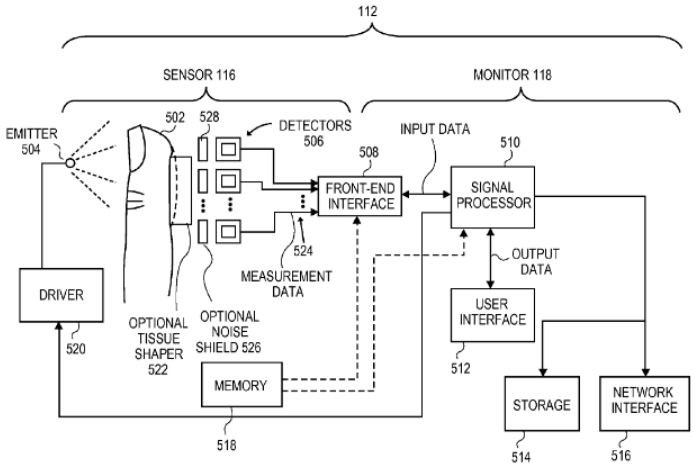
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	from the tissue in the measurement site 502. The detectors 506 can output a detector signal 524 responsive to the light captured or measured. The detectors 506 can be implemented using one or more photodiodes, phototransistors, or the like. Poeze 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]  FIG. 8

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	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 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	See claim 2 above. Poeze discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. In some embodiments, the measurement site 502 is located somewhere along a non-dominant arm or a non-domi nant hand, e.g., a right-handed person's left arm or left hand. In one embodiment, the data collection device 112 can rec ognize a user's or patient's non-dominant arm/hand by com paring the two arms/hands according to various types of physiological data/measurements. For example, in some patients, the non-dominant arm or hand can have less muscu lature and higher fat content, which can result in less water content in that tissue of the patient. Tissue having less water content can provide less interference with the particular wavelengths that are absorbed in a useful manner by blood analytes like glucose. Accordingly, in some embodiments, the data collection device 112 can be used on a person's non dominant hand or arm. Poeze at [0104] In some embodiments, the emitter 504 is used as a point optical source, and thus, the one or more optical sources of the emitter 504 can be located within a close distance to each other, such as within about a 2 mm to about 4 mm. The emitters 504 can be arranged in an array, such as is described in U.S. Publication No. 2006/0211924, filed Sep. 21, 2006, titled “Multiple Wavelength Sensor Emitters, the disclosure of which is hereby incorporated by reference in its entirety. In particular, the emitters 504 can be arranged at least in part as described in paragraphs 0061 through O068 of the afore mentioned publication, which paragraphs are hereby incor porated specifically by reference. Other relative spatial rela tionships can be used to arrange the emitters 504.

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	For analytes like glucose, currently available non invasive techniques often attempt to employ light near the water absorbance minima at or about 1600 nm. Typically, these devices and methods employ a single wavelength or single band of wavelengths at or about 1600 nm. However, to date, these techniques have been unable to adequately con sistently measure analytes like glucose based on spectros copy. 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 wave lengths between about 1600 nm to about 1700 nm. In particu lar, the emitter 504 can emit optical radiation at or about 1610 nm, about 1640 nm, and about 1665 nm. In some circum stances, 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. 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, com binations of the same or the like. For example, the emitter 504 can emit optical radia tion 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 radia tion ranging from about 860 nm to about 950 nm, about 950 nm to about 1100 nm, about 1100nm 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.

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	Due to the different responses of analytes to the different wavelengths, certain embodiments of the data col lection device 112 can advantageously use the measurements at these different wavelengths to 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. 0113. 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 [0107]-[0113] 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]. 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

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	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]  FIG. 8 Poeze at Fig. 8

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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.
Claim 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants’ do not take a position on whether the preamble is limiting. Poeze discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 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[a]. a wearable device adapted to be placed on a wrist or an ear of a user,	Poeze discloses or renders obvious a wearable device adapted to be placed on a wrist or an ear of a user, See above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.

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8[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Poeze discloses or renders obvious, the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the 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;	Poeze discloses or renders obvious the 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. See above at claim 1[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 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]. the wearable device further comprising 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 the wearable device further comprising 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, 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

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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 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]. wherein the detection system is configured to be synchronized to the light source;	Poeze discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. 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 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]. 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 spatially separated 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 spatially separated detectors. See above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a	Poeze discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a

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microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	portion of the processed output signal is configured to be transmitted over a wireless transmission link. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; See above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Poeze discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[i]. 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; and	Poeze discloses or renders obvious 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. See above at claim 1[i].

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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.
8[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. See above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[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. See above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.

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8[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. See above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Poeze discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. See above 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 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 8 above. Poeze discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 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 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	See claim 9 above Poeze discloses or renders obvious the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. See above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants' do not take a position on whether the preamble is limiting. Poeze discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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

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	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.
15[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Poeze discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, See above at claim 1[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[b].including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Poeze discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[c]. the wearable device comprising one or more lenses configured to receive at least a portion of the output optical light and to	Poeze discloses or renders obvious the 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. See above at claim 1[c]

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deliver a lens output light to tissue;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[d]. the wearable device further comprising 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 the wearable device further comprising 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, 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 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.
15[e]. wherein the detection system is configured to be synchronized to the light source;	Poeze discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. 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 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.

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15[f]. 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 spatially separated 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 spatially separated detectors. See above at claim 1[f] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal; wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link	Poeze discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link See above at claim 1[g] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[h]. wherein the output signal is indicative of one or	Poeze discloses or renders obvious the output signal is indicative of one or more of the physiological parameters.

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more of the physiological parameters;	See above at claim 1[h] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[i]. 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; and	Poeze discloses or renders obvious 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. See above at claim 1[i] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[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. See above at claim 1[j] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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 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.
15[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 semiconductor sources is on; and. See above at claim 1[k] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal;	Poeze discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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.
15[m]. wherein the plurality of semiconductor sources	Poeze discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes,

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comprises six light emitting diodes,	See above 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.
15[n]. wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Poeze discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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.
15[o]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Poeze discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. See above at claim 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

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	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.

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EXHIBIT E12

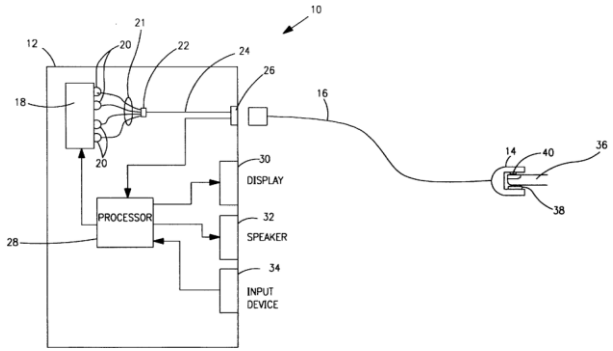
U.S. Pat. No. 11,160,455 in view of U.S. Patent No. 5,891,022 to Jonas A. Pologe ("Pologe")

As described in detail below, Pologe (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 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 E1-E11 and E13-E18, 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 '455 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 Pologe. The cited portions of Pologe are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Pologe. 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 Pologe "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Pologe 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 Pologe (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 Pologe anticipates and/or renders obvious the Asserted Claims of the '455 Patent.

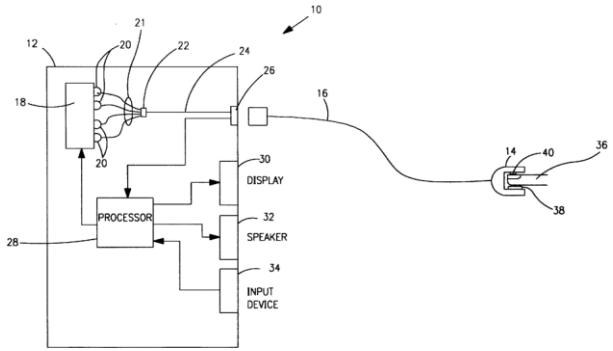
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that 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.

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Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Pologe discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. The present invention relates to a system for performing photoplethysmographic measurements using wavelength division multiplexing. The system is relatively inexpensive to produce and is capable of efficiently and accurately performing photoplethysmographic measurements. The system uses wavelength division multiplexing (WDM) to combine the light signals from multiple light sources in a main test unit into a single multiplexed signal before the signal is delivered to the probe. The multiplexed signal may then be delivered to the probe over a single optical line, such as a single fiber optic cable, a single fiber bundle, or any other single light guide. Pologe at 4:20-31  FIG. 1 Pologe at Fig. 1 In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger

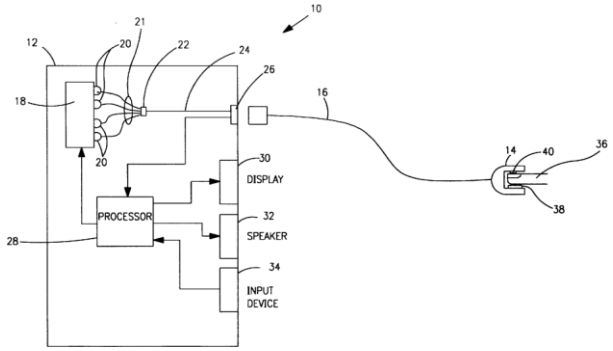
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	36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit 12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:32-54 The main test unit 12 includes: an emitter module 18 having a plurality of emitters 20, each capable of producing a light signal having a unique spectral content; a plurality of optical cables 21 each coupled to a single emitter source for carrying the corresponding light signal; an optical coupler 22 for coupling light signals from each of the plurality of cables 21 to a single output cable 24; a front panel connector 26 for use in coupling the probe cable 16 to the main test unit 12; a processor unit 28 for performing processing and control functions; a display unit 30 for displaying measurement values to a user; a speaker 32 for providing audible tones to the user; 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 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, and	Pologe discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user.

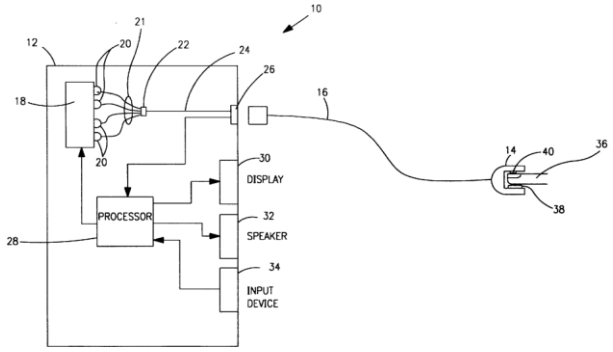
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	The present invention relates to a system for performing photoplethysmographic measurements using wavelength division multiplexing. The system is relatively inexpensive to produce and is capable of efficiently and accurately performing photoplethysmographic measurements. The system uses wavelength division multiplexing (WDM) to combine the light signals from multiple light sources in a main test unit into a single multiplexed signal before the signal is delivered to the probe. The multiplexed signal may then be delivered to the probe over a single optical line, such as a single fiber optic cable, a single fiber bundle, or any other single light guide. Pologe at 4:20-31  FIG. 1 Pologe at Fig. 1 In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. 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. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present

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	invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:32-54 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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b] including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	Pologe discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. The plurality of separate emitters includes multiple separate light sources, such as light emitting diodes (LEDs) and laser diodes. In general, the signal delivery means includes a single input/single output light guide such as a single optical fiber, a single fiber bundle, or other type of light guiding means. The single input/single output light guide delivers light to a probe head which couples the light into the tissue under test. The probe head can also include detection means for converting the light signal transmitted through the tissue under test into an electrical signal. In one embodiment, the plurality of emitters and the combining unit are included in a housing, such as a bench top test unit or a handheld unit. The housing may also include means for communicating measurement results to users and means for receiving commands from users. The probe head is physically separated from the housing with the single input/single output light guide connecting them. Pologe at 3:1-17 The present invention relates to a system for performing photoplethysmographic measurements using wavelength division multiplexing. The system is relatively inexpensive to produce and is capable of

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	efficiently and accurately performing photoplethysmographic measurements. The system uses wavelength division multiplexing (WDM) to combine the light signals from multiple light sources in a main test unit into a single multiplexed signal before the signal is delivered to the probe. The multiplexed signal may then be delivered to the probe over a single optical line, such as a single fiber optic cable, a single fiber bundle, or any other single light guide. Pologe at 4:20-31 The main test unit 12 includes: an emitter module 18 having a plurality of emitters 20, each capable of producing a light signal having a unique spectral content; a plurality of optical cables 21 each coupled to a single emitter source for carrying the corresponding light signal; an optical coupler 22 for coupling light signals from each of the plurality of cables 21 to a single output cable 24; a front panel connector 26 for use in coupling the probe cable 16 to the main test unit 12; a processor unit 28 for performing processing and control functions; a display unit 30 for displaying measurement values to a user; a speaker 32 for providing audible tones to the user; 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. To perform photoplethysmographic measurements, light sources must be used that are each capable of producing relatively narrow band light having a unique spectral content. As described above, some light sources capable of performing this function are, for example, light emitting diodes and laser diodes. It is also possible to use a single broadband light source in combination with a number of narrow band filters, although this technique has a number of distinct disadvantages which make it a suboptimal solution. Pologe at 5:35-43

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	 FIG. 1 Pologe at Fig. 1 The probe 14 also includes means for receiving the multiplexed light signal after it has been transmitted through the finger 36. In one embodiment, the means for receiving may include a photodetector, such as a pin or avalanche photodiode, for detecting the transmitted light signal and for converting it to an electrical signal. In another embodiment, the means for receiving may include means for coupling the transmitted light signal into the end of a return optical light guide. In one embodiment, this is accomplished by simply holding an end of the return cable against an opposite side of the finger 36. Because the functions performed by the probe 14 are not structurally demanding, the probe 14 can be constructed of a relatively lightweight, inexpensive material, such as plastics or cloth. In addition, because the probe 14 does not include any light sources, it can be relatively small in size, does not necessarily have to include heat shielding, and can potentially be inexpensive to manufacture. Pologe at 7:26-42 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. the 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;	Pologe discloses or renders obvious the 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.  FIG. 1 Pologe at Fig. 1 In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. 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. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future.

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	Pologe at 4:32-54 The optical coupler 22 may comprise any type of device capable of receiving individual light signals from multiple sources and combining them into a single multiplexed signal. In this regard, any of a number of different types of wavelength division multiplexing (WDM) couplers may be used, such as WDM couplers using lenses, prisms, interference filters, diffraction gratings, or butt coupling. Also, active WDM couplers can be used, such as those including cascaded or parallel emitters on a single substrate. Wavelength division multiplexing refers to any method whereby multiple light signals having unique and substantially non-overlapping spectral contents are coupled onto a common light guide. The individual components of the multiplexed signal can then be separated back out by any of a number of methods. Pologe at 5:45-59 The probe 14 includes means for directing the multiplexed light signal into the tissue under test (i.e., finger 36). In its simplest form, the means for directing consists of a structure for holding an end of the appropriate optical light guide adjacent to finger 36 while the probe 14 is properly positioned on the finger 36. For example, if the optical light guide is a fiber optic cable, the probe 14 can include mechanical fixturing for holding the cable so that an end of the cable is substantially flush with the base of the fingernail of the finger 36 and so that the light is directed into the finger. In one embodiment of this invention the light guide is actually brought into the probe parallel to the long axis of the finger and a miniature mirror is used to reflect the light 90 degrees down into the finger. Pologe at 7:12-25 The probe 14 also includes means for receiving the multiplexed light signal after it has been transmitted through the finger 36. In one embodiment, the means for receiving may include a photodetector, such as a pin or avalanche photodiode, for detecting the transmitted light signal and for converting it to an electrical signal. In another embodiment, the means for receiving may include means for coupling the transmitted light signal into the end of a return optical light guide. In one embodiment, this is accomplished by simply holding an end of the return cable against an opposite side of the finger 36. Because the functions performed by the probe 14 are not structurally demanding, the probe 14 can be constructed of a relatively lightweight, inexpensive material, such as plastics or cloth. In addition,

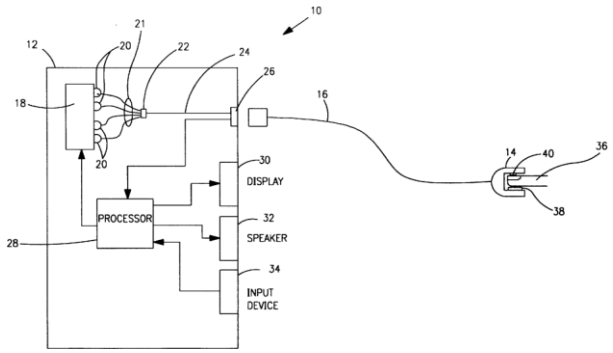
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	because the probe 14 does not include any light sources, it can be relatively small in size, does not necessarily have to include heat shielding, and can potentially be inexpensive to manufacture. Pologe at 7:26-42 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. the wearable device further comprising 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,	Pologe discloses or renders obvious the wearable device further comprising 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 another aspect of the present invention, a method is provided for photoplethysmographically measuring one or more arterial blood analytes. The method includes: providing a plurality of separate light signals, each light signal including a spectral content having a unique center frequency; combining the plurality of separate light signals into a single light signal; delivering, after the step of combining, the single light signal to the tissue so that the single light signal is directed into the tissue; detecting a transmitted light signal from the tissue; and processing the transmitted light signal to determine a blood analyte level for the tissue. Pologe at 30:18-28 In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. The received light pulses may then be delivered back to the main test unit

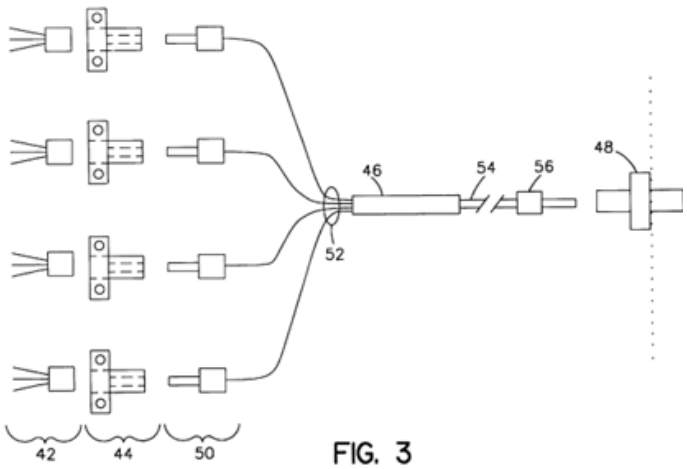
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	12, via probe cable 16, where they are processed to determine the level of one or more blood analytes in the person's arterial blood. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Before the light pulses are processed, it is generally required that they be converted to electrical form. This conversion may be performed in the probe, in which case the probe cable includes a thin electrical conductor for carrying the electrical signal back to the main test unit, or it may be performed in the main test unit 12, in which case the light signals are delivered back over the same or a different light transmission line in the probe cable. Pologe at 4:32-62 The main test unit 12 includes: an emitter module 18 having a plurality of emitters 20, each capable of producing a light signal having a unique spectral content; a plurality of optical cables 21 each coupled to a single emitter source for carrying the corresponding light signal; an optical coupler 22 for coupling light signals from each of the plurality of cables 21 to a single output cable 24; a front panel connector 26 for use in coupling the probe cable 16 to the main test unit 12; a processor unit 28 for performing processing and control functions; a display unit 30 for displaying measurement values to a user; a speaker 32 for providing audible tones to the user; 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 4:63-5:69 To perform an oxygen saturation measurement, the processor unit 28 sends a signal to the emitter unit 18 causing the emitters 20 to produce their corresponding light signals. The emitters 20 may include, for example, laser diodes or light emitting diodes (LEDs). In addition, in one embodiment of the invention, the plurality of emitters includes one or more broadband light sources and appropriate filtering means. As used herein, the term "light emitting diode" includes both infrared emitting diodes and ultraviolet emitting diodes. The light signals are combined in the optical coupler 22 into a single multiplexed light signal on output cable 24. Output cable 24 delivers the multiplexed signal to front panel connector 26 from which it is launched onto a single optical light guide within probe cable 16. Probe cable 16 delivers

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	the multiplexed light signal to the probe 14, from which it is directed into the test subject's finger 36. After the multiplexed light signal has been transmitted through the finger 36, it is returned to the main test unit 12 via probe cable 16 in either optical or electrical form. Pologe at 5:16-34 The optical coupler 22 may comprise any type of device capable of receiving individual light signals from multiple sources and combining them into a single multiplexed signal. In this regard, any of a number of different types of wavelength division multiplexing (WDM) couplers may be used, such as WDM couplers using lenses, prisms, interference filters, diffraction gratings, or butt coupling. Also, active WDM couplers can be used, such as those including cascaded or parallel emitters on a single substrate. Wavelength division multiplexing refers to any method whereby multiple light signals having unique and substantially non-overlapping spectral contents are coupled onto a common light guide. The individual components of the multiplexed signal can then be separated back out by any of a number of methods. Pologe at 5:45-59 The probe 14 includes means for directing the multiplexed light signal into the tissue under test (i.e., finger 36). In its simplest form, the means for directing consists of a structure for holding an end of the appropriate optical light guide adjacent to finger 36 while the probe 14 is properly positioned on the finger 36. For example, if the optical light guide is a fiber optic cable, the probe 14 can include mechanical fixturing for holding the cable so that an end of the cable is substantially flush with the base of the fingernail of the finger 36 and so that the light is directed into the finger. In one embodiment of this invention the light guide is actually brought into the probe parallel to the long axis of the finger and a miniature mirror is used to reflect the light 90 degrees down into the finger. Pologe at 7:12-25 The probe 14 also includes means for receiving the multiplexed light signal after it has been transmitted through the finger 36. In one embodiment, the means for receiving may include a photodetector, such as a pin or avalanche photodiode, for detecting the transmitted light signal and for converting it to an electrical signal. In another embodiment, the means for receiving may include means for coupling the

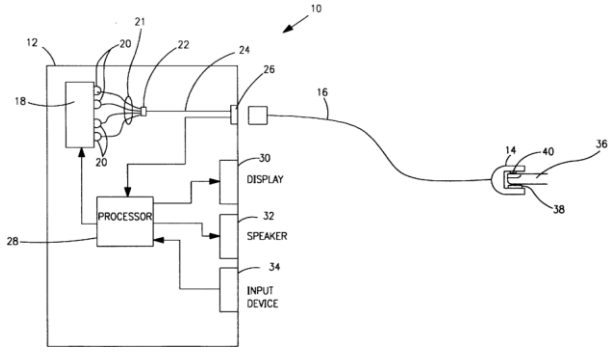
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	transmitted light signal into the end of a return optical light guide. In one embodiment, this is accomplished by simply holding an end of the return cable against an opposite side of the finger 36. Because the functions performed by the probe 14 are not structurally demanding, the probe 14 can be constructed of a relatively lightweight, inexpensive material, such as plastics or cloth. In addition, because the probe 14 does not include any light sources, it can be relatively small in size, does not necessarily have to include heat shielding, and can potentially be inexpensive to manufacture. Pologe at 7:26-42 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. wherein the detection system is configured to be synchronized to the light source;	Pologe discloses or renders obvious the detection system is configured to be synchronized to the light source. The main test unit 12 includes: an emitter module 18 having a plurality of emitters 20, each capable of producing a light signal having a unique spectral content; a plurality of optical cables 21 each coupled to a single emitter source for carrying the corresponding light signal; an optical coupler 22 for coupling light signals from each of the plurality of cables 21 to a single output cable 24; a front panel connector 26 for use in coupling the probe cable 16 to the main test unit 12; a processor unit 28 for performing processing and control functions; a display unit 30 for displaying measurement values to a user; a speaker 32 for providing audible tones to the user; 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 To perform an oxygen saturation measurement, the processor unit 28 sends a signal to the emitter unit 18 causing the emitters 20 to produce their corresponding light signals. The emitters 20 may include, for example, laser diodes or light emitting diodes (LEDs). In addition, in one embodiment of the invention,

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	the plurality of emitters includes one or more broadband light sources and appropriate filtering means. As used herein, the term "light emitting diode" includes both infrared emitting diodes and ultraviolet emitting diodes. The light signals are combined in the optical coupler 22 into a single multiplexed light signal on output cable 24. Output cable 24 delivers the multiplexed signal to front panel connector 26 from which it is launched onto a single optical light guide within probe cable 16. Probe cable 16 delivers the multiplexed light signal to the probe 14, from which it is directed into the test subject's finger 36. After the multiplexed light signal has been transmitted through the finger 36, it is returned to the main test unit 12 via probe cable 16 in either optical or electrical form. Pologe at 5:16-34  FIG. 1 Pologe at Fig. 1 The front panel connector 26 allows the probe cable 16 to be easily removed for storage, transport, or replacement purposes. These types of connectors are commercially available and are usually relatively low-loss. FIG. 3 is a diagram illustrating an emitter coupler configuration in accordance with one embodiment of the present invention. The configuration includes a plurality of laser diodes 42, a plurality of device mounts 44, and coupler unit 46, and a front panel connector 48. The laser diodes 42 each include multiple input leads for inputting electrical control signals. The device mounts 44 are each adapted to receive a single laser diode 42 and to align the diode with a multimode connector 50 in the coupler unit 46. The device mounts 44 are generally available off the shelf, such as part number 501474-

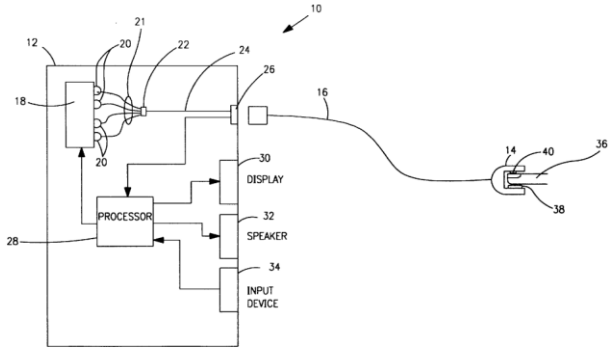
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	1 manufactured by Amp. The multimode connectors 50 feed a plurality of input optical fibers 52 that are coupled into a single output fiber 54. The output fiber 54 is coupled to another multimode connector 56 that is removably insertable into the front panel connector 48 for alignment with an external probe cable. Pologe at 6:31-43 The probe 14 also includes means for receiving the multiplexed light signal after it has been transmitted through the finger 36. In one embodiment, the means for receiving may include a photodetector, such as a pin or avalanche photodiode, for detecting the transmitted light signal and for converting it to an electrical signal. In another embodiment, the means for receiving may include means for coupling the transmitted light signal into the end of a return optical light guide. In one embodiment, this is accomplished by simply holding an end of the return cable against an opposite side of the finger 36. Because the functions performed by the probe 14 are not structurally demanding, the probe 14 can be constructed of a relatively lightweight, inexpensive material, such as plastics or cloth. In addition, because the probe 14 does not include any light sources, it can be relatively small in size, does not necessarily have to include heat shielding, and can potentially be inexpensive to manufacture. Pologe at 7:26-42 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. 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	Pologe 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 spatially separated detectors. The plurality of separate emitters includes multiple separate light sources, such as light emitting diodes (LEDs) and laser diodes. In general, the signal delivery means includes a single input/single output light guide such as a single optical fiber, a single fiber bundle, or other type of light guiding means. The single

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coupled to at least one of the spatially separated detectors;	input/single output light guide delivers light to a probe head which couples the light into the tissue under test. The probe head can also include detection means for converting the light signal transmitted through the tissue under test into an electrical signal. In one embodiment, the plurality of emitters and the combining unit are included in a housing, such as a bench top test unit or a handheld unit. The housing may also include means for communicating measurement results to users and means for receiving commands from users. The probe head is physically separated from the housing with the single input/single output light guide connecting them. Pologe at 3:1-17  FIG. 3 Pologe at Fig.3 The front panel connector 26 allows the probe cable 16 to be easily removed for storage, transport, or replacement purposes. These types of connectors are commercially available and are usually relatively low-loss. FIG. 3 is a diagram illustrating an emitter coupler configuration in accordance with one embodiment of the present invention. The configuration includes a plurality of laser diodes 42, a plurality of device mounts 44, and coupler unit 46, and a front panel connector 48. The laser diodes 42 each include multiple input leads for inputting electrical control signals. The device mounts 44 are each adapted to receive a single laser diode 42 and to align the diode with a multimode connector 50 in the

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	coupler unit 46. The device mounts 44 are generally available off the shelf, such as part number 501474-1 manufactured by Amp. The multimode connectors 50 feed a plurality of input optical fibers 52 that are coupled into a single output fiber 54. The output fiber 54 is coupled to another multimode connector 56 that is removably insertable into the front panel connector 48 for alignment with an external probe cable. Pologe at 6:31-43 The probe 14 also includes means for receiving the multiplexed light signal after it has been transmitted through the finger 36. In one embodiment, the means for receiving may include a photodetector, such as a pin or avalanche photodiode, for detecting the transmitted light signal and for converting it to an electrical signal. In another embodiment, the means for receiving may include means for coupling the transmitted light signal into the end of a return optical light guide. In one embodiment, this is accomplished by simply holding an end of the return cable against an opposite side of the finger 36. Because the functions performed by the probe 14 are not structurally demanding, the probe 14 can be constructed of a relatively lightweight, inexpensive material, such as plastics or cloth. In addition, because the probe 14 does not include any light sources, it can be relatively small in size, does not necessarily have to include heat shielding, and can potentially be inexpensive to manufacture. Pologe at 7:26-42 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input	Pologe discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least

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module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link.	a portion of the processed output signal is configured to be transmitted over a wireless transmission link.  FIG. 1 Pologe at Fig. 1 In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. 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. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Pologe at 4:32-54

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	The main test unit 12 includes: an emitter module 18 having a plurality of emitters 20, each capable of producing a light signal having a unique spectral content; a plurality of optical cables 21 each coupled to a single emitter source for carrying the corresponding light signal; an optical coupler 22 for coupling light signals from each of the plurality of cables 21 to a single output cable 24; a front panel connector 26 for use in coupling the probe cable 16 to the main test unit 12; a processor unit 28 for performing processing and control functions; a display unit 30 for displaying measurement values to a user; a speaker 32 for providing audible tones to the user; 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 In addition to the optical light guide that carries the light pulses to the probe 14, the probe cable 16 must also provide a path for the transmitted light pulses to travel back to the main test unit 12, for processing by the processor unit 28. As described above, the transmitted light pulses may be delivered back optically or electrically. If electrical transmission is used, the probe cable 16 includes conductive means, such as thin wires, for carrying the electrical signal. If optical transmission is used, the probe cable 16 may include a second optical light guide for transferring the transmitted pulses. Pologe at 7:1-11 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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, 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 one or more of the physiological parameters;	Pologe discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. The present invention relates to a system for performing photoplethysmographic measurements using wavelength division multiplexing. The system is relatively inexpensive to produce and is capable of efficiently and accurately performing photoplethysmographic measurements. The system uses

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	wavelength division multiplexing (WDM) to combine the light signals from multiple light sources in a main test unit into a single multiplexed signal before the signal is delivered to the probe. The multiplexed signal may then be delivered to the probe over a single optical line, such as a single fiber optic cable, a single fiber bundle, or any other single light guide. Pologe at 4:20-32  FIG. 1 Pologe at Fig. 1 In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. 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. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future.

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	Pologe at 4:32-54 The main test unit 12 includes: an emitter module 18 having a plurality of emitters 20, each capable of producing a light signal having a unique spectral content; a plurality of optical cables 21 each coupled to a single emitter source for carrying the corresponding light signal; an optical coupler 22 for coupling light signals from each of the plurality of cables 21 to a single output cable 24; a front panel connector 26 for use in coupling the probe cable 16 to the main test unit 12; a processor unit 28 for performing processing and control functions; a display unit 30 for displaying measurement values to a user; a speaker 32 for providing audible tones to the user; 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 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. 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;	Pologe discloses or renders obvious 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. In another aspect of the present invention, a method is provided for photoplethysmographically measuring one or more arterial blood analytes. The method includes: providing a plurality of separate light signals, each light signal including a spectral content having a unique center frequency; combining the plurality of separate light signals into a single light signal; delivering, after the step of combining, the single light signal to the tissue so that the single light signal is directed into the tissue; detecting a transmitted light signal from the tissue; and processing the transmitted light signal to determine a blood analyte level for the tissue. Pologe at 30:18-28

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	In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. 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. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Before the light pulses are processed, it is generally required that they be converted to electrical form. This conversion may be performed in the probe, in which case the probe cable includes a thin electrical conductor for carrying the electrical signal back to the main test unit, or it may be performed in the main test unit 12, in which case the light signals are delivered back over the same or a different light transmission line in the probe cable. Pologe at 4:32-62 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, 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	Pologe discloses or renders obvious the detection system further configured to generate a first signal responsive to light received while the semiconductor sources are off.

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while the semiconductor sources are off,	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, 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 semiconductor sources is on; and	Pologe discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the semiconductor sources is on. The plurality of separate emitters includes multiple separate light sources, such as light emitting diodes (LEDs) and laser diodes. In general, the signal delivery means includes a single input/single output light guide such as a single optical fiber, a single fiber bundle, or other type of light guiding means. The single input/single output light guide delivers light to a probe head which couples the light into the tissue under test. The probe head can also include detection means for converting the light signal transmitted through the tissue under test into an electrical signal. In one embodiment, the plurality of emitters and the combining unit are included in a housing, such as a bench top test unit or a handheld unit. The housing may also include means for communicating measurement results to users and means for receiving commands from users. The probe head is physically separated from the housing with the single input/single output light guide connecting them. Pologe at 3:1-17 To perform an oxygen saturation measurement, the processor unit 28 sends a signal to the emitter unit 18 causing the emitters 20 to produce their corresponding light signals. The emitters 20 may include, for example, laser diodes or light emitting diodes (LEDs). In addition, in one embodiment of the invention, the plurality of emitters includes one or more broadband light sources and appropriate filtering means. As used herein, the term "light emitting diode" includes both infrared emitting diodes and ultraviolet emitting diodes. The light signals are combined in the optical coupler 22 into a single multiplexed light signal on output cable 24. Output cable 24 delivers the multiplexed signal to front panel connector 26 from which it is launched onto a single optical light guide within probe cable 16. Probe cable 16 delivers the multiplexed light signal to the probe 14, from which it is directed into the test subject's finger 36.

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	After the multiplexed light signal has been transmitted through the finger 36, it is returned to the main test unit 12 via probe cable 16 in either optical or electrical form. Pologe at 5:16-34 The probe 14 also includes means for receiving the multiplexed light signal after it has been transmitted through the finger 36. In one embodiment, the means for receiving may include a photodetector, such as a pin or avalanche photodiode, for detecting the transmitted light signal and for converting it to an electrical signal. In another embodiment, the means for receiving may include means for coupling the transmitted light signal into the end of a return optical light guide. In one embodiment, this is accomplished by simply holding an end of the return cable against an opposite side of the finger 36. Because the functions performed by the probe 14 are not structurally demanding, the probe 14 can be constructed of a relatively lightweight, inexpensive material, such as plastics or cloth. In addition, because the probe 14 does not include any light sources, it can be relatively small in size, does not necessarily have to include heat shielding, and can potentially be inexpensive to manufacture. Pologe at 7:26-42 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, 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	Pologe discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. In another aspect of the present invention, a method is provided for photoplethysmographically measuring one or more arterial blood analytes. The method includes: providing a plurality of separate light signals, each light signal including a spectral content having a unique center frequency; combining the plurality of separate light signals into a single light signal; delivering, after the step of combining, the single light signal to the tissue so that the single light signal is directed into the tissue; detecting a

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	transmitted light signal from the tissue; and processing the transmitted light signal to determine a blood analyte level for the tissue. Pologe at 30:18-28 In one embodiment, as illustrated in FIG. 1, the invention is implemented in a pulse oximetry system 10. The system 10 comprises: a main test unit 12, a probe 14, and a probe cable 16. During a measurement, the probe 14 is first attached to an appropriate appendage of a person being tested, such as finger 36 illustrated in FIG. 1. Light pulses are then delivered from the main test unit 12 to the probe 14 via a single optical transmission line in the probe cable 16. The light pulses are then directed into the finger 36, travel through the finger 36, and emerge on the other side of the finger 36 where they are received by a light pick up device 38. 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. Processing methods to determine the blood analyte levels are known and, therefore, will not be discussed further. It should be understood, however, that the benefits of the present invention are independent of the precise method used to measure the analyte levels and, therefore, the invention may be used with virtually any processing method, whether currently known or developed in the future. Before the light pulses are processed, it is generally required that they be converted to electrical form. This conversion may be performed in the probe, in which case the probe cable includes a thin electrical conductor for carrying the electrical signal back to the main test unit, or it may be performed in the main test unit 12, in which case the light signals are delivered back over the same or a different light transmission line in the probe cable. Pologe at 4:32-62 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Pologe discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. It is an object of the present invention to provide a photoplethysmographic measurement system that utilizes wavelength division multiplexing (WDM) to deliver light pulses between a main test unit and a probe. Pologe at 2:8-11 The plurality of emitters can include, as described above, multiple separate light sources, such as light emitting diodes (LEDs) and laser diodes. Alternatively, the plurality of emitters can comprise one or more broadband light sources, such as a tungsten lamp, used with narrowband interference filters to generate multiple narrowband light signals. Pologe at 3:56-61 The present invention relates to a system for performing photoplethysmographic measurements using wavelength division multiplexing. The system is relatively inexpensive to produce and is capable of efficiently and accurately performing photoplethysmographic measurements. The system uses wavelength division multiplexing (WDM) to combine the light signals from multiple light sources in a main test unit into a single multiplexed signal before the signal is delivered to the probe. The multiplexed signal may then be delivered to the probe over a single optical line, such as a single fiber optic cable, a single fiber bundle, or any other single light guide. Pologe at 4:20-31 To perform an oxygen saturation measurement, the processor unit 28 sends a signal to the emitter unit 18 causing the emitters 20 to produce their corresponding light signals. The emitters 20 may include, for example, laser diodes or light emitting diodes (LEDs). In addition, in one embodiment of the invention,

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	the plurality of emitters includes one or more broadband light sources and appropriate filtering means. As used herein, the term "light emitting diode" includes both infrared emitting diodes and ultraviolet emitting diodes. The light signals are combined in the optical coupler 22 into a single multiplexed light signal on output cable 24. Output cable 24 delivers the multiplexed signal to front panel connector 26 from which it is launched onto a single optical light guide within probe cable 16. Probe cable 16 delivers the multiplexed light signal to the probe 14, from which it is directed into the test subject's finger 36. After the multiplexed light signal has been transmitted through the finger 36, it is returned to the main test unit 12 via probe cable 16 in either optical or electrical form. Pologe at 5:16-34 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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 1 above. Pologe disclsoes or renders obvious system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. The plurality of separate emitters includes multiple separate light sources, such as light emitting diodes (LEDs) and laser diodes. In general, the signal delivery means includes a single input/single output light guide such as a single optical fiber, a single fiber bundle, or other type of light guiding means. The single input/single output light guide delivers light to a probe head which couples the light into the tissue under test. The probe head can also include detection means for converting the light signal transmitted through the tissue under test into an electrical signal. In one embodiment, the plurality of emitters and the combining unit are included in a housing, such as a bench top test unit or a handheld unit. The housing may also include means for communicating measurement results to users and means for receiving

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	commands from users. The probe head is physically separated from the housing with the single input/single output light guide connecting them. Pologe at 3:1-17 The plurality of emitters can include, as described above, multiple separate light sources, such as light emitting diodes (LEDs) and laser diodes. Alternatively, the plurality of emitters can comprise one or more broadband light sources, such as a tungsten lamp, used with narrowband interference filters to generate multiple narrowband light signals. Pologe at 3:57-62 The probe 14 also includes means for receiving the multiplexed light signal after it has been transmitted through the finger 36. In one embodiment, the means for receiving may include a photodetector, such as a pin or avalanche photodiode, for detecting the transmitted light signal and for converting it to an electrical signal. In another embodiment, the means for receiving may include means for coupling the transmitted light signal into the end of a return optical light guide. In one embodiment, this is accomplished by simply holding an end of the return cable against an opposite side of the finger 36. Because the functions performed by the probe 14 are not structurally demanding, the probe 14 can be constructed of a relatively lightweight, inexpensive material, such as plastics or cloth. In addition, because the probe 14 does not include any light sources, it can be relatively small in size, does not necessarily have to include heat shielding, and can potentially be inexpensive to manufacture. Pologe at 7:26-42 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 3	

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3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	*See* claim 2 above. Pologe discloses or renders obvious the system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Pologe discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a wearable device adapted to be placed on a wrist or an ear of a user,	Pologe discloses or renders obvious a wearable device adapted to be placed on a wrist or an ear of a user. *See* above at claim 1[a].

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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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Pologe discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. the 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;	Pologe discloses or renders obvious the 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. *See* above at claim 1[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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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8[d]. the wearable device further comprising 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,	Pologe discloses or renders obvious the wearable device further comprising 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. *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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. wherein the detection system is configured to be synchronized to the light source;	Pologe discloses or renders obvious the detection system is configured to be synchronized to the light source. *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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. 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	Pologe 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 spatially separated detectors. *See* above at claim 1[f].

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coupled to at least one of the spatially separated detectors;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Pologe discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Pologe discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h].

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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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[i]. 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; and	Pologe discloses or renders obvious 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. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Pologe 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* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Pologe discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Pologe discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Pologe discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. *See* above 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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 8 above. Pologe discloses or renders obvious the system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths	*See* claim 9 above. Pologe discloses or renders obvious the system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. *See* above at claim 1[m].

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comprise near infrared and visible wavelengths.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Pologe discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Pologe discloses or renders obvious a wearable device adapted to be placed on a wrist or an ear of a user. *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Pologe discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[c]. the 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;	Pologe discloses or renders obvious the 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. *See* above at claim 1[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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[d]. the wearable device further comprising a detection system configured to receive at least a portion of the lens output light	Pologe discloses or renders obvious the wearable device further comprising 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. *See* above at claim 1[d].

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reflected from the tissue and to generate an output signal having a signal-to-noise ratio,	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[e]. wherein the detection system is configured to be synchronized to the light source;	Pologe discloses or renders obvious the detection system is configured to be synchronized to the light source. *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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[f]. 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 spatially separated detectors;	Pologe 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Pologe discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Pologe discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[i]. 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; and	Pologe discloses or renders obvious 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. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Pologe 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* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Pologe discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[k].

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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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal;	Pologe discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Pologe discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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 Pologe, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[j]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Pologe discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. *See* above at claim 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 Pologe, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Pologe, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT E13

U.S. Pat. No. 11,160,455 in view of U.S. Patent No. 8,108,036 to Bao Tran ("Tran")

As described in detail below, Tran (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 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 E1-E12 and E14-E18, 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 '455 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").

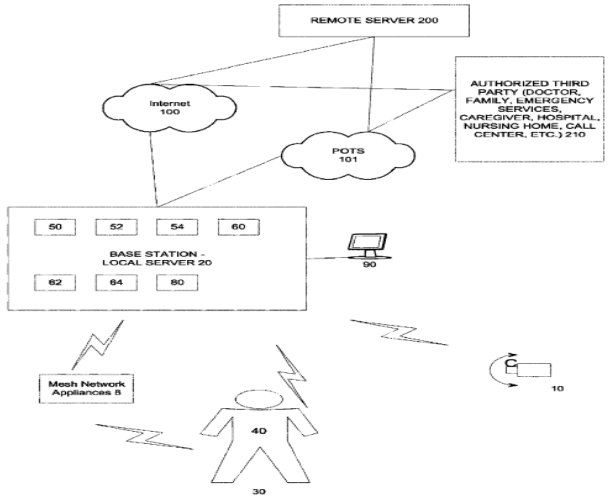
The following invalidity chart includes references to the structure, function, operation, and/or features of the technology described in Tran. The cited portions of Tran are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions 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 '455 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.

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Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Tran discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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, 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. In another aspect, a monitoring system for a person includes one or more wireless bases; and a cellular telephone having a wireless transceiver adapted to communicate with the one or more wireless bases; and an accelerometer to detect a dangerous condition and to generate a warning when the dangerous condition is detected. Tran at 3:48-4:19

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	Additionally, a sudden change ofactivity (or inactivity) can indicate a problem. The remote healthcare provider may receive alerts over the Internet or urgent notifications over the phone in case of such sudden accident indicating changes. Tran at 5:44-47  FIG. 1 Tran at Fig. 1 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

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	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 A module communicates with a third party such as the police department, a security monitoring center, or a call center. The module operates with a POTS telephone and can use a broadband medium such as DSL or cable network if available. The module 80 requires that at least the telephone is available as a lifeline support. In this embodiment, duplex sound transmission is done using the POTS telephone network. The broadband network, if available, is optional for high resolution video and other advanced services transmission. During operation, the module checks whether broadband network is available. If broadband network is available, the module 80 allows high resolution video, among others, to be broadcasted directly from the server 20 to the third party or indirectly from the server 20 to the remote server 200 to the third party. In parallel, the module 80 allows sound to be transmitted using the telephone circuit. In this manner, high resolution video can be transmitted since sound data is sepa- rately sent through the POTS network. If broadband network is not available, the system relies on the POTS telephone network for transmission of voice and images. In this system, one or more images are compressed for burst transmission, and at the request of the third party or the remote server 200, the telephone's sound system is placed on hold for a brief period to allow transmission ofimages over the POTS network. In this manner, existing POTS lifeline telephone can be used to monitor patients. The resolution and quantity of images are selectable by the third party. Thus, using only the lifeline as a communication medium, the person monitoring the

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	patient can elect to only listen, to view one high resolution image with duplex telephone voice transmission, to view a few low resolution images, to view a compressed stream of low resolution video with digitized voice, among others. Tran at 18:32-65 Communication between the patient's remote location and the central station can be initiated by a variety of techniques. One method is by manually or automatically placing a call on the telephone to the patient's home or from the patient's home to the central station. Tran at 19:30-34 In the camera embodiment, the transactions between the server 200 and one of the remote servers 200 are detailed. The server 200 compares one image frame to the next image frame. If no difference exists, the duplicate frame is deleted to minimize storage space. If a difference exists, only the difference information is stored as described in the JPEG standard. This operation effectively compresses video information so that the camera images can be transmitted even at telephone modem speed of 64 k or less. More aggressive compression techniques can be used. For example, patient movements can be clusterized into a group of known motion vectors, and patient movements can be described using a set of vectors. Only the vector data is saved. During view back, each vector is translated into a picture object which is suitably rasterized. The information can also be compressed as motion information. Next, the server 200 transmits the compressed video to the remote server 200. The server 200 stores and caches the video data so that multiple viewers can view the images at once since the server 200 is connected to a network link such as telephone line modem, cable modem, DSL modem, and ATM transceiver, among others. Tran at 20:14-35 The system also provides a patient interface 90 to assist the patient in easily accessing information. In one embodiment, the patient interface includes a touch screen; voice-activated text reading; one touch telephone dialing; and video conferencing. The touch screen has large icons that are pre-selected to the patient's needs, such as his or her favorite web sites or application programs. The voice activated text

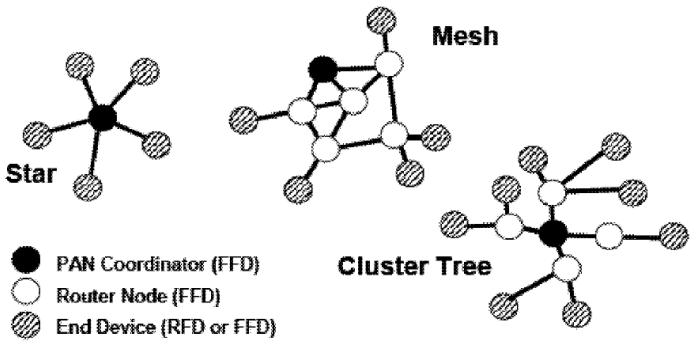
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	reading allows a user with poor eye-sight to get information from the patient interface 90. Buttons with pre-designated dialing numbers, or video conferencing contact information allow the user to call a friend or a healthcare provider quickly. Tran at 21:4-14 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, the wearable appliance permits direct access to the call center when the user pushes a switch or button on the appliance, for instance. In one implementation, telephones and switching systems in call centers are integrated with the home mesh network to provide for, among other things, better routing of telephone calls, faster delivery of telephone calls and associated information, and improved service with regard to client satisfaction through computer-telephony integration (CTI). CTI implementations of various design and purpose are implemented both within individual call-centers and, in some cases, at the telephone network level. For example, processors running CTI software applications may be linked to telephone switches, service control points (SCPs), and network entry points within a public or private telephone network. At the call-center level, CTI-enhanced processors, data servers, transaction servers, and the like, are linked to telephone switches and, in some cases, to similar CTI hardware at the network level, often by a dedicated digital link. CTI processors and other hardware within a call-center is commonly referred to as customer premises equipment (CPE). It is the CTI processor and application software is such centers that provides computer enhancement to a call center. In a CTI-enhanced call center, telephones at agent stations are connected to a central telephony switching apparatus, such as an automatic call distributor (ACD) switch or a private branch exchange (PBX). The agent stations may also be equipped with computer terminals such as personal computer/video display unit's (PC/VDU's) so that agents manning such stations may have access to stored data as well as being linked to incoming callers by telephone equipment. Such stations may be interconnected through the

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	PC/VDUs by a local area network (LAN). One or more data or transaction servers may also be connected to the LAN that interconnects agent stations. The LAN is, in turn, typically connected to the CTI processor, which is connected to the call switching apparatus of the call center. When a call from a patient arrives at a call center, whether or not the call has been pre-processed at an SCP, the telephone number of the calling line and the medical record are made available to the receiving switch at the call center by the network provider. This service is available by most networks as caller-ID information in one of several formats such as Automatic Number Identification (ANI). Typically the number called is also available through a service such as Dialed Number Identification Service (DNIS). If the call center is computer-enhanced (CTI), the phone number of the calling party may be used as a key to access additional medical and/or historical information from a customer information system (CIS) database at a server on the network that connects the agent workstations. In this manner information pertinent to a call may be provided to an agent, often as a screen pop on the agent's PC/VDU. Tran at 29:30-30:14 The system can also determine vital parameter including patient heart rate (1006). The system determines if patient needs assistance based on indoor position, fall detection and vital parameter (1008). If a fall is suspected, the system confirms the fall by communicating 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 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-todevice communications for PDAs and smart phones. C-

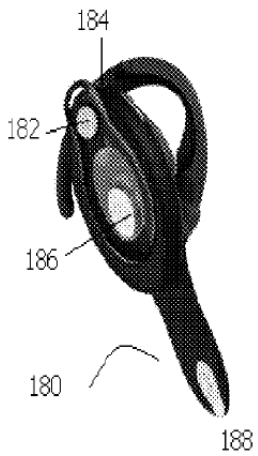
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	guys' ZigBee SDIO card includes the company's CG-100 SDIO application interface controller, which is designed to convert an application signal to an SD signal (or vice versa). The ZigBee card can provide signal ranges ofup to 10 min the 2.4 GHz band 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. Tran at 33:58-34:40 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 42:35-47  FIG. 7

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	Tran at Fig.7 FIG. 7 shows an exemplary mesh network that includes the wrist-watchof FIG. 6 in communication with a mesh network including a telephone such as a wired telephone as well as a cordless telephone. In one embodiment, the mesh network is an IEEE 802.15.4 (ZigBee) network. IEEE 802.15.4 defines two device types; the reduced function device (RFD) and the full function device (FFD). In ZigBee these are referred to as the ZigBee Physical Device types. In a ZigBee network a node can have three roles: ZigBee Coordinator, ZigBee Router, and ZigBee End Device. These are the ZigBee Logical Device types. The main responsibility of a ZigBee Coordinator is to establish a network and to define its main parameters (e.g. choosing a radio-frequency charmel and defining a unique network identifier). One can extend the communication range of a network by using ZigBee Routers. These can act as relays between devices that are too far apart to communicate directly. ZigBee End Devices do not participate in routing. An FFD can talk to RFDs or other FFDs, while an RFD can talk only to an FFD. An RFD is intended for applications that are extremely simple, such as a light switch or a passive infrared sensor; they do not have the need to send large amounts of data and may only associate with a single FFD at a time. Consequently, the RFD can be implemented using minimal resources and memory capacity and have lower cost than an FFD. An FFD can be used to implement all three ZigBee Logical Device types, while an RFD can take the role as an End Device. Tran at 64:23-49 The network nodes can be mesh network appliances to provide voice communications, home security, door access control, lighting control, power outlet control, dimmer control, switch control, temperature control, humidity control, carbon monoxide control, fire alarm control, blind control, shade control, window control, oven control, cooking range control, personal computer control, entertainment console control, television control, projector control, garage door control, car control, pool temperature control, water pump control, furnace control, heater control, thermostat control, electricity meter monitor, water meter monitor, gas meter monitor, or remote diagnotics. The telephone can be connected to a cellular telephone to answer calls directed at the cellular telephone. The connection can be wired or wireless using Bluetooth or ZigBee. The telephone synchronizes calendar, contact, emails, biogs, or instant messaging with the cellular telephone. Similarly, the telephone synchronizes calendar, contact, emails, biogs, or instant messaging with a personal computer. A web server can communicate with the Internet through the POTS to provide information to an authorized remote user who logs into the server. A

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	wireless router such as 802.11 router, 802.16 router, WiFi router, WiMAX router, Bluetooth router, Xl0 router can be connected to the mesh network. Tran at 65:39-62 In one exemplary monitoring service providing system, such as an emergency service providing system, the system includes a communication network (e.g., the Public Switch Telephone Network or PSTN or POTS), a wide area communication network (e.g., TCP /IP network) in call centers. The communication network receives calls destined for one of the call centers. In this regard, each call destined for one of the call centers is preferably associated with a particular patient, a call identifier or a call identifier of a particular set of identifiers. A call identifier associated with an incoming call may be an identifier dialed or otherwise input by the caller. For example, the call centers may be locations for receiving calls from a particular hospital or nursing home. Tran at 70:61-71:6 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 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

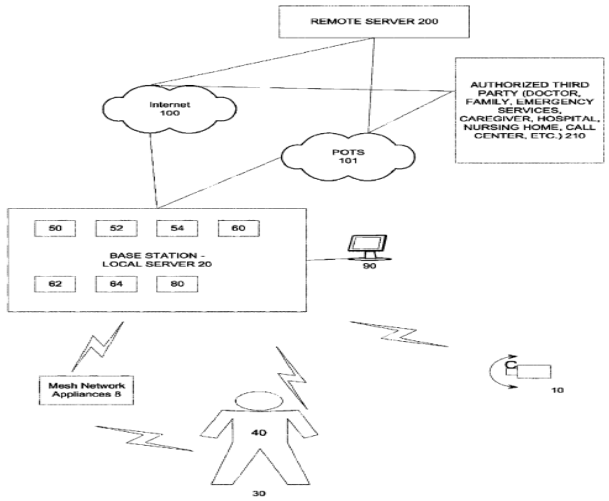
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	 FIG. 13 Tran at Fig.13 FIG. 13 shows an exemplary ear phone embodiment 180. The ear phone 180 has an optical transmitter 182 which emits LED wavelengths that are received by the optical receiver 184. The blood oximetry information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication 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 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

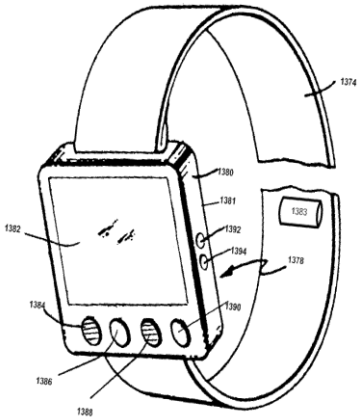
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	identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Tran, it would have been obvious to one of ordinary 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[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, and	Tran discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. 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 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

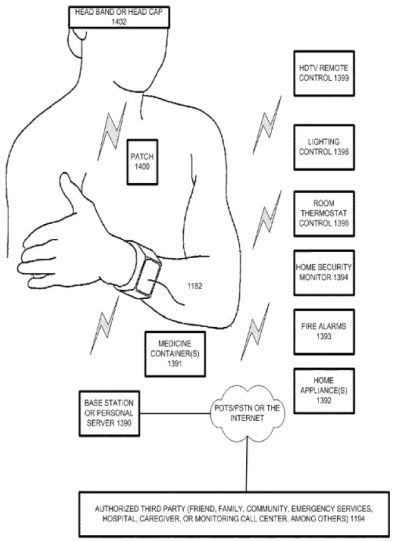
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	The wearable appliance is small, easily worn by the patient during periods of exercise or day-to-day activities, and noninvasively measures blood pressure can be done in a matter of seconds without affecting the patient. An on-board or remote processor 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 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

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	 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

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	could be plotted on a map by the server, and used to locate a patient during an emergency, e.g. to dispatch an ambulance. Tran at 26:11-16  FIG. 6A Tran at Fig.6A FIG. 6A shows a portable embodiment of the present invention where the voice recognizer is housed in a wristwatch. 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 34:41-56

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	 FIG. 6B Tran at Fig.6B 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

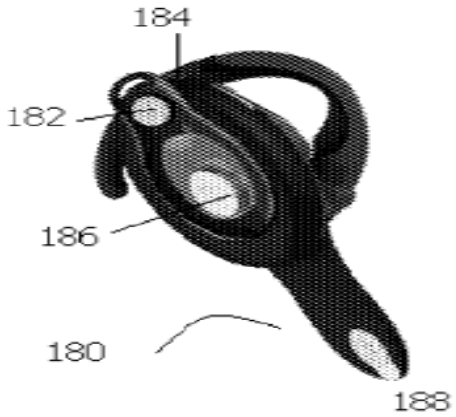
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	In one embodiment, the sensors are mounted on the patient's wrist (such as a wristwatch sensor) and other convenient anatomical locations. Tran at 58:60-62 In one embodiment, the sensors for monitoring vital signs are enclosed in a wrist-watch sized 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 Tran at 61:63-62:7 In a digital stethoscope embodiment, a microphone or a piezoelectric transducer is placed near the wrist artery to pick up heart rate information. In one embodiment, the microphone sensor and optionally the EKG sensor are place on the wristband 1374 of the watch to analyze the acoustic signal or signals emanating from the cardiovascular system and, optionally can combine the sound with an electric signal (EKG) emanating from the cardiovascular system and/or an acoustic signal emanating from the respiratory system. Tran at 63:6-14

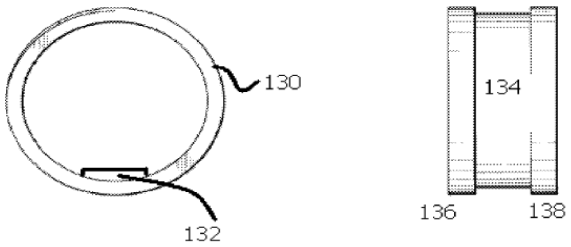
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	In an embodiment to be worn on the patient's ear lo be, the monitoring device can be part of an earring jewelry clipped to the ear lobe. In the implementation of FIG. 10, the monitoring device has a jewelry body 149 that contains the monitoring electronics and power source. The surface of the body 149 is an ornamental surface such as jade, ivory, pearl, silver, or gold, among others. The body 149 has an opening 148 that transmits energy such as optical or acoustic energy through the ear lobe to be detected by a sensor 144 mounted on a clamp portion that is secured to the body 149 at a base 147. The energy detected through the sensor 144 is communicated through an electrical connector to the electronics in the jewelry body 149 for processing the received energy and for performing wireless communication with a base station. In FIG. 2E, a bolt 145 having a stop end 146 allows the user to adjust the pressure of the clamp against the ear lobe. In other implementations, a spring biased clip is employed to retain the clip on the wearer's ear lobe. A pair of members, which snap together under pressure, are commonly used and the spring pressure employed should be strong enough to suit different thicknesses of the ear lobe. 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 67:49-68:13 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

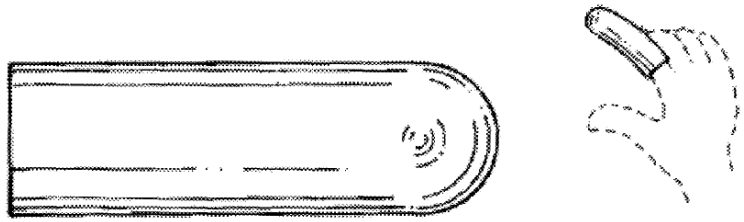
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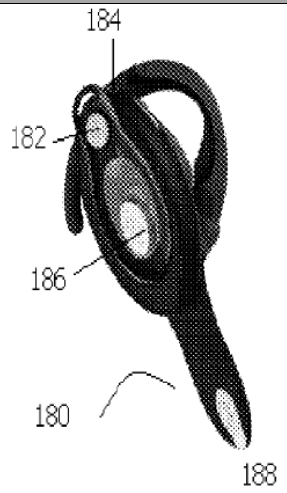
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	FIG. 14B shows a sunglass or eyeglass embodiment which contains electronics for communicating with the mesh network and for sensing acceleration and bioimpedance, EKG/ ECG, EMG, heart sound, microphone, optical sensor, or ultrasonic sensor in contacts 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 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

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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[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	Tran discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths.  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

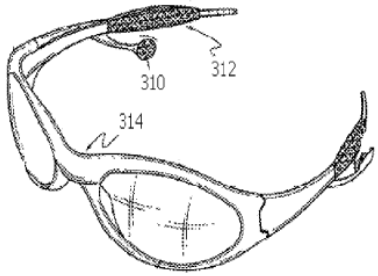
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	light source and the photo-detector are slidably adjustable and can be moved along the wrist band to optimize beam transmission and pick up. As the heart pumps blood through the patient's finger, blood cells absorb and transmit varying amounts of 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 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

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	A driving and receiving circuit generates electrical pulses which, when applied to the transducer, produce acoustic energy having a frequency on the order of 8 MHz, a pulse width or duration of approximately 8 microseconds, and a pulse repetition interval (PRI) of approximately 16 μs, although other values of frequency, pulse width, and PRI may be used. In one embodiment, the transducer 84 emits an 8 microsecond pulse, which is followed by an 8 microsecond “listen” period, every 16 microseconds. The echoes from these pulses are received by the ultrasonic transducer 84 during the listen period. The ultrasonic transducer can be a ceramic piezoelectric device of the type well known in the art, although other types may be substituted. Tran at 62: 5-29  FIG. 8 Tran at Fig. 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 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

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	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 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. 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 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the

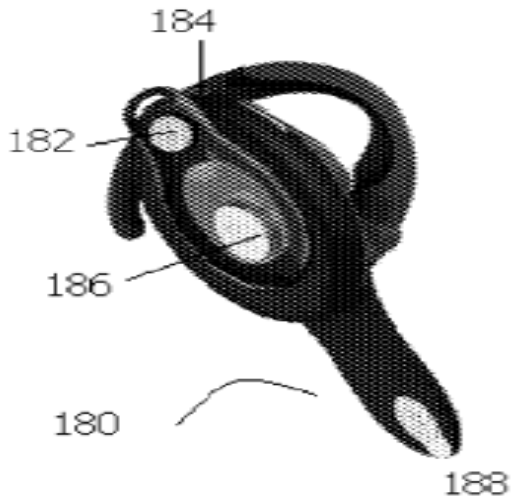
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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To 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[c]. the 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;	Tran discloses or renders obvious the 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. 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 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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	 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 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 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.
1[d]. the wearable device further comprising a detection system configured to receive at least a portion of the lens output light	Tran discloses or renders obvious the wearable device further comprising 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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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 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. 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

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	 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.

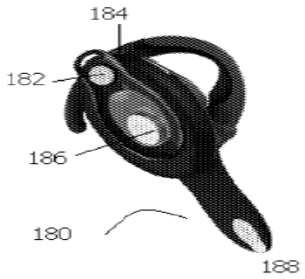
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	Tran at 36:62-37:12 In one implementation, BIA measurements can be made using an array of bipolar or tetrapolar electrodes that deliver a constant alternating current at 50 KHz frequency. Whole body measurements can be done using standard right-sided. 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 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.

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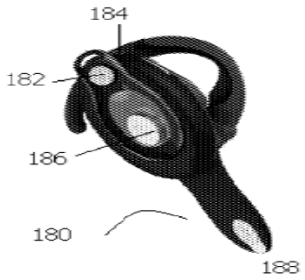
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	Tran at 60:58-61:5 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical 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 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

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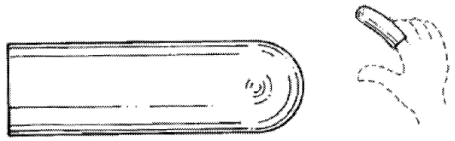
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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Tran, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. wherein the detection system is configured to be synchronized to the light source;	Tran discloses or renders obvious the detection system is configured to be synchronized to the light source.  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

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	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[f]. 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 spatially separated 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 spatially separated detectors. The amplified EKG signal is internally fed to the on chip analog to digital converter. Tran at 35:8-9 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

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	 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 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

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	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 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 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  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.
1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Tran discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. 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, 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. In another aspect, a monitoring system for a person includes one or more wireless bases; and a cellular telephone having a wireless transceiver adapted to communicate with the one or more wireless bases; and an accelerometer to detect a dangerous condition and to generate a warning when the dangerous condition is detected.

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	Tran at 3:48-4:19 Additionally, a sudden change ofactivity (or inactivity) can indicate a problem. The remote healthcare provider may receive alerts over the Internet or urgent notifications over the phone in case of such sudden accident indicating changes. Tran at 5:44-47 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 The case may be of a number of variations of shape but can be conveniently made a rectangular, approaching a box-like configuration. 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-

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	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 10:10-31 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 A module communicates with a third party such as the police department, a security monitoring center, or a call center. The module operates with a POTS telephone and can use a broadband medium such as DSL or cable network if available. The module 80 requires that at least the telephone is available as a lifeline support. In this embodiment, duplex sound transmission is done using the POTS telephone network. The broadband network, if available, is optional for high resolution video and other advanced services transmission. During operation, the module checks whether broadband network is available. If broadband network is available, the module 80 allows high resolution video, among others, to be broadcasted directly from the server 20 to the third party or indirectly from the server 20 to the remote server 200 to the third party. In parallel, the module 80 allows sound to be transmitted using the telephone circuit. In this manner, high resolution video can be transmitted since sound data is separately sent through the POTS network. If broadband network is not available, the system relies on the POTS telephone network for transmission of voice and images. In this system, one or more images are compressed for burst transmission, and at the request of the third party or the remote server 200, the telephone's sound system is placed on hold for a brief period to allow transmission ofimages over the POTS network. In this manner, existing POTS

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	lifeline telephone can be used to monitor patients. The resolution and quantity of images are selectable by the third party. Thus, using only the lifeline as a communication medium, the person monitoring the patient can elect to only listen, to view one high resolution image with duplex telephone voice transmission, to view a few low resolution images, to view a compressed stream of low resolution video with digitized voice, among others. Tran at 18:32-65 Communication between the patient's remote location and the central station can be initiated by a variety of techniques. One method is by manually or automatically placing a call on the telephone to the patient's home or from the patient's home to the central station. Tran at 19:30-34 In the camera embodiment, the transactions between the server 200 and one of the remote servers 200 are detailed. The server 200 compares one image frame to the next image frame. If no difference exists, the duplicate frame is deleted to minimize storage space. If a difference exists, only the difference information is stored as described in the JPEG standard. This operation effectively compresses video information so that the camera images can be transmitted even at telephone modem speed of 64 k or less. More aggressive compression techniques can be used. For example, patient movements can be clusterized into a group of known motion vectors, and patient movements can be described using a set of vectors. Only the vector data is saved. During view back, each vector is translated into a picture object which is suitably rasterized. The information can also be compressed as motion information. Next, the server 200 transmits the compressed video to the remote server 200. The server 200 stores and caches the video data so that multiple viewers can view the images at once since the server 200 is connected to a network link such as Hypertelephone line modem, cable modem, DSL modem, and ATM transceiver, among others. Tran at 20:14-35 The system also provides a patient interface 90 to assist the patient in easily accessing information. In one embodiment, the patient interface includes a touch screen; voice-activated text reading; one touch

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	telephone dialing; and video conferencing. The touch screen has large icons that are pre-selected to the patient's needs, such as his or her favorite web sites or application programs. The voice activated text reading allows a user with poor eye-sight to get information from the patient interface 90. Buttons with pre-designated dialing numbers, or video conferencing contact information allow the user to call a friend or a healthcare provider quickly. Tran at 21:4-14 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, the wearable appliance permits direct access to the call center when the user pushes a switch or button on the appliance, for instance. In one implementation, telephones and switching systems in call centers are integrated with the home mesh network to provide for, among other things, better routing of telephone calls, faster delivery of telephone calls and associated information, and improved service with regard to client satisfaction through computertelephony integration (CTI). CTI implementations of various design and purpose are implemented both within individual call-centers and, in some cases, at the telephone network level. For example, processors running CTI software applications may be linked to telephone switches, service control points (SCPs), and network entry points within a public or private telephone network. At the call-center level, CTI-enhanced processors, data servers, transaction servers, and the like, are linked to telephone switches and, in some cases, to similar CTI hardware at the network level, often by a dedicated digital link. CTI processors and other hardware within a call-center is commonly referred to as customer premises equipment (CPE). It is the CTI processor and application software is such centers that provides computer enhancement to a call center. In a CTI-enhanced call center, telephones at agent stations are connected to a central telephony switching apparatus, such as an automatic call distributor (ACD) switch or a private branch exchange (PBX). The agent stations may also be equipped with computer terminals such as personal computer/video display

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	unit's (PC/VDU's) so that agents manning such stations may have access to stored data as well as being linked to incoming callers by telephone equipment. Such stations may be interconnected through the PC/VDUs by a local area network (LAN). One or more data or transaction servers may also be connected to the LAN that interconnects agent stations. The LAN is, in turn, typically connected to the CTI processor, which is connected to the call switching apparatus of the call center. When a call from a patient arrives at a call center, whether or not the call has been pre-processed at an SCP, the telephone number of the calling line and the medical record are made available to the receiving switch at the call center by the network provider. This service is available by most networks as caller-ID information in one of several formats such as Automatic Number Identification (ANI). Typically the number called is also available through a service such as Dialed Number Identification Service (DNIS). If the call center is computer-enhanced (CTI), the phone number of the calling party may be used as a key to access additional medical and/or historical information from a customer information system (CIS) database at a server on the network that connects the agent workstations. In this manner information pertinent to a call may be provided to an agent, often as a screen pop on the agent's PC/VDU. Tran at 29:30-30:14 The system can also determine vital parameter including patient heart rate (1006). The system determines if patient needs assistance based on indoor position, fall detection and vital parameter (1008). If a fall is suspected, the system confirms the fall by communicating 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 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

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	SDIO card from C-guys, Inc., enables device-todevice 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 ofup to 10 min 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 charmel 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 33:58-34:40 The wrist-band 1374 further contains an antenna 1376 for transmitting or receiving radio frequency signals. The wristband 13 7 4 and the antenna 13 7 6 inside the band are mechanically coupled to the top and bottom sides of the wrist-watch housing 1380. Further, the antenna 1376 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 1380 contains the processor and associated peripherals to provide the human-machine interface. A display 1382 is located on the front section of the housing 1380. A speaker 1384, a microphone 1388, and a plurality of push-button switches 1386 and 1390 are also located on the front section of housing 1380. Tran at 37:35-50 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

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	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 42:35-47 FIG. 7 shows an exemplary mesh network that includes the wrist-watch of FIG. 6 in communication with a mesh network including a telephone such as a wired telephone as well as a cordless telephone. In one embodiment, the mesh network is an IEEE 802.15.4 (ZigBee) network. IEEE 802.15.4 defines two device types; the reduced function device (RFD) and the full function device (FFD). In ZigBee these are referred to as the ZigBee Physical Device types. In a ZigBee network a node can have three roles: ZigBee Coordinator, ZigBee Router, and ZigBee End Device. These are the ZigBee Logical Device types. The main responsibility of a ZigBee Coordinator is to establish a network and to define its main parameters (e.g. choosing a radio-frequency charmel and defining a unique network identifier). One can extend the communication range of a network by using ZigBee Routers. These can act as relays between devices that are too far apart to communicate directly. ZigBee End Devices do not participate in routing. An FFD can talk to RFDs or other FFDs, while an RFD can talk only to an FFD. An RFD is intended for applications that are extremely simple, such as a light switch or a passive infrared sensor; they do not have the need to send large amounts of data and may only associate with a single FFD at a time. Consequently, the RFD can be implemented using minimal resources and memory capacity and have lower cost than an FFD. An FFD can be used to implement all three ZigBee Logical Device types, while an RFD can take the role as an End Device. Tran at 64:23-49 The network nodes can be mesh network appliances to provide voice communications, home security, door access control, lighting control, power outlet control, dimmer control, switch control, temperature control, humidity control, carbon monoxide control, fire alarm control, blind control, shade control, window control, oven control, cooking range control, personal computer control, entertainment console control, television control, projector control, garage door control, car control, pool temperature control, water pump control, furnace control, heater control, thermostat control, electricity meter monitor, water

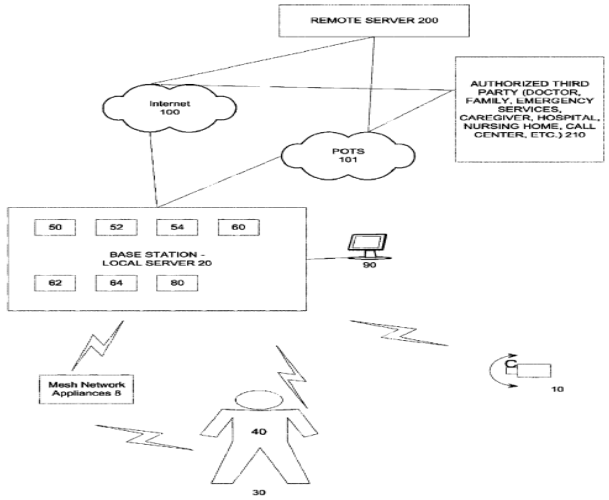
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	meter monitor, gas meter monitor, or remote diagnotics. The telephone can be connected to a cellular telephone to answer calls directed at the cellular telephone. The connection can be wired or wireless using Bluetooth or ZigBee. The telephone synchronizes calendar, contact, emails, biogs, or instant messaging with the cellular telephone. Similarly, the telephone synchronizes calendar, contact, emails, biogs, or instant messaging with a personal computer. A web server can communicate with the Internet through the POTS to provide information to an authorized remote user who logs into the server. A wireless router such as 802.11 router, 802.16 router, WiFi router, 60 WiMAX router, Bluetooth router, Xl0 router can be connected to the mesh network. Tran at 65:39-62 In one exemplary monitoring service providing system, such as an emergency service providing system, the system includes a communication network (e.g., the Public Switch Telephone Network or PSTN or POTS), a wide area communication network (e.g., TCP /IP network) in call centers. The communication network receives calls destined for one of the call centers. In this regard, each call destined for one of the call centers is preferably associated with a particular patient, a call identifier or a call identifier of a particular set of identifiers. A call identifier associated with an incoming call may be an identifier dialed or otherwise input by the caller. For example, the call centers may be locations for receiving calls from a particular hospital or nursing home. Tran at 70:61-71:6 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 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 one or more of the physiological parameters;	Tran discloses or renders obvious the output signal is indicative of one or more of the physiological parameters.

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	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

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	 FIG. 1 Tran at Fig. 1 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 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

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	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 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 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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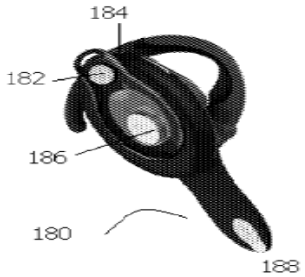
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	information is generated and used to determine blood pulse or blood pressure. Additionally, a module 186 contains mesh network communication electron ics, accelerometer, and physiological sensors such as EKG/ ECG sensors or temperature sensors or 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 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.
1[i]. 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;	Tran discloses or renders obvious 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. 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.

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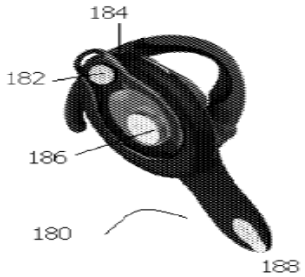
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	Tran at 37: 13-34 Turning now to FIGS. 8-13, various exemplary monitoring devices are shown. In FIG. 8, a ring 130 has an opening 132 for transmitting and receiving acoustic energy to and from the sensor 84 in an acoustic implementation. In an optical 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 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

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	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 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	Tran discloses or renders obvious the detection system further configured to generate a first signal responsive to light received while the semiconductor sources are off. 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

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while the semiconductor sources are off,	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  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

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	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[k]. generate a second signal responsive to light received while at least one of the semiconductor sources is on; and	Tran discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the semiconductor sources is on. 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

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	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  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

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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 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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 first signal and the second signal; and	Tran discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. 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

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	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 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 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.

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	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 plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Tran discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. 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

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	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 36:62-67:12 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 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 1 above. Tran discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. 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

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	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 52:36-57 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. 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.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	*See* claim 2 above. Tran discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. 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 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

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	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 68:24-27 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 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 system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Tran discoses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 wearable device adapted to be placed on a wrist or an ear of a user,	Tran discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, and *See* above at claim 1[a].

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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.
8[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Tran discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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]. the 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;	Tran discloses or renders obvious the 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. *See* above at claim 1[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 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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8[d]. the wearable device further comprising 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 the wearable device further comprising 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. *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[e]. 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. *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 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]. 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 spatially separated 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly 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.
8[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link.	Tran discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Tran discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
8[h]. 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; and	Tran discloses or renders obvious 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. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[i]. 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* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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[j]. 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 the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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.
8[k]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Tran discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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[l]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Tran discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. *See* above 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 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 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially	*See* claim 8 above. Tran discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.

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separated detectors are located on one or more arcs.	*See* above 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 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 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	*See* claim 9 above. Tran discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. *See* above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity 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 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Tran discoses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *See* above at claim 1[pre].

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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.
15[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Tran discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Tran discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[c]. the 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;	Tran discloses or renders obvious the 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. *See* above at claim 1[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 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.
15[d]. the wearable device further comprising 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 the wearable device further comprising 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. *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.
15[e]. 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. *See* above at claim 1[e].

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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.
15[f]. 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 spatially separated 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and	Tran discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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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display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	identified in Defendants’ Invalidity 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.
15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Tran discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[i]. 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; and	Tran discloses or renders obvious 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. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[j]. the detection system further configured to:	Tran discloses or renders obvious the detection system further configured to generate a first signal responsive to light received while the semiconductor sources are off.

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generate a first signal responsive to light received while the light emitting diodes are off,	*See* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[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 the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Tran discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity 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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15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Tran discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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 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.
15[m]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Tran discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. *See* above at claim 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 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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EXHIBIT E14

U.S. Pat. No. 11,160,455 in view of US Patent Publication No. 2012/0197093 ("Valencell")

As described in detail below, Valencell (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 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 E1-E13 and E15-E18, 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 '455 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 Valencell. The cited portions of Valencell are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Valencell. 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 Valencell "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Valencell 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 Valencell (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 Valencell anticipates and/or renders obvious the Asserted Claims of the '455 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.

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Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Valencell discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. Apparatus and methods for attenuating environmental interference are described. A wearable monitoring apparatus includes a housing configured to be attached to the body of a subject and a sensor module that includes an energy emitter that directs energy at a target region of the subject, a detector that detects an energy response signal—or physiological condition—from the subject, a filter that removes time-varying environmental interference from the energy response signal, and at least one processor that controls operations of the energy emitter, detector, and filter. Valencell at [Abstract] The present invention relates generally to monitoring apparatus and methods and, more particularly, to physiological monitoring apparatus and methods. Valencell at [0002] According to some embodiments of the present invention, a medium (e.g., physiological material of a subject), having a region of interest, is monitored via a sensor module having at least one energy emitter for interrogating the medium with energy to generate an energy response associated with the medium, at least one circuit to drive at least one energy emitter, at least one detector for detecting the energy response associated with the medium, a filter that removes time-varying environmental interference from the energy response signal, and a processor that controls operations of the energy emitter, detector, and filter. Valencell at [0005] According to some embodiments of the present invention, a wearable monitoring apparatus includes a housing (e.g., an earpiece, earbud, etc.), and a sensor module disposed within or attached to the housing. The housing is configured to be attached to a body of a subject, for example the ear. The sensor module includes an energy emitter, a detector, a filter, and at least one processor. The energy emitter directs

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	energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, mechanical energy, magnetic energy, nuclear energy, etc.) at a target region of the subject and the detector detects an energy response signal from the subject. The energy response signal is associated with a physiological condition of the subject (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.). The filter removes or attenuates time-varying environmental interference from the energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Valencell at [0006] According to some embodiments of the present invention, a monitoring apparatus includes a housing configured to be attached to the ear of a subject, and a sensor module disposed within or attached to the housing. The sensor module includes an optical emitter, a detector, a motion/position sensor, a filter, and at least one processor that controls operations of the optical emitter, detector, and/or filter. The optical emitter directs optical energy at a target region of the subject and the detector detects an optical energy response signal from the subject, wherein the energy response signal is associated with a physiological condition of the subject. Light-opaque material surrounds at least part of the sensor module to prevent ambient light from interfering with the detector. Output from the motion/position sensor is associated with the motion or position between the housing and ear of the subject. The filter removes or attenuates time-varying environmental interference from the optical energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, and temperature. Valencell at [0012] According to other embodiments of the present invention, an earbud for a headset includes a housing that is configured to be positioned within an ear of a subject, a speaker, and at least one sensor module disposed within or attached to the housing. The at least one sensor module includes a printed circuit board (PCB) having opposite first and second sides, an optical emitter attached to at least one side of the PCB that directs electromagnetic radiation at a target region of the ear, an optical detector attached to at least one side of the PCB adjacent to the optical emitter that detects an energy response signal associated with a physiological condition of the subject from the subject, and an optical filter overlying at least a

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	portion of the optical detector, wherein the optical filter is configured to attenuate (e.g., reduce or block) light at one or more selected wavelengths. A filter may be included that removes time-varying environmental interference from the energy response signal. Time-varying environmental interference may be caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. The at least one sensor module may include at least one processor that controls operations of the optical emitter, optical detector, and/or filter. Valencell at [0019] According to other embodiments of the present invention, a method of monitoring at least one physiological property of a subject includes directing pulsed energy at a target region of the subject via an energy emitter, obtaining a first energy response signal from the subject when the emitter is on, obtaining a second energy response signal from the subject when the emitter is off, and processing the first and second energy response signals via an interference filter to produce a processed energy response signal that is associated with a physiological condition (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.) of the subject, wherein the filter removes or attenuates time-varying environmental interference caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Directing pulsed energy at a target region may include directing energy selected from the group consisting of optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc. Valencell at [0033] In some embodiments of the present invention, the processed energy response signal is transmitted to a remote device, for example wirelessly transmitted. Valencell at [0035] The sensor module includes an energy emitter, a detector, a filter, and at least one processor. The energy emitter directs energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, mechanical energy, magnetic energy, nuclear energy, etc.) at a target region of the subject and the detector detects an energy response signal from the subject. The energy response signal

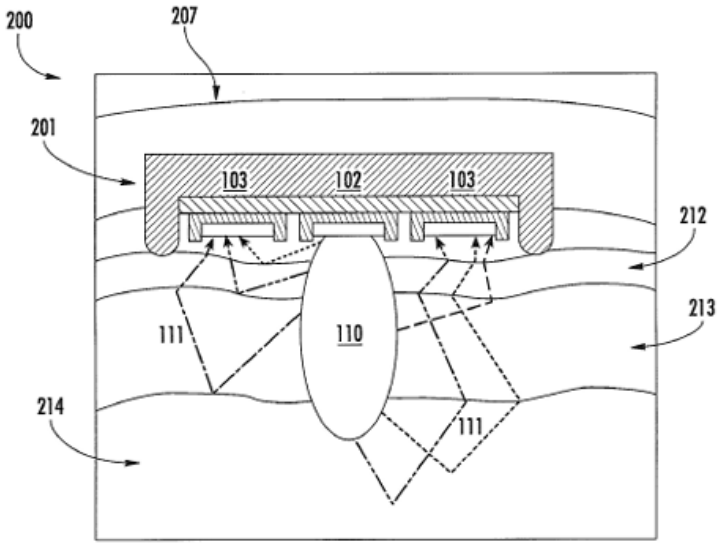
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	is associated with a physiological condition of the subject (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.). The filter removes or attenuates time-varying environmental interference from the energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Valencell at [0044] The detectors that may be incorporated into headsets, earbuds, and/or substrates (e.g., wristbands, armbands, legbands, neckbands, waistbands, anklebands, footbands, handbands, ringbands, headbands, etc.) 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/conditions: 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. Valencell at [0050]

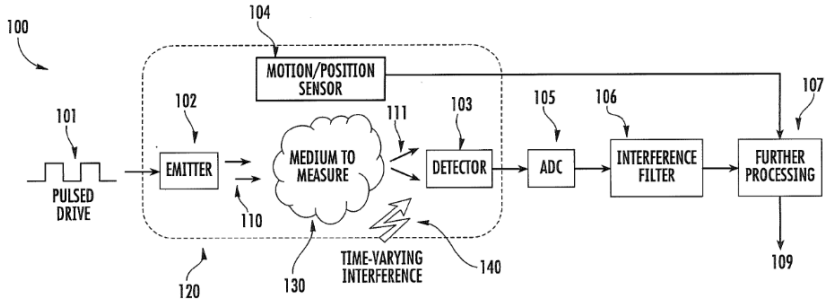
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	The term “monitoring” refers to the act of measuring, quantifying, qualifying, estimating, sensing, calculating, interpolating, extrapolating, inferring, deducing, or any combination of these actions. More generally, “monitoring” refers to a way of getting information via one or more sensing elements. For example, “blood health monitoring” includes monitoring blood gas levels, blood hydration, and metabolite/electrolyte levels. The term “physiological” refers to matter or energy of or from the body of a creature (e.g., humans, animals, etc.). In embodiments of the present invention, the term “physiological” is intended to be used broadly, covering both physical and psychological matter and energy of or from the body of a creature. However, in some cases, the term “psychological” is called-out separately to emphasize aspects of physiology that are more closely tied to conscious or subconscious brain activity rather than the activity of other organs, tissues, or cells. Valencell at [0099]-[0100] The human ear is an ideal location for wearable health and environmental monitors. The ear is a relatively immobile platform that does not obstruct a person's movement or vision. Headsets located at an ear have, for example, access to the inner-ear canal and tympanic membrane (for measuring core body temperature), muscle tissue (for monitoring muscle tension), the pinna and earlobe (for monitoring blood gas levels), the region behind the ear (for measuring skin temperature and galvanic skin response), and the internal carotid artery (for measuring cardiopulmonary functioning), etc. The ear is also at or near the point of exposure to: environmental breathable toxicants of interest (volatile organic compounds, pollution, etc.); noise pollution experienced by the ear; and lighting conditions for the eye. Furthermore, as the ear canal is naturally designed for transmitting acoustical energy, the ear provides a good location for monitoring internal sounds, such as heartbeat, breathing rate, and mouth motion. 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

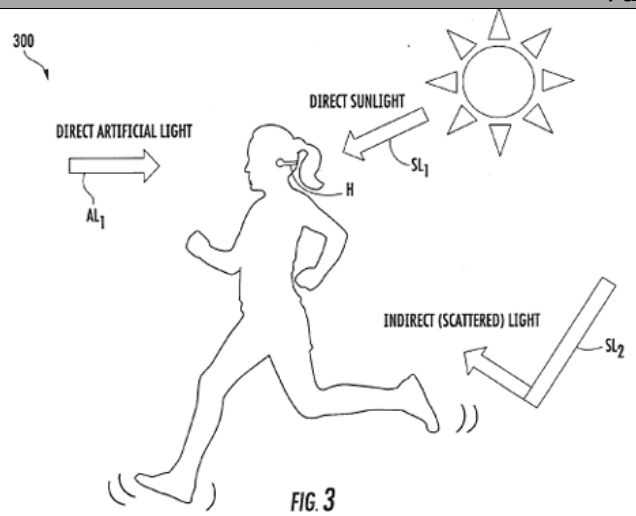
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	and multimedia applications, thereby encouraging user compliance. Exemplary physiological and environmental sensors that may be incorporated into a Bluetooth® or other type of headsets include, but are not limited to accelerometers, auscultatory sensors, pressure sensors, humidity sensors, color sensors, light intensity sensors, pressure sensors, etc. Valencell at [0104] 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 or there may be a combination of wired and wireless communications. 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 invention may be employed around another part of the body, such as a digit, finger, toe, limb, wrist, ankle, around the nose or earlobe, or the like. In other embodiments, the invention may be integrated into a patch, such as a bandage that sticks on a person's body. Valencell at [0106] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical

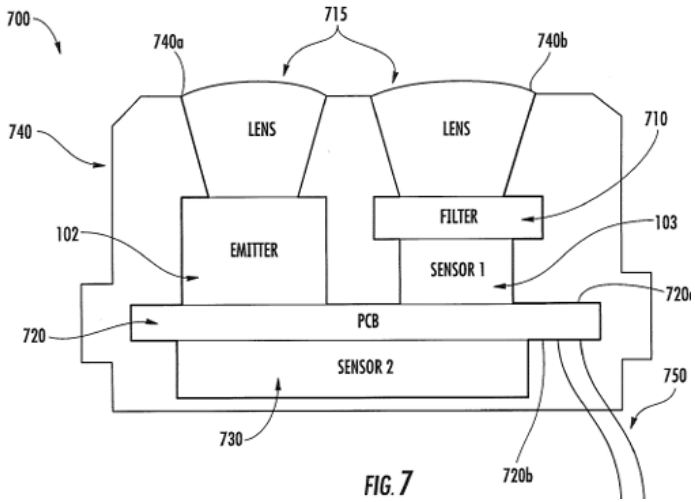
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	energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject.

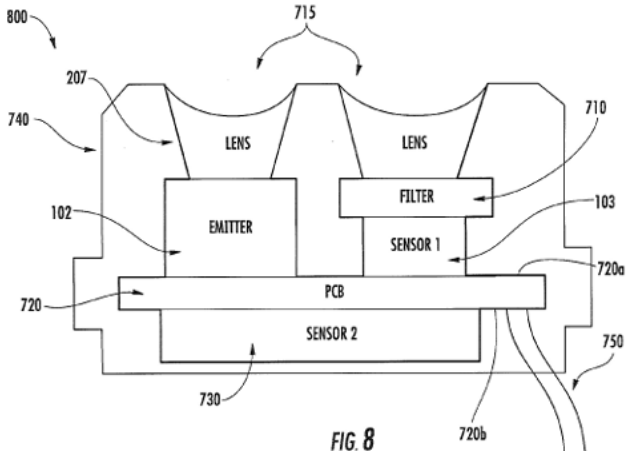
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	 FIG. 2 Valencell at Fig. 2 Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-

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	detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain 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. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject.  FIG. 1 Valencell at Fig. 1

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	 FIG. 3 Valencell at Fig. 3 In real-world environments, the energy response signal 111 collected by a wearable sensor module 207 may be corrupted by time-varying environmental interference 140 (FIG. 1). Moreover, the energy response signal 111 may be even further corrupted by motion of the subject in a time-varying environment. For example, the motion caused by running may cause motion with respect to the emitter 102, detector 103, and medium 130 (in this case tissue of the subject), and this motion may cause an unwanted signal on the detector 103. Moreover, the time-varying environmental interference 140 (FIG. 1) may be caused by, or exacerbated by, the motion of the subject. A specific example of time-varying interference in a real-world environment 300 is summarized in FIG. 3. In FIG. 3, the runner is wearing an audio headset H containing biometric monitoring technology, such as Valencell's Healthset® brand technology (Valencell, Inc., Raleigh, N.C.), where at least one photoplethysmography sensor module 207 (FIG. 2) is included within a biometric audio earbud 404 as shown in FIG. 4. The sensor module 207 may contain at least one optical emitter 102, at least one optical detector 103, and at least one processor to measure heart rate, respiration rate, pulse pressure, motion, and/or other physiological conditions near the ear region 130 of the subject. These types of measurements may be achieved by detecting the optical scatter response 111 from the ear region as summarized in FIG. 2. However, direct sunlight SL1, indirect sunlight SL2 and/or artificial light AL1 from the environment may pass into the

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	audio headset H. Time-varying sunlight SL1, SL2 and artificial ambient light AL1 may impart time-varying optical interference 140 on the optical detector 103 embedded within the audio headset H. For example, a time-varying interference signal 140 (FIG. 1) from environmental light may impart substantial artifacts on an energy response signal 111 (FIG. 1) in many real life scenarios, such as when clouds pass through the sky, when a subject runs through shadows, when a subject runs to/from an artificial light source, and/or various thereof. These time-varying artifacts may be difficult to distinguish from the desired time-varying signals associated with time-varying physiological conditions. For example, the interference frequencies associated with a time-varying change in shadows, or the harmonics of these interference frequencies, may correspond with at least one signal frequency associated with footsteps, respiration, or heart rate, and the optical energy response 111 may contain convoluted information comprising interference signals and desired physiological signals. Valencell at [0108]-[0110]  FIG. 7 Valencell at FIGS. 7

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	 FIG. 8 Valencell at FIGS. 8 As shown in FIGS. 7 and 8, the emitter 102 and detector 103 may be integrated within a circuit board 720 assembly, such as a printed circuit board (PCB) assembly. The PCB board 720 may have opposite first and second sides 720 a, 720 b, with at least one optical emitter and optical detector adjacent to each other on the first side 720 a, and with at least one secondary sensor 730 on the second side 720 b. The secondary sensor 730 may be integrated within the PCB 720 for sensing another parameter. In one particular embodiment, the secondary sensor 730 may serve as a motion/position sensor 104 (FIG. 1). Connections or wiring 750 may be used to connect the sensor module 700 to another apparatus, connector, PCB, circuit, or the like. For example, electrical wiring or fiber optic cables may be overmolded such that sunlight cannot pass through the interface between the wires/cables and the overmold layer 740. Valencell at [0120] FIGS. 9A and 9B illustrate an environmentally protected earbud 900 that can incorporate overmolded sensor modules 700, 800, according to some embodiments of the present invention. In the illustrated embodiment, at least two sensor modules 700 are shown to emphasize that multiple sensor locations can be used, as long as the sensor modules 700 are configured to direct energy towards the ear and detect the energy response from the ear. Additionally, having multiple sensor modules 700 located around the

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	earbud housing 901 may help with: a) making the environmentally protected earbud 900 work uniformly well on a variety of persons having a variety of differing ear physiology and/or b) enabling additional sensor functionality, such as the ability to sense blood gas levels, blood metabolite levels, pulse pressure, blood pressure, glucose, and a variety of other physiological metrics or analytes. At least one supporting arm 902 may be connected to the earbud housing 901 to support a wire, electrical connections, and/or provide additional support around the ear. For example, a supporting arm 902 may be used to house wires or wrapped around the ear to further support the earbud housing 901 within the ear. Valencell at [0122] The lenses 715 described herein may be comprised of any material that is at least partially transparent to the wavelengths of light generated by the emitter 102 and/or the desired wavelengths of light detected by the detector 103. In some embodiments of the present invention, the lenses 715 are completely transparent to the light of interest, but in other embodiments of the present invention the lenses 715 may be configured to diffuse, attenuate, disperse, or redistribute light uniformly across the lens. For example, a lens 715 incorporating diffusing material, placed over the emitter 102, may help spread more light from the emitter more uniformly across the area of the lens such that a broader physiological region may be excited by optical radiation. Similarly, a diffusing lens configuration placed over the detector 103 may help detect light from a broader area of the body and direct that light towards the detector 103. Some plastic materials contain scattering centers or materials that tend to scatter light. For example, silicones may be used to diffuse light in a lens. Partially opaque lenses may also be used to provide diffusion or internal scattering of light within a lens. Additionally, roughened surfaces, such as roughened plastic or glass, may encourage diffuse optical scatter without greatly attenuating the intensity of light. Other methods of creating optical diffusion or scattering in light-guiding materials such as lenses may be utilized. Valencell at [0126] Monitoring apparatus, according to embodiments of the present invention can be adapted to fit around various parts of the body, such as an arm, leg, neck, etc. For example, monitoring apparatus, according to embodiments of the present invention can be implemented as a substrate, such as a wristband, armband, legband, neckband, waistband, ankleband, footband, handband, ringband, headband, or the like. The substrate may be flexible and may be configured to surround all or a portion of a body of a

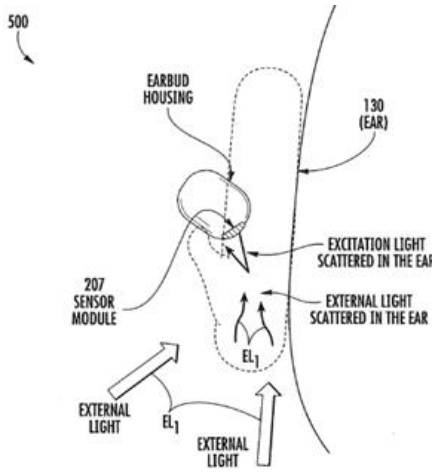
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	subject. The substrate may be configured to be attached to a body of a subject adhesively, similar to a bandage. The location of a sensor module (e.g., 700, 800) may be virtually any place along the skin of a subject; however, better PPG results may be obtained when a sensor module is placed along an major artery. Valencell at [0150] 30. The method of claim 26, further comprising transmitting the processed energy response signal to a remote device. Valencell at Claims 30 31. The method of claim 30, wherein transmitting the processed energy response signal to a device comprises wirelessly transmitting the processed energy response signal. Valencell at Claims 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Valencell discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. Apparatus and methods for attenuating environmental interference are described. A wearable monitoring apparatus includes a housing configured to be attached to the body of a subject and a sensor module that includes an energy emitter that directs energy at a target region of the subject, a detector that detects an energy response signal—or physiological condition—from the subject, a filter that removes time-varying environmental interference from the energy response signal, and at least one processor that controls operations of the energy emitter, detector, and filter.

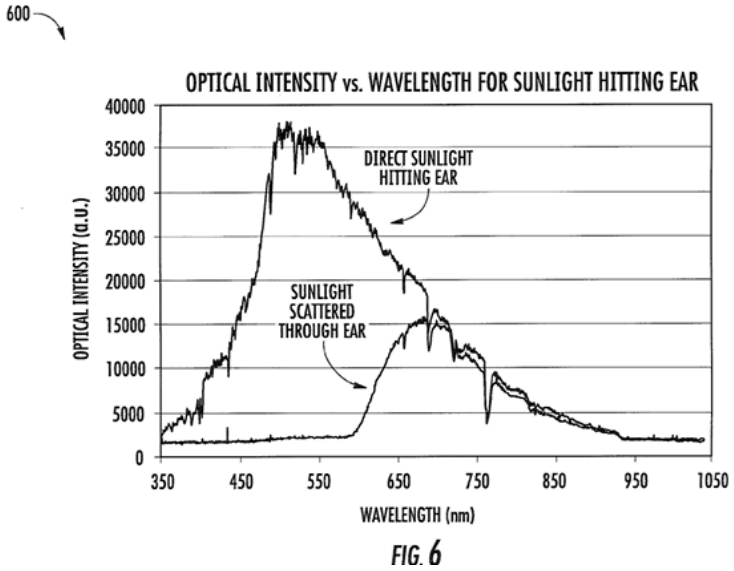
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	Valencell at [Abstract] According to some embodiments of the present invention, a wearable monitoring apparatus includes a housing (e.g., an earpiece, earbud, etc.), and a sensor module disposed within or attached to the housing. The housing is configured to be attached to a body of a subject, for example the ear. The sensor module includes an energy emitter, a detector, a filter, and at least one processor. The energy emitter directs energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, mechanical energy, magnetic energy, nuclear energy, etc.) at a target region of the subject and the detector detects an energy response signal from the subject. The energy response signal is associated with a physiological condition of the subject (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.). The filter removes or attenuates time-varying environmental interference from the energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Valencell at [0006] According to some embodiments of the present invention, a monitoring apparatus includes a housing configured to be attached to the ear of a subject, and a sensor module disposed within or attached to the housing. The sensor module includes an optical emitter, a detector, a motion/position sensor, a filter, and at least one processor that controls operations of the optical emitter, detector, and/or filter. The optical emitter directs optical energy at a target region of the subject and the detector detects an optical energy response signal from the subject, wherein the energy response signal is associated with a physiological condition of the subject. Light-opaque material surrounds at least part of the sensor module to prevent ambient light from interfering with the detector. Output from the motion/position sensor is associated with the motion or position between the housing and ear of the subject. The filter removes or attenuates time-varying environmental interference from the optical energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, and temperature. Valencell at [0012]

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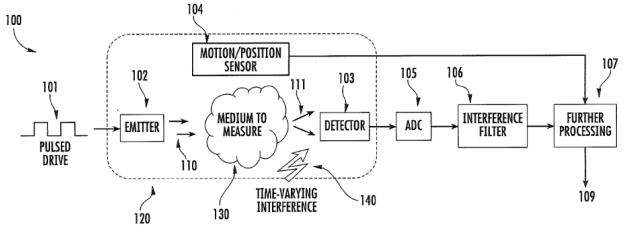
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	According to other embodiments of the present invention, an earbud for a headset includes a housing that is configured to be positioned within an ear of a subject, a speaker, and at least one sensor module disposed within or attached to the housing. The at least one sensor module includes a printed circuit board (PCB) having opposite first and second sides, an optical emitter attached to at least one side of the PCB that directs electromagnetic radiation at a target region of the ear, an optical detector attached to at least one side of the PCB adjacent to the optical emitter that detects an energy response signal associated with a physiological condition of the subject from the subject, and an optical filter overlying at least a portion of the optical detector, wherein the optical filter is configured to attenuate (e.g., reduce or block) light at one or more selected wavelengths. A filter may be included that removes time-varying environmental interference from the energy response signal. Time-varying environmental interference may be caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. The at least one sensor module may include at least one processor that controls operations of the optical emitter, optical detector, and/or filter. Valencell at [0019] According to some embodiments of the present invention, a wearable monitoring apparatus includes a substrate configured to be attached to a body of a subject, and a sensor module attached to the substrate. The substrate may be configured to surround a portion of a body, and may be flexible. For example, the substrate may be a wristband, armband, legband, neckband, waistband, ankleband, footband, handband, ringband, headband, etc. In other embodiments, the substrate is configured to be adhesively attached to the body of the subject, similar to a bandage. Valencell at [0043] The detectors that may be incorporated into headsets, earbuds, and/or substrates (e.g., wristbands, armbands, legbands, neckbands, waistbands, anklebands, footbands, handbands, ringbands, headbands, etc.) 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/conditions: 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

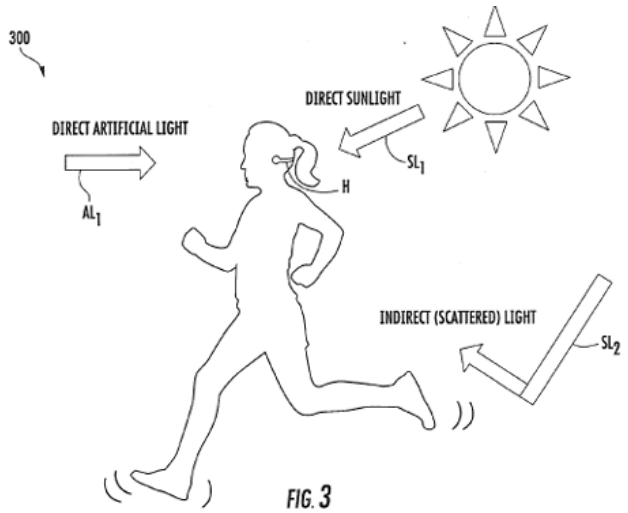
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	chemistry, biochemistry, position and/or balance, body strain, neurological functioning, brain activity, brain waves, blood pressure, cranial pressure, hydration level, auscultatory information, auscultatory signals associated with pregnancy, physiological 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. Valencell at [0050]  FIG. 5

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	Valencell at FIG. 5 FIG. 5 is a schematic illustration of how external light interference can pass through a human ear and reach an optical detector in an earbud monitor attached to the ear.  FIG. 6 Valencell at FIG. 6 FIG. 6 is a comparison graph showing optical detector intensity vs. wavelength for direct sunlight exposure and indirect sunlight exposure caused by scattering through the ear region. [0058]-[0059] The human ear is an ideal location for wearable health and environmental monitors. The ear is a relatively immobile platform that does not obstruct a person's movement or vision. Headsets located at an ear have, for example, access to the inner-ear canal and tympanic membrane (for measuring core body temperature), muscle tissue (for monitoring muscle tension), the pinna and earlobe (for monitoring blood gas levels), the region behind the ear (for measuring skin temperature and galvanic skin response), and

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	the internal carotid artery (for measuring cardiopulmonary functioning), etc. The ear is also at or near the point of exposure to: environmental breathable toxicants of interest (volatile organic compounds, pollution, etc.); noise pollution experienced by the ear; and lighting conditions for the eye. Furthermore, as the ear canal is naturally designed for transmitting acoustical energy, the ear provides a good location for monitoring internal sounds, such as heartbeat, breathing rate, and mouth motion. 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. Optical coupling into the blood vessels of the ear may vary between individuals. As used herein, the term “coupling” refers to the interaction or communication between excitation light entering a region and the region itself. For example, one form of optical coupling may be the interaction between excitation light generated from within a light-guiding earbud and the blood vessels of the ear. Light guiding earbuds are described in co-pending U.S. Patent Application Publication No. 2010/0217102, which is incorporated herein by reference in its entirety. In one embodiment, this interaction may involve excitation light entering the ear region and scattering from a blood vessel in the ear such that the intensity of scattered light is proportional to blood flow within the blood vessel. Another form of optical coupling may be the interaction between excitation light generated by an optical emitter within an earbud and the light-guiding region of the earbud. 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 or there may be a combination of wired and wireless communications. 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

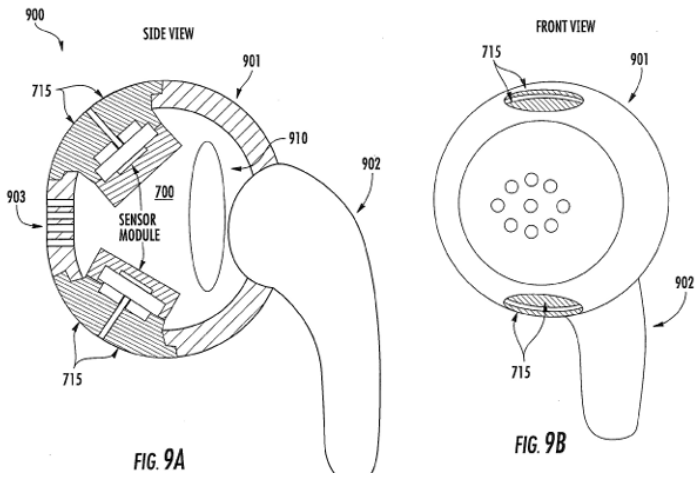
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	embodiments, the invention may be employed around another part of the body, such as a digit, finger, toe, limb, wrist, ankle, around the nose or earlobe, or the like. In other embodiments, the invention may be integrated into a patch, such as a bandage that sticks on a person's body. Valencell at [0104] - [0106] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present

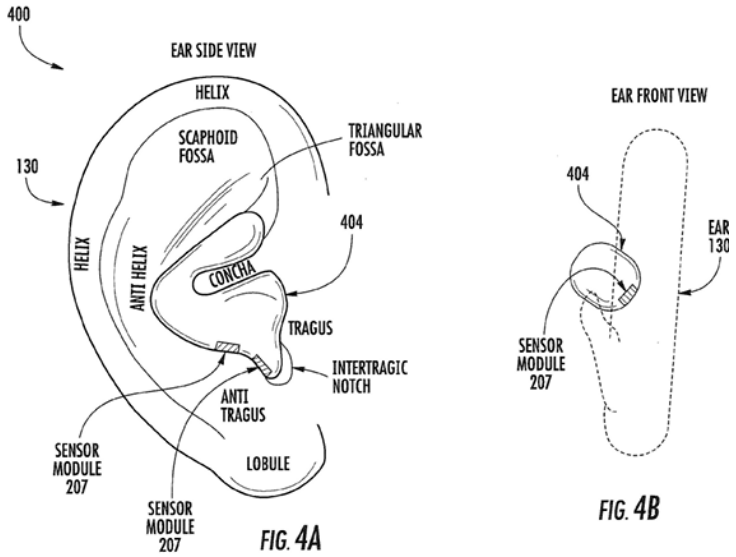
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	invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108]  FIG. 1 Valencell at Fig. 1 Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy

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	111. The optical source-detector assembly 201 may contain 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. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject.  FIG. 3 Valencell at Fig. 3 In real-world environments, the energy response signal 111 collected by a wearable sensor module 207 may be corrupted by time-varying environmental interference 140 (FIG. 1). Moreover, the energy response signal 111 may be even further corrupted by motion of the subject in a time-varying environment. For example, the motion caused by running may cause motion with respect to the emitter 102, detector 103, and medium 130 (in this case tissue of the subject), and this motion may cause an

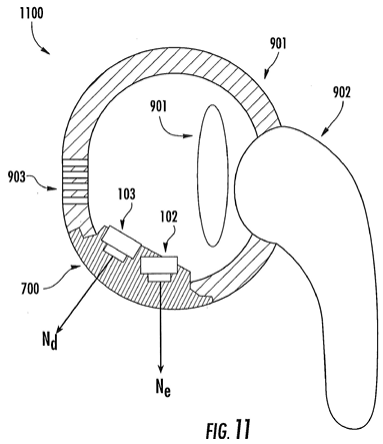
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	unwanted signal on the detector 103. Moreover, the time-varying environmental interference 140 (FIG. 1) may be caused by, or exacerbated by, the motion of the subject. A specific example of time-varying interference in a real-world environment 300 is summarized in FIG. 3. In FIG. 3, the runner is wearing an audio headset H containing biometric monitoring technology, such as Valencell's Healthset® brand technology (Valencell, Inc., Raleigh, N.C.), where at least one photoplethysmography sensor module 207 (FIG. 2) is included within a biometric audio earbud 404 as shown in FIG. 4. The sensor module 207 may contain at least one optical emitter 102, at least one optical detector 103, and at least one processor to measure heart rate, respiration rate, pulse pressure, motion, and/or other physiological conditions near the ear region 130 of the subject. These types of measurements may be achieved by detecting the optical scatter response 111 from the ear region as summarized in FIG. 2. However, direct sunlight SL1, indirect sunlight SL2 and/or artificial light AL1 from the environment may pass into the audio headset H. Time-varying sunlight SL1, SL2 and artificial ambient light AL1 may impart time-varying optical interference 140 on the optical detector 103 embedded within the audio headset H. For example, a time-varying interference signal 140 (FIG. 1) from environmental light may impart substantial artifacts on an energy response signal 111 (FIG. 1) in many real life scenarios, such as when clouds pass through the sky, when a subject runs through shadows, when a subject runs to/from an artificial light source, and/or various thereof. These time-varying artifacts may be difficult to distinguish from the desired time-varying signals associated with time-varying physiological conditions. For example, the interference frequencies associated with a time-varying change in shadows, or the harmonics of these interference frequencies, may correspond with at least one signal frequency associated with footsteps, respiration, or heart rate, and the optical energy response 111 may contain convoluted information comprising interference signals and desired physiological signals. Valencell at [0109]-[0110]

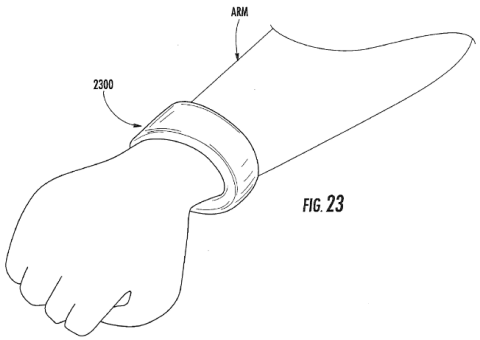
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	 Valencell at Figs. 9A and 9B FIGS. 9A and 9B illustrate an environmentally protected earbud 900 that can incorporate overmolded sensor modules 700, 800, according to some embodiments of the present invention. In the illustrated embodiment, at least two sensor modules 700 are shown to emphasize that multiple sensor locations can be used, as long as the sensor modules 700 are configured to direct energy towards the ear and detect the energy response from the ear. Additionally, having multiple sensor modules 700 located around the earbud housing 901 may help with: a) making the environmentally protected earbud 900 work uniformly well on a variety of persons having a variety of differing ear physiology and/or b) enabling additional sensor functionality, such as the ability to sense blood gas levels, blood metabolite levels, pulse pressure, blood pressure, glucose, and a variety of other physiological metrics or analytes. At least one supporting arm 902 may be connected to the earbud housing 901 to support a wire, electrical connections, and/or provide additional support around the ear. For example, a supporting arm 902 may be used to house wires or wrapped around the ear to further support the earbud housing 901 within the ear. Valencell at [0122]

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	 Valencell at Figs. 4A-B It should be noted that the angling of the emitters 102 or detectors 103 in the right location within not only the earbud housing 901, but also within the ear itself, may be critical for blocking out sunlight 140 while still generating a strong enough physiological signal from the ear region. For this reason, the earbud 1100 (FIG. 11) may also employ at least one earpiece fitting, or other additional mounting support, to keep the earbud in place within the ear and/or keep the sensor module 700, 800 directed at the right angle within the ear. Several types of earpiece fittings are well known in the art, such as: ear hooks, ear clips, ear pads, ear loops, concha support, headbands, and the like. A specific example of a supportive earpiece fitting, a concha support that loops around the concha-helix area of the ear, is shown in the earbud 404 of FIG. 4. In some embodiments of the present invention, the earpiece fitting supports the earbud within the ear while also placing pressure against the earbud to keep the sensor module in place, away from outside light interference.

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	 FIG. 11 Valencell at Fig. 11 At least part of the earbud housing 901 (FIG. 11) or sensor module 700 (FIG. 11) may comprise a soft material which deforms when inserted within the ear and that facilitates retention of the earbud within the ear. For example, the shape of earbud housing 901 shown in FIG. 11 may facilitate retention of the earbud 1100 within the ear because it may be shaped to mate or engage with the concha or outer ear canal of the ear. Furthermore, if part of the earbud 1100 comprises a soft material, such as soft plastic, polymer, silicone, or rubber, the material may deform when the earbud 1100 is inserted within the ear such that this part of the earbud 1100 mates or engages with the ear. The sensor modules of FIGS. 7 and 8 may be integrated within the earbud housing 901, such that at least a portion of the housing 901 may comprise optically transmissive material to allow light to move from the emitter 102 to the ear region or from the ear region to the detector 103. The soft deforming material may be adjacent to the optically transmissive material or may comprise at least part of the optically transmissive material itself. For example, the lenses 715 of FIG. 9 may be comprised of optically transparent material that is also soft, such as silicone or transparent plastic, polymer, rubber, or the like. In another embodiment, a second layer of soft, yet transparent, material may cover the lenses 715. Valencell at [0127]-[0128],

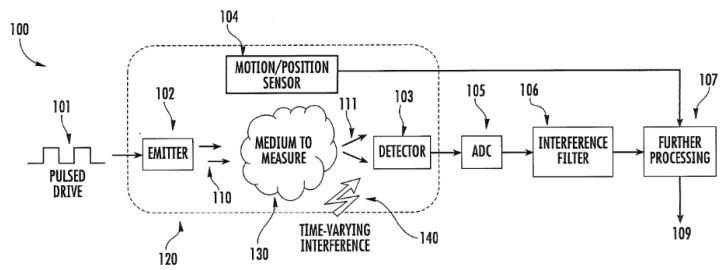
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	Monitoring apparatus, according to embodiments of the present invention can be adapted to fit around various parts of the body, such as an arm, leg, neck, etc. For example, monitoring apparatus, according to embodiments of the present invention can be implemented as a substrate, such as a wristband, armband, legband, neckband, waistband, ankleband, footband, handband, ringband, headband, or the like. The substrate may be flexible and may be configured to surround all or a portion of a body of a subject. The substrate may be configured to be attached to a body of a subject adhesively, similar to a bandage. The location of a sensor module (e.g., 700, 800) may be virtually any place along the skin of a subject; however, better PPG results may be obtained when a sensor module is placed along an major artery.  FIG. 23 Valencell at Fig. 23 Referring to FIGS. 23-29, an exemplary wristband monitoring apparatus 2300 is illustrated. The wristband 2300 houses a power source, circuitry, a sensor module, and electronics as described above with respect to the various earbud embodiments. As illustrated in FIG. 24, a sensor module 700, 800 is positioned on the inside surface 2302 of the wristband 2300. The sensor module 700, 800 may include an isolation region 2304 that is configured to keep the sensor module 700, 800 stable with respect to the subject's wrist during use so as to reduce motion artifacts. The isolation region may be constructed out of any sturdy material, but for comfort, a foamy and/or flexible sturdy material may be utilized. Furthermore, the isolation region 2304 may further shield against environmental interference such as sunlight, external temperature, wind, and the like.

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	Valencell at [0150]-[0151] Referring to FIGS. 28 and 29, the sensor module 700, 800 may be tilted with respect to a body part region (e.g., the wrist area) of a subject. In the illustrated embodiments of FIGS. 28 and 29, the sensor module 700, 800 is tilted towards the wrist (away from the upper arm). The embodiment illustrated in FIG. 28 has a light guiding region 2306 with a different configuration from the light guiding region 2306 illustrated in the embodiment of FIG. 29. The tilting of the sensor module 700, 800 serves at least the following functions: 1) protection from sunlight and 2) improvement of coupling between light from the sensor module 700, 800 and blood flow in the body part (i.e., wrist area). Sunlight immunity may be improved in this fashion because a human's wrist is typically pointed away from sunlight, and so pointing the sensor module down along the arm may help prevent environmental (i.e., sunlight) interference. Also, pointing the sensor module 700, 800 towards the wrist may increase the surface area of blood flow exposed to the sensor module 700, 800, thus increasing the blood flow signal intensity for PPG and the like. Valencell at [0153] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a	Valencell discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. According to some embodiments of the present invention, a medium (e.g., physiological material of a subject), having a region of interest, is monitored via a sensor module having at least one energy emitter for interrogating the medium with energy to generate an energy response associated with the medium, at least one circuit to drive at least one energy emitter, at least one detector for detecting the energy response

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plurality of optical wavelengths;	associated with the medium, a filter that removes time-varying environmental interference from the energy response signal, and a processor that controls operations of the energy emitter, detector, and filter. Valencell at [0005] In some embodiments of the present invention, the energy emitter comprises at least one optical emitter, and the detector comprises at least one optical detector. Exemplary optical emitters include, but are not limited to, laser diodes (LDs), light-emitting diodes (LEDs), and organic light-emitting diodes (OLEDs). Exemplary optical detectors include, but are not limited to, photodetectors, photodiodes, phototransistors, photoactive resistors, photomultiplier tubes, photomultiplier diodes, photodetector modules, and the like. Valencell at [0009] In some embodiments, multiple emitters, detectors, lenses, light guides, and/or diffusion regions may be employed within a sensor module. Valencell at [0038] In some embodiments of the present invention, the energy emitter comprises at least one optical emitter, and the detector comprises at least one optical detector. Exemplary optical emitters include, but are not limited to, LDs, LEDs, and OLEDs. Exemplary optical detectors include, but are not limited to, photodetectors, photodiodes, phototransistors, photoactive resistors, photomultiplier tubes, photomultiplier diodes, photodetector modules, and the like. Valencell at [0047]

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	 FIG. 1 Valencell at Fig. 1 FIG. 1 illustrates an interference filtering apparatus/method 100, according to some embodiments of the present invention. A medium 130, preferably physiological material of a living subject, comprises at least one target region of interest 120 which is interrogated by energy 110, preferably modulated energy, such as pulsed energy, generated by an energy emitter 102. A pulsed driving circuit 101 is used to drive at least one energy emitter 102 at one or more pulsed frequencies to interrogate at least one target region of at least one medium 130 with the pulsed energy 110. The energy may be in the form of electromagnetic, acoustical, mechanical, nuclear, electrical, magnetic, thermal, or other forms of energy, but typically optical energy from the electromagnetic spectrum. The energy reaching the medium 130 can interact with the medium to generate at least one energy response signal 111, such as an optical scatter signal 111 between emitted optical energy 110 and the medium 130. The energy response 111 caused by this interaction is detected by at least one detector 103, configured to detect energy in the forms described above, but typically in the form of optical energy scattered from the medium 130. A motion/position sensor 104 may be configured to measure movement, positional changes, or inertial changes in the vicinity of the medium 130. The outputs of the detector 103 may be sent to at least one analog-to-digital convertor (ADC) 105 and the digitized output may be sent to at least one interference filter 106, which is configured to remove the effects of time-varying environmental interference 140 from the signal output of the detector 103. At least one motion/position sensor 104 may be incorporated in the interference filtering method 100 to provide a reference signal for removing the effects of motion from the extracted energy response signal 111 to produce a desired signal 109. For example, the output of the interference filter 106 may be further processed by signal extraction filter 107 to extract accurate

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	information from the medium 130, and this signal extraction filter 107 may utilize the output of the motion/position sensor 104 to remove motion artifacts from the desired signal (the extracted energy response signal) 109. At least one signal processor (not shown) may be used to control the operations of the energy emitter 102, detector 103, filter 106, and/or other components of the interference filtering method 100. Valencell at [0107] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact

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	reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain 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. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy

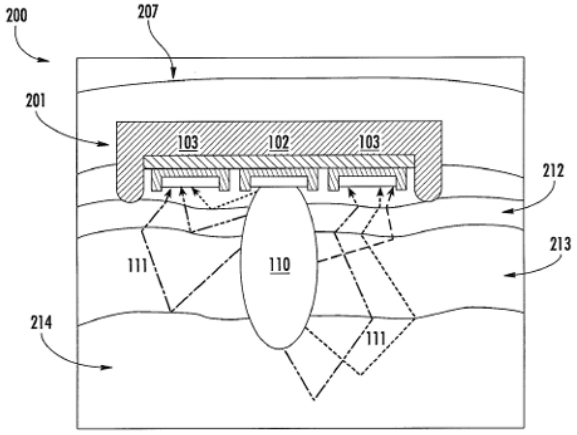
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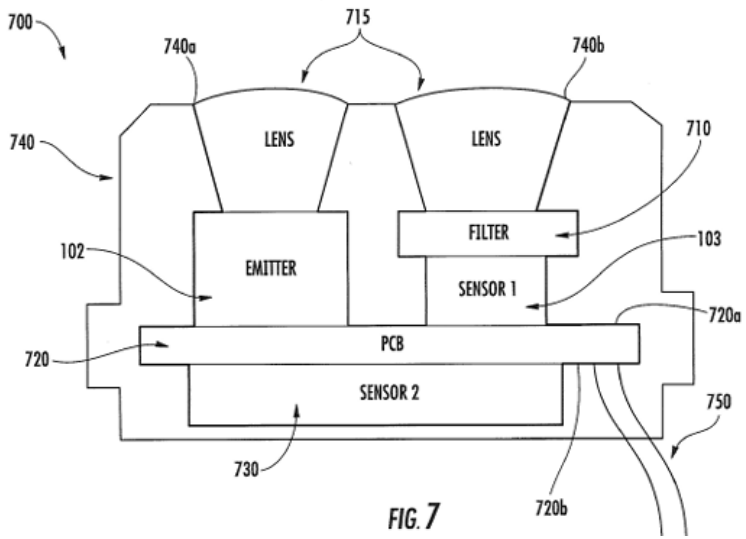
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	from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109] An experiment was performed by the Applicant to address the magnitude of the aforementioned sunlight convolution problem for an earbud physiological monitor. In this experiment, an optical spectrometer was optically coupled to a light guide embedded within an earbud worn by a subject in an outdoor sunlight environment. The only light reaching the spectrometer was light guided by an earbud-embedded light guide, positioned in the same basic region as the sensor module 207 shown in FIGS. 4 and 5. Thus, the light guide was guiding light from the ear region on one end towards the input of the spectrometer at the other end. Because the light guide was covered at one end by the spectrometer and at another end by the ear of the subject, the only significant light reaching the light guide was light generated by external light EL1 passing through the ear, as shown in FIG. 5. With the earbud worn by the subject, a first spectrogram was taken of this indirect external sunlight scattered through the ear. The earbud was then removed and pointed directly at the sun, and a second spectrogram was taken of direct sunlight hitting the ear with the earbud directly facing the sun to provide a comparison graph 600, as shown in FIG. 6. The comparison graph 600 shows that sunlight at wavelengths shorter than 600 nm is greatly attenuated through the subject's ear, whereas sunlight at wavelengths longer than 650 nm is minimally absorbed through the subject's ear. In light of the comparative graph 600 of FIG. 6, one approach to reducing the effects of sunlight on the optical response signal 111 (FIG. 1) is to choose an optical emitter 102 (FIG. 1) that emits light at wavelengths shorter than 600 nm and to choose an optical detector 103 (FIG. 1) having an optical filter that blocks light having wavelengths longer than 600 nm or that passes light within an optical bandwidth provided by the optical emitter 102 (FIG. 1). For example, a 400 to 500 nm optical emitter 102 (FIG. 1) may provide 400-500 nm optical excitation 110 (FIG. 1) to the ear region 130 (FIG. 1), and an optical detector 103 (FIG. 1) having a 400-500 nm optical filter may be used to detect the energy response signal 111 (FIG. 1) with low interference 140 (FIG. 1) from sunlight. While this method may be employed, the apparent benefits may be deceiving because the intensity of the optical scatter signal associated with physiological information may be orders of magnitude smaller than the sunlight interference—even with the combined attenuation effects of the optical filtering method and the strategic sensor module placement between the earbud housing and ear region (as shown in FIGS. 4 & 5). A better approach for

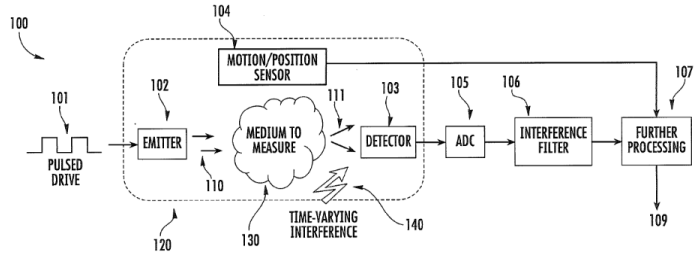
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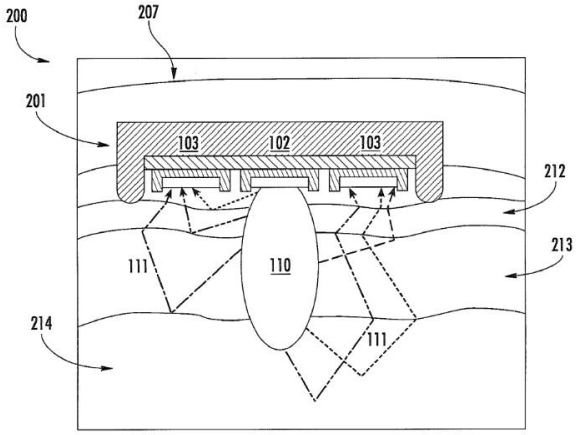
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	attenuating the optical interference signal may be to employ optical filters within the optical detectors 103 such that the only wavelengths passing into an optical detection window may be wavelengths that are naturally attenuated by the earth's atmosphere. For example, there are several attenuation bands for sunlight well-known in the art due to the absorption of sunlight by O2, O3, CO2, and H2O in the atmosphere. The sharp absorption peak near 763 nm in FIG. 6 is just one example. Thus, a novel design for rejecting sunlight interference may incorporate at least one optical emitter that generates optical wavelengths within at least one sunlight attenuation band combined with at least one bandpass-filtered optical detector, incorporating at least one optical bandpass filter to pass only wavelengths falling within this attenuation band. Valencell at [0113]-[0114] FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, 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. FIGS. 15A-15B show a multi-detector earbud 1500, where two separate optical detectors 103 are covered by two separate optical lenses, at least one optical emitter is covered by at least one optical lens, and

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	where the emitter 102 and detector 103 configuration is oriented perpendicularly to the antitragus (as that shown in FIG. 11). In FIGS. 15A-15B, the optical detectors 103, emitters 102, and lenses are not readily visible as they are surrounded, at least in part, by an optical coupling area 1510. The lenses (not shown) may cover each separate emitter 102 and detector 103 as shown in FIGS. 7 and 8. Note that in this configuration, the emitter- detector module 700, 800 of FIGS. 7 and 8 is oriented towards the back of the ear (near the back of the head). This arrangement may serve two purposes: 1) sunlight may be further blocked from reaching the detectors 103, as the back of the ear may serve as a shield and 2) there may be less motion artifacts convoluting the desired blood flow signals, as the detectors 103 may be oriented away from mouth-motion-prone areas located near the front of the ear. Another feature of the earbud 1500 of FIGS. 15A and 15B is that an optical coupling area 1510 is located on top of the optical emitter 102 and surrounding (but not covering) the optical detector 103. This optical coupling area 1510 may help diffuse, scatter, and/or guide light from the optical emitter to couple with a broader area of the ear region. Having a broader coupling area may help excite more regions of the ear with optical energy 110 (FIG. 1) and reduce the chance that the optical energy may miss important blood vessels, which may be located in different regions for different persons. Thus, such a design may promote a more universal design for a biometric earbud. Without an optical coupling area 1510, the optical energy 110 from the optical emitter(s) 102 may miss blood vessels in different persons due to physiological differences that may exist between different people. Alternatively, the optical coupling area 1510 may be configured to cover the optical detector 103 area and not the optical emitter 102 area, such that more light is guided from different regions of the ear and coupled into the detector 103. Alternatively, a plurality of optical diffusion areas may be configured to cover the emitter 102 and detector 103 separately. Valencell at [0130]-[0131] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. the wearable device comprising one or more	Valencell discloses or renders obvious the 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.

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lenses configured to receive at least a portion of the output optical light and to deliver a lens output light to tissue;	 FIG. 2 Valencell at Fig.2 FIG. 2 illustrates a multi-wavelength reflection-mode pulse oximetry apparatus that may be utilized in accordance with some embodiments of the present invention. Valencell at [0054]

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	 FIG. 7 Valencell at Fig. 7. FIG. 7 illustrates a sensor module with a convex lens configuration, according to some embodiments of the present invention. Valencell at [0060] 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 or there may be a combination of wired and wireless communications. 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 invention may be employed around another part of the body, such as a digit, finger, toe, limb, wrist, ankle, around the nose or earlobe, or the like. In other embodiments, the invention may be integrated into a patch, such as a bandage that sticks on a person's body. Valencell at [0106]

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	 FIG. 1 Valencell at Fig. 1 In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant,

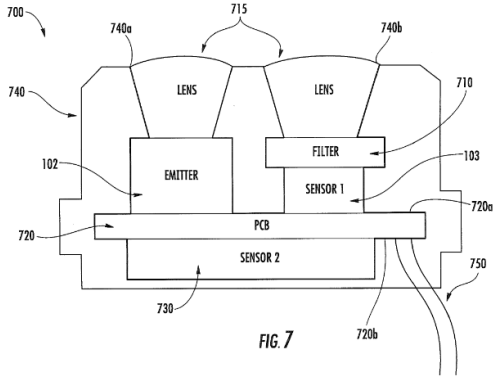
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	such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108]  FIG. 2 Valencell at Fig. 2 Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of

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	the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain 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. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109] According to some embodiments of the present invention, a sensor module 700 with an overmolded design, as shown in FIG. 7, may be employed to remedy the problems associated with sunlight leaking towards the optical detector 103. In this design, an overmold layer 740 surrounds the components of the sensor module 700 to prevent light leakage into any spot along the periphery of the sensor module 700. The overmold layer 740 comprises a light-opaque material surrounding the optical emitter 102 and optical detector 103 such that the optical emitter 102 and optical detector 103 are not in direct optical communication with each other. The light-opaque material of the overmold layer 740 may include a first

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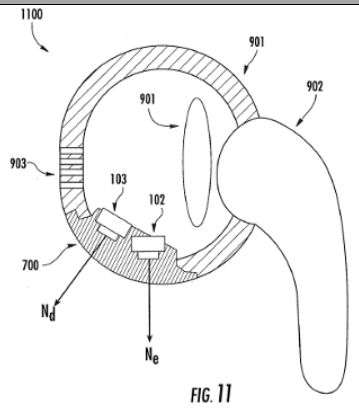
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	aperture 740 a in communication with the optical emitter 102, and a second aperture 740 b in communication with the optical detector 103. Thus, the only device regions having access to outside light may be the regions of the optical emitter 102 and detector 103, but these may be covered by at least one optical filter 710 tuned to a wavelength region of interest. If utilized, the wavelength pass-band of an optical filter covering the emitter 102 should be tuned to the emitter wavelength band so that all other light is blocked. If utilized, the wavelength pass-band of the optical filter 710 covering the detector 103 should be tuned to at least one wavelength band associated with the optical scatter 111 (FIG. 1) of interest from the medium 130 (FIG. 1) so that all other light is blocked. In some embodiments of the present invention, an optical filter for the emitter 102 and detector 103 may be the same filter, such as may be the case for optical scatter 111 (FIG. 1) detection by the detector 103 where all light other than the emitter light of interest may be blocked by the filter 710. According to some embodiments of the present invention, the optical filter 710 covering the detector 103 is configured to block unwanted sunlight but still allow wavelengths from the optical emitter 102 to pass therethrough. In some embodiments of the present invention, the optical filter 710 over the detector 103 is configured to pass wavelengths centered around 930 nm, and the optical emitter 102 is configured to emit wavelengths centered around 930 nm. According to some embodiments of the present invention, the optical filter 710 may have a surface area greater than a surface area of the optical detector 103. In some embodiments of the present invention, the optical filter 710 overlies the optical detector 103 such that a periphery of the optical filter 710 overlaps a periphery of the optical detector 103, as shown in FIG. 7 and FIG. 8. To guide light from the optical emitter 102 towards the skin 130 of a subject and to direct light from the skin 130 to the optical detector 103, lenses 715 may be utilized, as illustrated in FIG. 7. The lenses 715 may be physically separated lenses (as shown in FIGS. 7 and 8) or combined or conjoined lenses. In some embodiments of the present invention, there is no optical coupling between the emitter lens 715 and detector lens 715. For this reason, a barrier region may be incorporated in the case where the lenses are combined or conjoined. Separated lenses may be isolated by at least one light opaque barrier region greater than 50 μm in thickness. Light opaque plastic, rubber, metal, or polymeric material are a few examples of good choices for the light opaque region. The optical lenses 715 may be designed for the desired optical coupling between the skin/blood vessel region and the emitter 102 or detector 103. For example, a convex lens design (such as that of FIG. 7) placed over the emitter 102 may focus light onto the skin, and a concave lens design (such as that of FIG. 8) placed over the emitter 102 may diverge light

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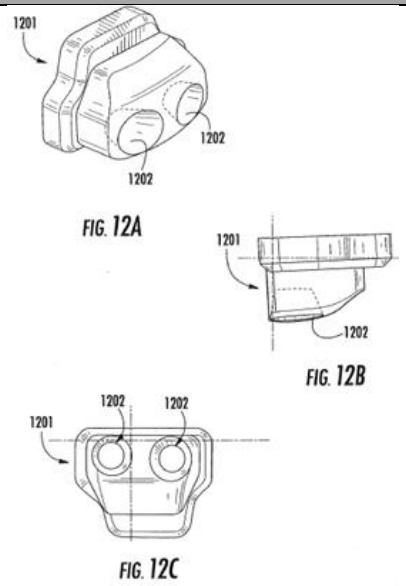
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	over the skin region. In the other direction, a convex lens design placed over the detector 103 may capture more light over a broader region and direct that light towards the detector 103, whereas a concave lens may collimate light towards the detector 103. The optical lenses 715 may be separate from the overmold layer 740 or may be part of the overmold layer 740. For example, the overmold layer 740 may be comprised of material that is transparent to light 110 (FIG. 1) coming from the emitter 102. In such case, the lenses 715 may integral with the overmold layer 740. In other cases, the optical lenses 715 may be comprised of different material than the overmold layer 740, such that the lenses 715 may fit within the overmold layer 740 and be matingly engaged with the overmold layer 740. Valencell at [0116]-[0119]  FIG. 7 Valencell at Fig. 7 Another benefit of the overmolded design of FIGS. 7 and 8 is that it may also provide resistance to water, humidity, sweat, wind, and other environmental interferants. For example, an overmolded plastic design around the emitters 102 and detectors 103, combined with overmolded or glued lenses 715, may at least partially encapsulate the emitters 102 and detectors 103 and hence at least partially isolate these devices from the environment.

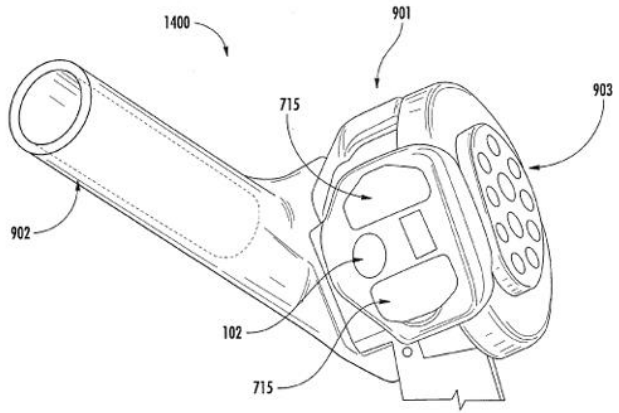
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	Valencell at [0121] In some embodiments of the present invention, an additional optical filter (e.g., 710, FIGS. 7 and 8) may be utilized that serves (or also serves) as an attenuation filter, such as a “neutral density filter”, gelatin filter, opaque material, or other optical attenuation filter or filtering materials. In one embodiment, an optical filter 710 may serve as both an optical wavelength filter and an attenuation filter. Because sunlight is so powerful, it may be beneficial to reduce sunlight interference as much as possible, even if that means also reducing the amount of optical scatter 111 (FIG. 1) of interest from the medium 130 (FIG. 1). To offset this unwanted reduction in optical scatter 111, 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 at [0123] The lenses 715 described herein may be comprised of any material that is at least partially transparent to the wavelengths of light generated by the emitter 102 and/or the desired wavelengths of light detected by the detector 103. In some embodiments of the present invention, the lenses 715 are completely transparent to the light of interest, but in other embodiments of the present invention the lenses 715 may be configured to diffuse, attenuate, disperse, or redistribute light uniformly across the lens. For example, a lens 715 incorporating diffusing material, placed over the emitter 102, may help spread more light from the emitter more uniformly across the area of the lens such that a broader physiological region may be excited by optical radiation. Similarly, a diffusing lens configuration placed over the detector 103 may help detect light from a broader area of the body and direct that light towards the detector 103. Some plastic materials contain scattering centers or materials that tend to scatter light. For example, silicones may be used to diffuse light in a lens. Partially opaque lenses may also be used to provide diffusion or internal scattering of light within a lens. Additionally, roughened surfaces, such as roughened plastic or glass, may encourage diffuse optical scatter without greatly attenuating the intensity of light. Other methods of creating optical diffusion or scattering in light-guiding materials such as lenses may be utilized. Valencell at [0125]

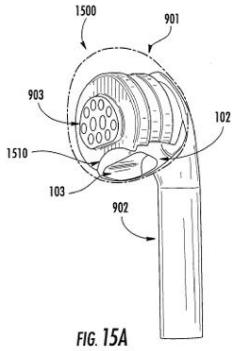
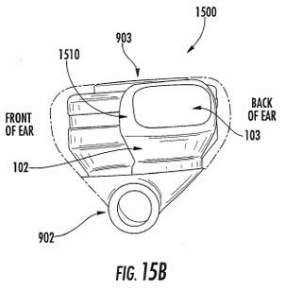
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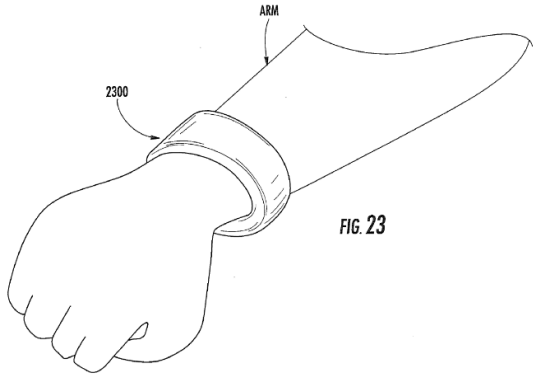
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	 FIG. 11 Valencell at Fig.11 At least part of the earbud housing 901 (FIG. 11) or sensor module 700 (FIG. 11) may comprise a soft material which deforms when inserted within the ear and that facilitates retention of the earbud within the ear. For example, the shape of earbud housing 901 shown in FIG. 11 may facilitate retention of the earbud 1100 within the ear because it may be shaped to mate or engage with the concha or outer ear canal of the ear. Furthermore, if part of the earbud 1100 comprises a soft material, such as soft plastic, polymer, silicone, or rubber, the material may deform when the earbud 1100 is inserted within the ear such that this part of the earbud 1100 mates or engages with the ear. The sensor modules of FIGS. 7 and 8 may be integrated within the earbud housing 901, such that at least a portion of the housing 901 may comprise optically transmissive material to allow light to move from the emitter 102 to the ear region or from the ear region to the detector 103. The soft deforming material may be adjacent to the optically transmissive material or may comprise at least part of the optically transmissive material itself. For example, the lenses 715 of FIG. 9 may be comprised of optically transparent material that is also soft, such as silicone or transparent plastic, polymer, rubber, or the like. In another embodiment, a second layer of soft, yet transparent, material may cover the lenses 715.

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	 Valencell at Figs.12A-12C An exemplary overmolding configuration of a sensor module 1201 is illustrated in FIGS. 12A-12C. The sensor module 1201 is shown without an emitter, detector, or lenses, but rather with recesses/apertures 1202 showing where lenses may be located. Exemplary dimensions are also presented in FIG. 12. In some embodiments of the present invention, dimensions are on the order of millimeters or less, such that the sensor module 1201 can fit within a small-sized earbud without obstructing, or minimally obstructing, the audio cavity. In the illustrated embodiment, an emitter and detector to be used with the sensor module 1201 can be arranged in a line that is parallel with the antitragus. This arrangement is illustrated in FIGS. 13A-13C. However, embodiments of the present invention are not limited to any particular set of dimensions or to any shape or configuration.

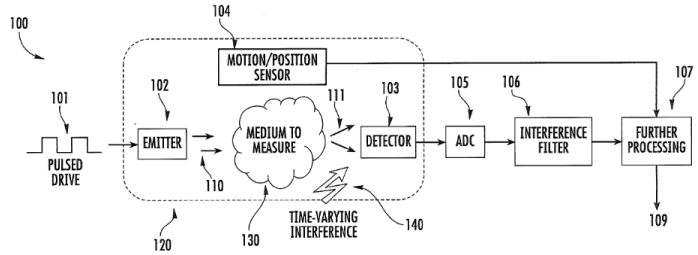
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	 FIG. 14 Valencell at Fig.14 FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, 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

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	optical emitters, or the like. In such case, multiple optical emitters 102 may be located between the two optical filters 715.  FIG. 15A  FIG. 15B Valencell at Figs.15A-15B FIGS. 15A-15B show a multi-detector earbud 1500, where two separate optical detectors 103 are covered by two separate optical lenses, at least one optical emitter is covered by at least one optical lens, and where the emitter 102 and detector 103 configuration is oriented perpendicularly to the antitragus (as that shown in FIG. 11). In FIGS. 15A-15B, the optical detectors 103, emitters 102, and lenses are not readily visible as they are surrounded, at least in part, by an optical coupling area 1510. The lenses (not shown) may cover each separate emitter 102 and detector 103 as shown in FIGS. 7 and 8. Note that in this configuration, the emitter- detector module 700, 800 of FIGS. 7 and 8 is oriented towards the back of the ear (near the back of the head). This arrangement may serve two purposes: 1) sunlight may be further blocked from reaching the detectors 103, as the back of the ear may serve as a shield and 2) there may be less motion artifacts convoluting the desired blood flow signals, as the detectors 103 may be oriented away from mouth-motion-prone areas located near the front of the ear. Another feature of the earbud 1500 of FIGS. 15A and 15B is that an optical coupling area 1510 is located on top of the optical emitter 102 and surrounding (but not covering) the optical detector 103. This optical coupling area 1510 may help diffuse, scatter, and/or guide light from the optical emitter to couple with a broader area of the ear region. Having a broader coupling area may help excite more regions of the ear with optical energy 110 (FIG. 1) and reduce the chance that the optical energy may miss important blood vessels, which may be located in different regions for different persons. Thus, such a design may promote a more universal

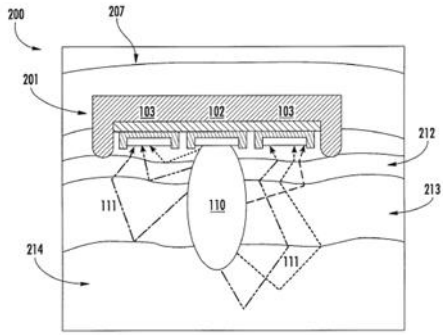
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	design for a biometric earbud. Without an optical coupling area 1510, the optical energy 110 from the optical emitter(s) 102 may miss blood vessels in different persons due to physiological differences that may exist between different people. Alternatively, the optical coupling area 1510 may be configured to cover the optical detector 103 area and not the optical emitter 102 area, such that more light is guided from different regions of the ear and coupled into the detector 103. Alternatively, a plurality of optical diffusion areas may be configured to cover the emitter 102 and detector 103 separately. Valencell at [0128]-[0131]  Valencell at Fig. 23 Referring to FIGS. 23-29, an exemplary wristband monitoring apparatus 2300 is illustrated. The wristband 2300 houses a power source, circuitry, a sensor module, and electronics as described above with respect to the various earbud embodiments. As illustrated in FIG. 24, a sensor module 700, 800 is positioned on the inside surface 2302 of the wristband 2300. The sensor module 700, 800 may include an isolation region 2304 that is configured to keep the sensor module 700, 800 stable with respect to the subject's wrist during use so as to reduce motion artifacts. The isolation region may be constructed out of any sturdy material, but for comfort, a foamy and/or flexible sturdy material may be utilized. Furthermore, the isolation region 2304 may further shield against environmental interference such as sunlight, external temperature, wind, and the like.

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	Valencell at [0151] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. the wearable device further comprising 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,	Valencell discloses or renders obvious the wearable device further comprising 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. 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 or there may be a combination of wired and wireless communications. 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 invention may be employed around another part of the body, such as a digit, finger, toe, limb, wrist, ankle, around the nose or earlobe, or the like. In other embodiments, the invention may be integrated into a patch, such as a bandage that sticks on a person's body. Valencell at [0106]

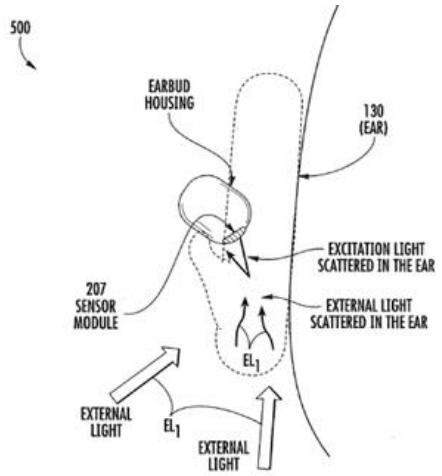
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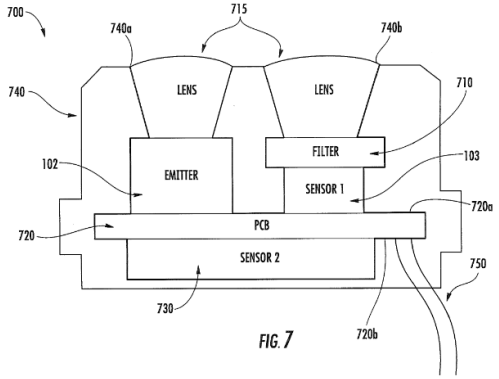
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	 FIG. 1 Valencell at Fig. 1 FIG. 1 illustrates an interference filtering apparatus/method 100, according to some embodiments of the present invention. A medium 130, preferably physiological material of a living subject, comprises at least one target region of interest 120 which is interrogated by energy 110, preferably modulated energy, such as pulsed energy, generated by an energy emitter 102. A pulsed driving circuit 101 is used to drive at least one energy emitter 102 at one or more pulsed frequencies to interrogate at least one target region of at least one medium 130 with the pulsed energy 110. The energy may be in the form of electromagnetic, acoustical, mechanical, nuclear, electrical, magnetic, thermal, or other forms of energy, but typically optical energy from the electromagnetic spectrum. The energy reaching the medium 130 can interact with the medium to generate at least one energy response signal 111, such as an optical scatter signal 111 between emitted optical energy 110 and the medium 130. The energy response 111 caused by this interaction is detected by at least one detector 103, configured to detect energy in the forms described above, but typically in the form of optical energy scattered from the medium 130. A motion/position sensor 104 may be configured to measure movement, positional changes, or inertial changes in the vicinity of the medium 130. The outputs of the detector 103 may be sent to at least one analog-to-digital convertor (ADC) 105 and the digitized output may be sent to at least one interference filter 106, which is configured to remove the effects of time-varying environmental interference 140 from the signal output of the detector 103. At least one motion/position sensor 104 may be incorporated in the interference filtering method 100 to provide a reference signal for removing the effects of motion from the extracted energy response signal 111 to produce a desired signal 109. For example, the output of the interference filter 106 may be further processed by signal extraction filter 107 to extract accurate

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	information from the medium 130, and this signal extraction filter 107 may utilize the output of the motion/position sensor 104 to remove motion artifacts from the desired signal (the extracted energy response signal) 109. At least one signal processor (not shown) may be used to control the operations of the energy emitter 102, detector 103, filter 106, and/or other components of the interference filtering method 100. Valencell at [0107] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact

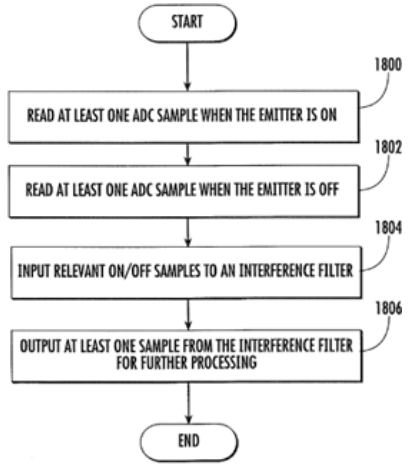
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	reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108]  FIG. 2 Valencell at Fig.2 Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and

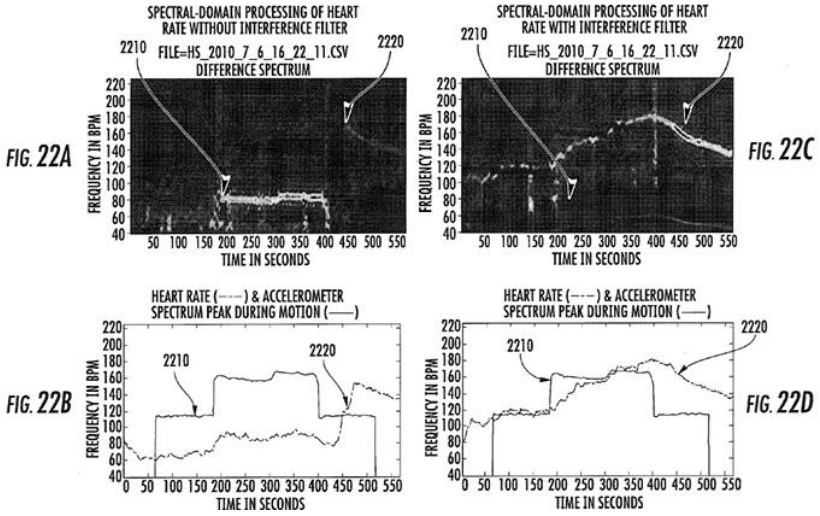
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	photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain 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. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. In real-world environments, the energy response signal 111 collected by a wearable sensor module 207 may be corrupted by time-varying environmental interference 140 (FIG. 1). Moreover, the energy response signal 111 may be even further corrupted by motion of the subject in a time-varying environment. For example, the motion caused by running may cause motion with respect to the emitter 102, detector 103, and medium 130 (in this case tissue of the subject), and this motion may cause an unwanted signal on the detector 103. Moreover, the time-varying environmental interference 140 (FIG. 1) may be caused by, or exacerbated by, the motion of the subject. A specific example of time-varying interference in a real-world environment 300 is summarized in FIG. 3. In FIG. 3, the runner is wearing an audio headset H containing biometric monitoring technology, such as Valencell's Healthset® brand technology (Valencell, Inc., Raleigh, N.C.), where at least one photoplethysmography sensor module 207 (FIG. 2) is included within a biometric audio earbud 404 as shown in FIG. 4. The sensor module 207 may contain at least one optical emitter 102, at least one optical detector 103, and at least one processor to measure heart rate, respiration rate, pulse pressure, motion, and/or other physiological conditions near the ear region 130 of the subject. These types of measurements may be achieved by detecting the optical scatter response 111 from the ear region as summarized in FIG. 2. However, direct sunlight SL1, indirect sunlight SL2 and/or artificial light AL1 from the environment may pass into the audio headset H. Time-varying sunlight SL1, SL2 and artificial ambient light AL1 may impart time-varying optical interference 140 on the optical detector 103 embedded within the audio headset H. For

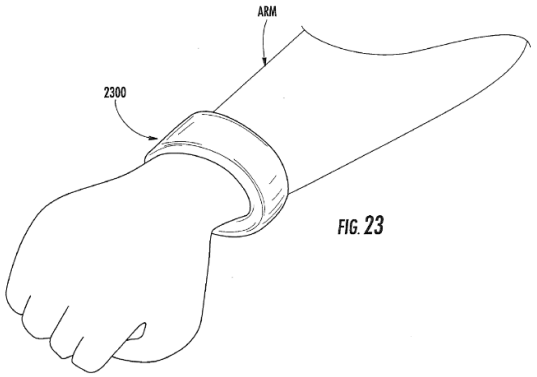
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	example, a time-varying interference signal 140 (FIG. 1) from environmental light may impart substantial artifacts on an energy response signal 111 (FIG. 1) in many real life scenarios, such as when clouds pass through the sky, when a subject runs through shadows, when a subject runs to/from an artificial light source, and/or various thereof. These time-varying artifacts may be difficult to distinguish from the desired time-varying signals associated with time-varying physiological conditions. For example, the interference frequencies associated with a time-varying change in shadows, or the harmonics of these interference frequencies, may correspond with at least one signal frequency associated with footsteps, respiration, or heart rate, and the optical energy response 111 may contain convoluted information comprising interference signals and desired physiological signals.  FIG. 5 Valencell at Fig.5 The aforementioned time-varying interference signal 140 (FIG. 1) from direct sunlight SL1 during jogging may be considered to be “direct interference”, in that interfering sunlight may be detected directly by the optical detector 103. However, there may be cases where the interference may reach the optical detector 103 indirectly, causing the same signal processing challenges as with direct interference. For example, FIG. 5 summarizes how external light EL1 from the sun or other external source can pass through the ear region and reach the optical detector 103 embedded within the sensor module 207. It may

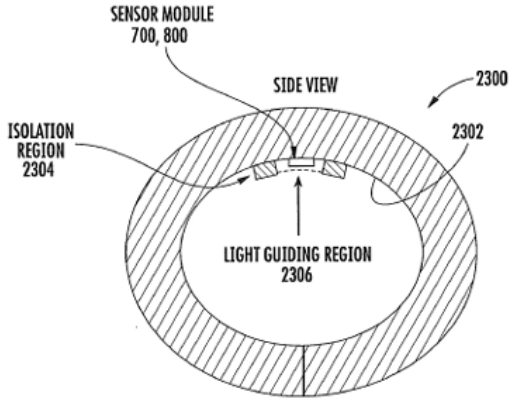
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	be difficult to distinguish this external light from the scattered excitation light associated with at least one physiological condition of the subject. To address these problems, a novel embodiment of the interference filtering method and apparatus 100 is to employ both novel filtering methods and novel optomechanical earbud designs to: 1) remove sunlight from the desired signal response 109 (FIG. 1) and 2) prevent sunlight from reaching the detector 103 in the first place. Embodiments of the present invention described herein employ at least one of these approaches, but typically both, to teach how to make a wearable monitor, such as an earbud monitor, that may provide accurate information on physiological conditions in the midst of environmental noise, such as noise from ambient light and/or sunlight. Valencell at [0109]-[0112]  FIG. 7 Valencell at Fig. 7 To guide light from the optical emitter 102 towards the skin 130 of a subject and to direct light from the skin 130 to the optical detector 103, lenses 715 may be utilized, as illustrated in FIG. 7. The lenses 715 may be physically separated lenses (as shown in FIGS. 7 and 8) or combined or conjoined lenses. In some embodiments of the present invention, there is no optical coupling between the emitter lens 715 and detector lens 715. For this reason, a barrier region may be incorporated in the case where the lenses

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	are combined or conjoined. Separated lenses may be isolated by at least one light opaque barrier region greater than 50 μm in thickness. Light opaque plastic, rubber, metal, or polymeric material are a few examples of good choices for the light opaque region. The optical lenses 715 may be designed for the desired optical coupling between the skin/blood vessel region and the emitter 102 or detector 103. For example, a convex lens design (such as that of FIG. 7) placed over the emitter 102 may focus light onto the skin, and a concave lens design (such as that of FIG. 8) placed over the emitter 102 may diverge light over the skin region. In the other direction, a convex lens design placed over the detector 103 may capture more light over a broader region and direct that light towards the detector 103, whereas a concave lens may collimate light towards the detector 103. Valencell at [0118] An exemplary filter processes samples 1910, the off/on samples 1920/1930 respectively, taken from a digitized physiological sensor signal 1911 generated by a detector (e.g., 103, FIG. 1) as shown in FIGS. 19A-19B. A pulsed emitter (e.g., 102, FIG. 1) generates a pulsed beam of light such that some samples 1920 represent signal 1911 from a detector with the emitter turned off and other samples 1930 represent signal 1911 from the detector with the emitter turned on. Both types of samples 1920 and 1930 may contain environmental noise from environmental interferants, but only emitter-on samples 1930 contain physiological information generated by the emitter energy. The digitized samples taken from detector signal 1911, provided by an ADC (e.g., 105, FIG. 1), are processed by an interference filter (e.g., 106, FIG. 1) and the output of the interference filter may be directed for further processing (represented by 107, FIG. 1).

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	 FIG. 18 Valencell at Fig. 18 These operations are summarized in FIG. 18, which is a flow chart of operations for removing environmental noise from a sensor signal via an interference filter, according to some embodiments of the present invention. At Block 1800, at least one ADC sample is read when the emitter is on. At Block 1802, at least one ADC sample is read when the emitter is off. At Block 1804, relevant on/off samples are input to an interference filter. At Block 1806, at least one sample from the interference filter is output for further processing. Valencell at [0137]-[0138] It should be noted that the modulated light 110 may be pulsed completely on or completely off, or it may be pulsed partially on or partially off. In some embodiments, for example, the modulated light may be sinusoidal. A benefit of complete on/off pulsing is that it may better-facilitate the signal processing methodologies outlined herein for attenuating environmental noise and motion-coupled environmental noise from one or more output signals. Valencell at [0143]

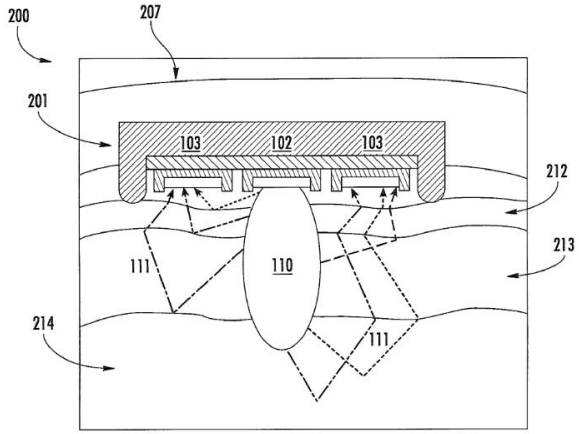
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	 Valencell at Figs. 22A-22D FIGS. 22A-22D are graphs of a processed heart rate signal output 109 of an earbud module (e.g., earbud module 207, 700, FIGS. 2, 7) employing two different filter configurations, according to some embodiments of the present invention. The graphs illustrated in FIGS. 22A-22D were generated from data collected from a user wearing an earbud (e.g., 404, FIGS. 4A, 4B) during an outdoor run. FIGS. 22A and 22C show relative spectrograms of frequency vs. time, where the strongest spectral signals show the brightest relative intensities. FIGS. 22B and 22D show the estimates of step rate 2210 and heart rate 2220 following further processing 107 to extract the desired frequencies of interest. FIG. 22A shows the spectrogram of the digitized sensor output from an optical detector (e.g., 103, FIG. 1) following the ADC process (e.g., 105, FIG. 1) without employing an interference filter (e.g., 106, FIG. 1). FIG. 22C shows the spectrogram of the same digitized sensor output of FIG. 22A following signal processing via the interference filter 2130 of FIG. 21. FIG. 22A shows a great deal of broadband noise from sunlight, the strongest signal appears to be the step rate signal 2210, and the heart rate spectrum 2220 appears very faint with respect to the step rate signal. In contrast, FIG. 22C shows substantially less broadband noise from sunlight, the strongest signal appears to be the heart rate signal 2220, and the step rate signal 2210 appears very faint with respect to the heart rate signal. Through further filtering (e.g., 107, FIG. 1), the

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	heart rate 2220 and step rate 2210 may be extracted, as shown in FIGS. 22B and 22D. FIG. 22B shows that the estimated heart rate signal 2200 is incorrect and does not match that of the spectrogram illustrated in FIG. 22A. In contrast, FIG. 22D shows that the estimated heart rate signal 2200 is correct and does match that of the spectrogram illustrated in FIG. 22C. Namely, the advanced interference filter 2130 is able to remove enough unwanted sunlight interference that the heart rate spectrum may be more easily extracted by spectral algorithms 107 (FIG. 1) designed to pick out the strongest frequency as heart rate. Valencell at [0149]  Valencell at Fig. 23

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	 FIG. 24 Valencell at Fig. 24 Referring to FIGS. 23-29, an exemplary wristband monitoring apparatus 2300 is illustrated. The wristband 2300 houses a power source, circuitry, a sensor module, and electronics as described above with respect to the various earbud embodiments. As illustrated in FIG. 24, a sensor module 700, 800 is positioned on the inside surface 2302 of the wristband 2300. The sensor module 700, 800 may include an isolation region 2304 that is configured to keep the sensor module 700, 800 stable with respect to the subject's wrist during use so as to reduce motion artifacts. The isolation region may be constructed out of any sturdy material, but for comfort, a foamy and/or flexible sturdy material may be utilized. Furthermore, the isolation region 2304 may further shield against environmental interference such as sunlight, external temperature, wind, and the like. Valencell at [0151] In some embodiments of the present invention, a light guiding region 2306 may surround or partially surround the sensor module 700, 800 and/or isolation region 2304, as illustrated in FIGS. 24-27. In FIGS. 24-26, the light guiding region 2306 surrounds the sensor module 700, 800. In FIG. 27, the light guiding region 2306 partially surrounds the sensor module 700, 800. The light guiding region 2306 helps direct light to and/or from the sensor module 700, 800 and a blood flow region within the body part. In some

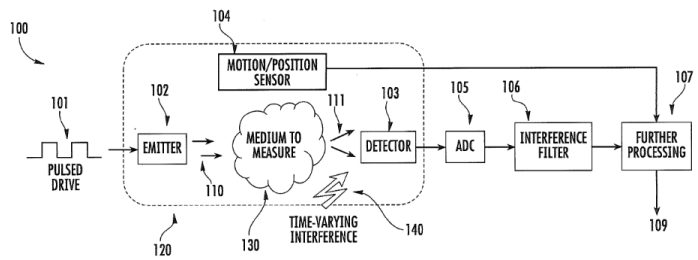
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	embodiments, the light guiding region 2306 may be a reflector, such as a metal, metallic alloy, mylar, mica, reflective plastic, reflective textile, or the like. In other embodiments, the light guiding region 2306 may be a transparent light guide, such as transparent silicone, polymers, rubbers, textiles, glass, epoxies, glues, or the like. In the case of a reflective layer, the sensor module 700, 800 is at least partially exposed. In the case of a transparent light-guiding layer, the sensor module 700, 800 may be completely covered. Valencell 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. wherein the detection system is configured to be synchronized to the light source;	Valencell discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into

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	sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain 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. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109]  FIG. 2 Valencell 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

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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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. 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 spatially separated detectors;	Valencell 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 spatially separated detectors. In some embodiments of the present invention, the monitoring apparatus includes at least one analog-to-digital (ADC) converter that converts analog signals generated by the detector to digital signals. Valencell at [0011] In some embodiments of the present invention, the at least one sensor module includes an analog-to-digital (ADC) converter that converts analog signals generated by the optical detector to digital signals. Valencell at [0027] In some embodiments of the present invention, the geometrical configuration of an emitter and detector may be oriented to maximize the collection of the energy response signal associated with physiological conditions and to minimize the collection of the unwanted scattered light response. Valencell at [0037] In some embodiments of the present invention, the monitoring apparatus includes at least one ADC converter that converts analog signals generated by the detector to digital signals. Valencell at [0049]

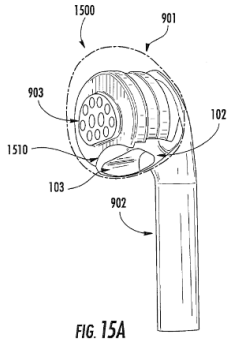
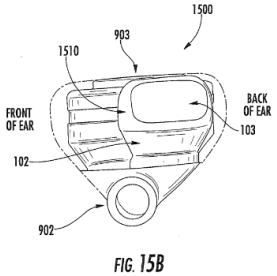
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	 FIG. 1 Valencell at Fig. 1 FIG. 1 illustrates an interference filtering apparatus/method 100, according to some embodiments of the present invention. A medium 130, preferably physiological material of a living subject, comprises at least one target region of interest 120 which is interrogated by energy 110, preferably modulated energy, such as pulsed energy, generated by an energy emitter 102. A pulsed driving circuit 101 is used to drive at least one energy emitter 102 at one or more pulsed frequencies to interrogate at least one target region of at least one medium 130 with the pulsed energy 110. The energy may be in the form of electromagnetic, acoustical, mechanical, nuclear, electrical, magnetic, thermal, or other forms of energy, but typically optical energy from the electromagnetic spectrum. The energy reaching the medium 130 can interact with the medium to generate at least one energy response signal 111, such as an optical scatter signal 111 between emitted optical energy 110 and the medium 130. The energy response 111 caused by this interaction is detected by at least one detector 103, configured to detect energy in the forms described above, but typically in the form of optical energy scattered from the medium 130. A motion/position sensor 104 may be configured to measure movement, positional changes, or inertial changes in the vicinity of the medium 130. The outputs of the detector 103 may be sent to at least one analog-to-digital convertor (ADC) 105 and the digitized output may be sent to at least one interference filter 106, which is configured to remove the effects of time-varying environmental interference 140 from the signal output of the detector 103. At least one motion/position sensor 104 may be incorporated in the interference filtering method 100 to provide a reference signal for removing the effects of motion from the extracted energy response signal 111 to produce a desired signal 109. For example, the output of the interference filter 106 may be further processed by signal extraction filter 107 to extract accurate

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	information from the medium 130, and this signal extraction filter 107 may utilize the output of the motion/position sensor 104 to remove motion artifacts from the desired signal (the extracted energy response signal) 109. At least one signal processor (not shown) may be used to control the operations of the energy emitter 102, detector 103, filter 106, and/or other components of the interference filtering method 100. Valencell at [0107] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact

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	reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, 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 at [0130]

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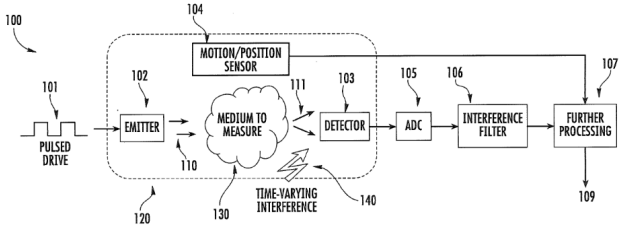
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	 FIG. 15A  FIG. 15B Valencell at Fig. 15A &15B FIGS. 15A-15B show a multi-detector earbud 1500, where two separate optical detectors 103 are covered by two separate optical lenses, at least one optical emitter is covered by at least one optical lens, and where the emitter 102 and detector 103 configuration is oriented perpendicularly to the antitragus (as that shown in FIG. 11). In FIGS. 15A-15B, the optical detectors 103, emitters 102, and lenses are not readily visible as they are surrounded, at least in part, by an optical coupling area 1510. The lenses (not shown) may cover each separate emitter 102 and detector 103 as shown in FIGS. 7 and 8. Note that in this configuration, the emitter- detector module 700, 800 of FIGS. 7 and 8 is oriented towards the back of the ear (near the back of the head). This arrangement may serve two purposes: 1) sunlight may be further blocked from reaching the detectors 103, as the back of the ear may serve as a shield and 2) there may be less motion artifacts convoluting the desired blood flow signals, as the detectors 103 may be oriented away from mouth-motion-prone areas located near the front of the ear. Another feature of the earbud 1500 of FIGS. 15A and 15B is that an optical coupling area 1510 is located on top of the optical emitter 102 and surrounding (but not covering) the optical detector 103. This optical coupling area 1510 may help diffuse, scatter, and/or guide light from the optical emitter to couple with a broader area of the ear region. Having a broader coupling area may help excite more regions of the ear with optical energy 110 (FIG. 1) and reduce the chance that the optical energy may miss important blood vessels, which may be located in different regions for different persons. Thus, such a design may promote a more universal design for a biometric earbud. Without an optical coupling area 1510, the optical energy 110 from the optical emitter(s) 102 may miss blood vessels in different persons due to physiological differences that

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	may exist between different people. Alternatively, the optical coupling area 1510 may be configured to cover the optical detector 103 area and not the optical emitter 102 area, such that more light is guided from different regions of the ear and coupled into the detector 103. Alternatively, a plurality of optical diffusion areas may be configured to cover the emitter 102 and detector 103 separately. Valencell at [0131] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Valencell discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. In some embodiments of the present invention, the processed energy response signal is transmitted to a remote device, for example wirelessly transmitted. Valencell at [0035] 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 or there may be a combination of wired and wireless communications. 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 invention may be employed around another part of the body, such as a digit, finger,

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	toe, limb, wrist, ankle, around the nose or earlobe, or the like. In other embodiments, the invention may be integrated into a patch, such as a bandage that sticks on a person's body. Valencell at [0106] 30. The method of claim 26, further comprising transmitting the processed energy response signal to a remote device. Valencell at Claims 30 31. The method of claim 30, wherein transmitting the processed energy response signal to a device comprises wirelessly transmitting the processed energy response signal. Valencell 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, 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 one or more of the physiological parameters;	Valencell discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. According to some embodiments of the present invention, a wearable monitoring apparatus includes a housing (e.g., an earpiece, earbud, etc.), and a sensor module disposed within or attached to the housing. The housing is configured to be attached to a body of a subject, for example the ear. The sensor module includes an energy emitter, a detector, a filter, and at least one processor. The energy emitter directs energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, mechanical energy, magnetic energy, nuclear energy, etc.) at a target region of the subject and the detector detects an energy response signal from the subject. The energy response signal is associated with a physiological condition of the subject (e.g., heart rate, pulse pressure, respiration rate, lactic

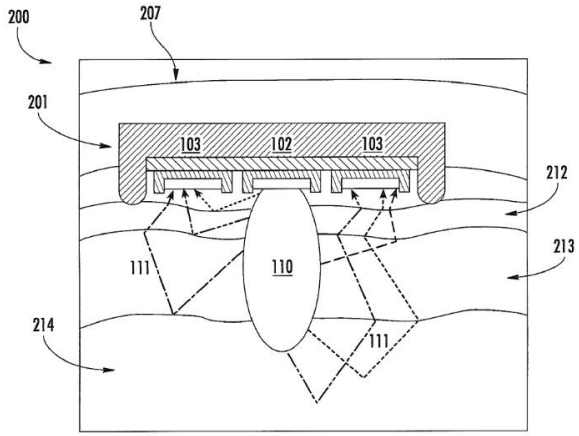
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	threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.). The filter removes or attenuates time-varying environmental interference from the energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Valencell at [0006] According to some embodiments of the present invention, a monitoring apparatus includes a housing configured to be attached to the ear of a subject, and a sensor module disposed within or attached to the housing. The sensor module includes an optical emitter, a detector, a motion/position sensor, a filter, and at least one processor that controls operations of the optical emitter, detector, and/or filter. The optical emitter directs optical energy at a target region of the subject and the detector detects an optical energy response signal from the subject, wherein the energy response signal is associated with a physiological condition of the subject. Light-opaque material surrounds at least part of the sensor module to prevent ambient light from interfering with the detector. Output from the motion/position sensor is associated with the motion or position between the housing and ear of the subject. The filter removes or attenuates time-varying environmental interference from the optical energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, and temperature. Valencell at [0012] According to other embodiments of the present invention, an earbud for a headset includes a housing that is configured to be positioned within an ear of a subject, a speaker, and at least one sensor module disposed within or attached to the housing. The at least one sensor module includes a printed circuit board (PCB) having opposite first and second sides, an optical emitter attached to at least one side of the PCB that directs electromagnetic radiation at a target region of the ear, an optical detector attached to at least one side of the PCB adjacent to the optical emitter that detects an energy response signal associated with a physiological condition of the subject from the subject, and an optical filter overlying at least a portion of the optical detector, wherein the optical filter is configured to attenuate (e.g., reduce or block) light at one or more selected wavelengths. A filter may be included that removes time-varying environmental interference from the energy response signal. Time-varying environmental interference may be caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. The

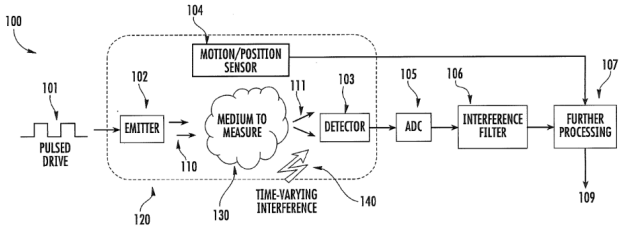
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	at least one sensor module may include at least one processor that controls operations of the optical emitter, optical detector, and/or filter. Valencell at [0019] According to other embodiments of the present invention, a method of monitoring at least one physiological property of a subject includes directing pulsed energy at a target region of the subject via an energy emitter, obtaining a first energy response signal from the subject when the emitter is on, obtaining a second energy response signal from the subject when the emitter is off, and processing the first and second energy response signals via an interference filter to produce a processed energy response signal that is associated with a physiological condition (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.) of the subject, wherein the filter removes or attenuates time-varying environmental interference caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Directing pulsed energy at a target region may include directing energy selected from the group consisting of optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc. Valencell at [0033] The sensor module includes an energy emitter, a detector, a filter, and at least one processor. The energy emitter directs energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, mechanical energy, magnetic energy, nuclear energy, etc.) at a target region of the subject and the detector detects an energy response signal from the subject. The energy response signal is associated with a physiological condition of the subject (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.). The filter removes or attenuates time-varying environmental interference from the energy response signal, wherein the time-varying environmental interference is caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Valencell at [0044]

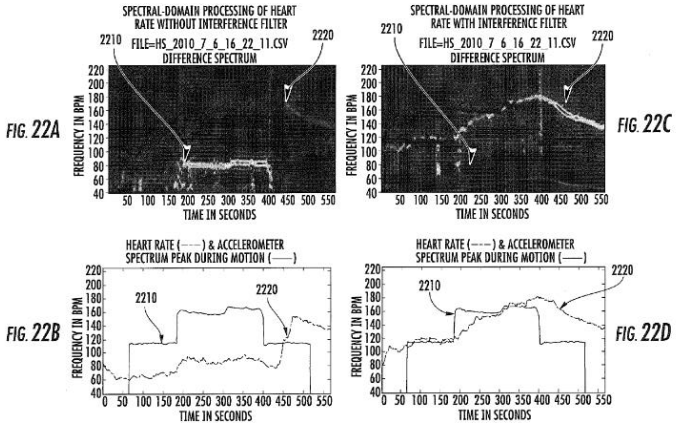
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	Embodiments of the present invention are not limited to headsets that communicate wirelessly. In some embodiments of the present invention, headsets configured to monitor an individual's physiology and/or environment may be wired to a device that stores and/or processes data or there may be a combination of wired and wireless communications. 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 invention may be employed around another part of the body, such as a digit, finger, toe, limb, wrist, ankle, around the nose or earlobe, or the like. In other embodiments, the invention may be integrated into a patch, such as a bandage that sticks on a person's body. Valencell at [0106]  FIG. 1 Valencell at Fig. 1 In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-

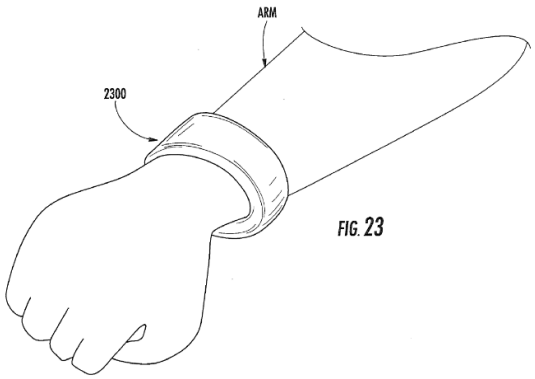
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	varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body

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	of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain 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. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109]

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	 FIG. 2 Valencell 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. 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;	Valencell discloses or renders obvious 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. The term “modulated energy”, as used herein, refers to energy (e.g., optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc.) that is emitted in pulses and/or that is emitted such that the amplitude, frequency, phase, or intensity is varied. A pulsed energy source modulates by effectively multiplying by a waveform that is a periodic sequence of zeros and ones.

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	Valencell at [0097] In some embodiments of the present invention, an additional optical filter (e.g., 710, FIGS. 7 and 8) may be utilized that serves (or also serves) as an attenuation filter, such as a “neutral density filter”, gelatin filter, opaque material, or other optical attenuation filter or filtering materials. In one embodiment, an optical filter 710 may serve as both an optical wavelength filter and an attenuation filter. Because sunlight is so powerful, it may be beneficial to reduce sunlight interference as much as possible, even if that means also reducing the amount of optical scatter 111 (FIG. 1) of interest from the medium 130 (FIG. 1). To offset this unwanted reduction in optical scatter 111, 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 at [0123]  FIG. 1 Valencell at Fig. 1 FIGS. 22A-22D are graphs of a processed heart rate signal output 109 of an earbud module (e.g., earbud module 207, 700, FIGS. 2, 7) employing two different filter configurations, according to some embodiments of the present invention. The graphs illustrated in FIGS. 22A-22D were generated from data collected from a user wearing an earbud (e.g., 404, FIGS. 4A, 4B) during an outdoor run. FIGS. 22A and 22C show relative spectrograms of frequency vs. time, where the strongest spectral signals show the brightest relative intensities. FIGS. 22B and 22D show the estimates of step rate 2210 and heart rate 2220 following further processing 107 to extract the desired frequencies of interest. FIG. 22A shows the spectrogram of the digitized sensor output from an optical detector (e.g., 103, FIG. 1) following the ADC

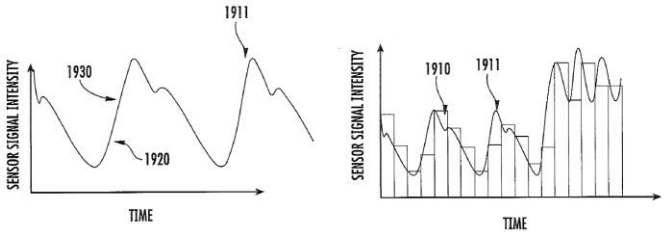
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	process (e.g., 105, FIG. 1) without employing an interference filter (e.g., 106, FIG. 1). FIG. 22C shows the spectrogram of the same digitized sensor output of FIG. 22A following signal processing via the interference filter 2130 of FIG. 21. FIG. 22A shows a great deal of broadband noise from sunlight, the strongest signal appears to be the step rate signal 2210, and the heart rate spectrum 2220 appears very faint with respect to the step rate signal. In contrast, FIG. 22C shows substantially less broadband noise from sunlight, the strongest signal appears to be the heart rate signal 2220, and the step rate signal 2210 appears very faint with respect to the heart rate signal. Through further filtering (e.g., 107, FIG. 1), the heart rate 2220 and step rate 2210 may be extracted, as shown in FIGS. 22B and 22D. FIG. 22B shows that the estimated heart rate signal 2200 is incorrect and does not match that of the spectrogram illustrated in FIG. 22A. In contrast, FIG. 22D shows that the estimated heart rate signal 2200 is correct and does match that of the spectrogram illustrated in FIG. 22C. Namely, the advanced interference filter 2130 is able to remove enough unwanted sunlight interference that the heart rate spectrum may be more easily extracted by spectral algorithms 107 (FIG. 1) designed to pick out the strongest frequency as heart rate. Valencell at [0149]  Valencell at Fig. 22A-22D

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	Referring to FIGS. 23-29, an exemplary wristband monitoring apparatus 2300 is illustrated. The wristband 2300 houses a power source, circuitry, a sensor module, and electronics as described above with respect to the various earbud embodiments. As illustrated in FIG. 24, a sensor module 700, 800 is positioned on the inside surface 2302 of the wristband 2300. The sensor module 700, 800 may include an isolation region 2304 that is configured to keep the sensor module 700, 800 stable with respect to the subject's wrist during use so as to reduce motion artifacts. The isolation region may be constructed out of any sturdy material, but for comfort, a foamy and/or flexible sturdy material may be utilized. Furthermore, the isolation region 2304 may further shield against environmental interference such as sunlight, external temperature, wind, and the like. Valencell at [0151]  Valencell at Fig. 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 Valencell, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, 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 semiconductor sources are off,	Valencell discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off. According to other embodiments of the present invention, a method of monitoring at least one physiological property of a subject includes directing pulsed energy at a target region of the subject via an energy emitter, obtaining a first energy response signal from the subject when the emitter is on, obtaining a second energy response signal from the subject when the emitter is off, and processing the first and second energy response signals via an interference filter to produce a processed energy response signal that is associated with a physiological condition (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.) of the subject, wherein the filter removes or attenuates time-varying environmental interference caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Directing pulsed energy at a target region may include directing energy selected from the group consisting of optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc. Valencell at [0033] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical

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	detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate

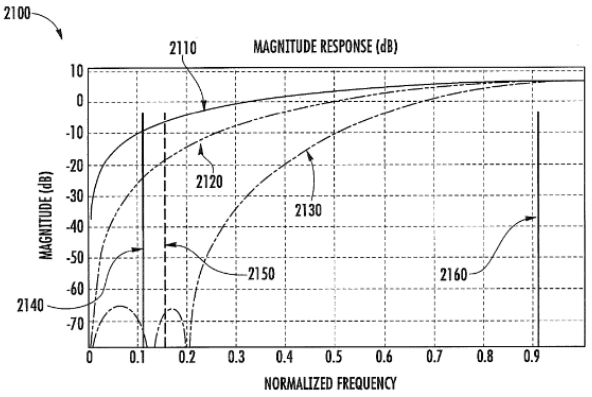
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	an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, collecting light at different wavelengths, and processing these signals collectively, can be used to generate assessments of blood gas levels, such as blood oxygen (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 at [0130]  FIG. 19A FIG. 19B Valencell at Fig. 19A & 19B An exemplary filter processes samples 1910, the off/on samples 1920/1930 respectively, taken from a digitized physiological sensor signal 1911 generated by a detector (e.g., 103, FIG. 1) as shown in FIGS. 19A-19B. A pulsed emitter (e.g., 102, FIG. 1) generates a pulsed beam of light such that some samples 1920 represent signal 1911 from a detector with the emitter turned off and other samples 1930 represent signal 1911 from the detector with the emitter turned on. Both types of samples 1920 and 1930 may contain environmental noise from environmental interferants, but only emitter-on samples 1930 contain physiological information generated by the emitter energy. The digitized samples taken from detector signal 1911, provided by an ADC (e.g., 105, FIG. 1), are processed by an interference filter (e.g., 106, FIG. 1) and the output of the interference filter may be directed for further processing (represented by 107, FIG. 1). Valencell at [0137]

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	These operations are summarized in FIG. 18, which is a flow chart of operations for removing environmental noise from a sensor signal via an interference filter, according to some embodiments of the present invention. At Block 1800, at least one ADC sample is read when the emitter is on. At Block 1802, at least one ADC sample is read when the emitter is off. At Block 1804, relevant on/off samples are input to an interference filter. At Block 1806, at least one sample from the interference filter is output for further processing. An interference filter (e.g., 106, FIG. 1) utilized according to embodiments of the present invention, may vary in nature and complexity. For example, an interference filter may subtract temporally neighboring emitter-off samples 1920 (FIG. 19A) from temporally neighboring emitter-on samples 1930 (FIG. 19A) and output a “subtraction” signal for further processing. In this embodiment, the subtraction may involve subtracting temporally neighboring on/off samples, averaging temporally neighboring on samples and averaging temporally neighboring off samples and then subtracting the average off samples from the average on samples, or by other approaches to subtracting off signals 1920 from on signals 1930. When choosing a subtraction approach, it is important to consider the emitter pulsing frequency and sampling approach. For example, choosing a frequency that is too low may result in unsatisfactory subtraction, as the dynamic environmental conditions between off-states 1920 and on-states 1930 may be too abrupt for the sampling frequency, such that the physiological state of interest is not properly characterized by the interference filter. Thus, the sampling frequency may need to be much higher than the Nyquist frequency required for characterizing the signal in a stationary environment. As a specific example, if an interference filter (e.g., 106, FIG. 1) is being used to remove sunlight interference (e.g., SL1, SL2, FIG. 3), from a photoplethysmogram 1911 (FIGS. 19A, 19B), and if the desired processed output from the final filtering is heart rate, then the Nyquist criteria for pulsing the emitter may be 2×fmax, where fmax is the maximum heart rate of interest, which is likely to be somewhere around 200 beats/minute (BPM) or 3.33 Hz. However, a person running through alternating shadows may generate a sunlight interference frequency greater than 10 Hz. In such case, it may be desirable to select a sampling frequency greater than twice the sunlight interference frequency, which in this case would be greater than 20 Hz. Samples that are temporally neighboring (located close to each other in time) may be averaged in this case to help remove noise associated with unintended transients. For example, the off samples 1920 (FIGS. 19A, 19B) that come before, and/or after, a given on sample 1930 (FIGS. 19A, 19B) may be averaged and then that

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	average may be subtracted from the on sample 1930 (or average of the on samples), and this final result may be passed along for further processing. As another example, a batch of data may be defined to consist of: 1) a set number of on/off optical detector samples, for instance 6 interleaved on/off samples, 2) a set number of motion sensor samples, for instance 3 samples (one for each on/off optical sample), and 3) a time delay. The time delay may be adjusted to generate the desired batch rate or batch frequency. The 6 on/off optical samples may be input to a multi-tap filter, for instance an M-tap weighted sum filter, and the output may be defined as 1 output per batch for the interference filter. If the optical on/off samples are extended to fill the whole batch period by “N” samples, then the decimation factor is “N”, and the effective sample rate is N*batch rate. The parameters for adjustment in this filter may then be N and M, where M is the number of taps in the filter. The batch rate may be chosen to avoid aliasing of interfering harmonics from the desired physical condition monitored, such as the heart rate. For example, batch rate may be chosen as 10*HRmax, where HRmax is the maximum heart rate to be measured. The batch rate may dominate the MIPS (million instructions per second) used by a signal processor, such as a DSP (digital signal processor), since it affects the spectral transform of the desired output signal. In this filtering embodiment, to minimize aliasing from interfering sunlight-shadow changes on the desired heart rate output signal (especially for running or cycling through shadows), a increasing the N and/or M may be preferred. Another example of a batch may include nine (9) optical segments per batch: off-on-off-on-off-on-off-on-off. Within a given batch, the average of the “off” samples may be subtracted from the average of the “on” samples, providing one output per batch. This would generate a decimation factor of nine (9). Additional batch configurations and on/off configurations may be used in this invention. Valencell at [0138]-[0142] It should be noted that the modulated light 110 may be pulsed completely on or completely off, or it may be pulsed partially on or partially off. In some embodiments, for example, the modulated light may be sinusoidal. A benefit of complete on/off pulsing is that it may better-facilitate the signal processing methodologies outlined herein for attenuating environmental noise and motion-coupled environmental noise from one or more output signals. Valencell at [0143]

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	A finite impulse response (FIR) version of an interference filter, according to some embodiments of the present invention, levering the pulsed-emitter on/off sampling rate, is presented in FIG. 20 and identified as 2000. The illustrated interference filter 2000 employs a delay of “n” samples according to Z−n. Coefficients in the filter “bn” allow multi-tap filtering. Pulsing an emitter (e.g., 102, FIG. 1) and selectively sampling on/off signals, as described herein, may modulate the physiological signal to a higher frequency. Thus, the output y(n) of the interference filter 2000 may be decimated to demodulate the output back into the baseband. A specific example of a decimation-by-2 algorithm may reject odd-numbered samples such that the decimated signal, w(m), may be described by even-numbered samples according to w(m)=y(2*m). Valencell at [0144]  FIG. 21 Valencell at Fig. 21 Examples of filters embodying the interference filter 2000, for removing sunlight interference from a PPG signal 1911 (FIGS. 19A, 19B) to extract heart rate, according to embodiments of the present invention, are illustrated in the plot 2100 of FIG. 21. The plot 2100 presents the magnitude response (in dB) for each interference filter vs. normalized frequency (1=Nyquist). Also shown in FIG. 21 is a representation of the modulated heart rate 2160 modulated by the emitter on/off sample rate, the

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	demodulated heart rate 2140 demodulated by decimation, and the interference frequency associated with dynamic sunlight noise 2150. As a specific example for the previously described “subtraction filter” 2110, the FIR coefficients may be [b1 b2]=[1 −1]. A filter 2120 for subtracting the temporally neighboring off-samples 1920, coming before and after a given on-sample 1930, may employ coefficients of [−0.05 1 −0.5]. A filter 2130 using multiple on/off samples may employ coefficients of [−0.07 0.3−0.6 0.6−0.3 0.07]. Valencell at [0145] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, 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 semiconductor sources is on; and	Valencell discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on; and. According to other embodiments of the present invention, a method of monitoring at least one physiological property of a subject includes directing pulsed energy at a target region of the subject via an energy emitter, obtaining a first energy response signal from the subject when the emitter is on, obtaining a second energy response signal from the subject when the emitter is off, and processing the first and second energy response signals via an interference filter to produce a processed energy response signal that is associated with a physiological condition (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.) of the subject, wherein the filter removes or attenuates time-varying environmental interference caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Directing pulsed energy at a target region may include directing energy selected from the group consisting of optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc.

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	Valencell at [0033] FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, 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 at [0130] These operations are summarized in FIG. 18, which is a flow chart of operations for removing environmental noise from a sensor signal via an interference filter, according to some embodiments of the present invention. At Block 1800, at least one ADC sample is read when the emitter is on. At Block 1802, at least one ADC sample is read when the emitter is off. At Block 1804, relevant on/off samples are input to an interference filter. At Block 1806, at least one sample from the interference filter is output for further processing. An interference filter (e.g., 106, FIG. 1) utilized according to embodiments of the present invention, may vary in nature and complexity. For example, an interference filter may subtract temporally neighboring emitter-off samples 1920 (FIG. 19A) from temporally neighboring emitter-on samples 1930 (FIG. 19A)

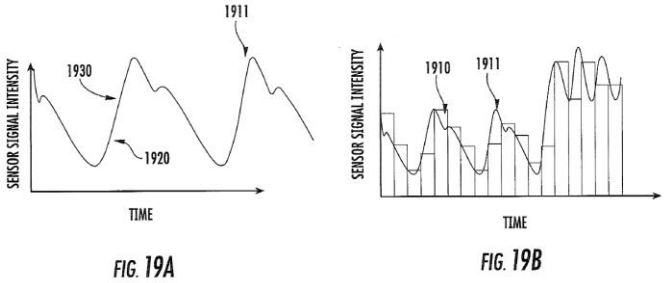
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	and output a “subtraction” signal for further processing. In this embodiment, the subtraction may involve subtracting temporally neighboring on/off samples, averaging temporally neighboring on samples and averaging temporally neighboring off samples and then subtracting the average off samples from the average on samples, or by other approaches to subtracting off signals 1920 from on signals 1930. When choosing a subtraction approach, it is important to consider the emitter pulsing frequency and sampling approach. For example, choosing a frequency that is too low may result in unsatisfactory subtraction, as the dynamic environmental conditions between off-states 1920 and on-states 1930 may be too abrupt for the sampling frequency, such that the physiological state of interest is not properly characterized by the interference filter. Thus, the sampling frequency may need to be much higher than the Nyquist frequency required for characterizing the signal in a stationary environment. As a specific example, if an interference filter (e.g., 106, FIG. 1) is being used to remove sunlight interference (e.g., SL1, SL2, FIG. 3), from a photoplethysmogram 1911 (FIGS. 19A, 19B), and if the desired processed output from the final filtering is heart rate, then the Nyquist criteria for pulsing the emitter may be 2×fmax, where fmax is the maximum heart rate of interest, which is likely to be somewhere around 200 beats/minute (BPM) or 3.33 Hz. However, a person running through alternating shadows may generate a sunlight interference frequency greater than 10 Hz. In such case, it may be desirable to select a sampling frequency greater than twice the sunlight interference frequency, which in this case would be greater than 20 Hz. Samples that are temporally neighboring (located close to each other in time) may be averaged in this case to help remove noise associated with unintended transients. For example, the off samples 1920 (FIGS. 19A, 19B) that come before, and/or after, a given on sample 1930 (FIGS. 19A, 19B) may be averaged and then that average may be subtracted from the on sample 1930 (or average of the on samples), and this final result may be passed along for further processing. As another example, a batch of data may be defined to consist of: 1) a set number of on/off optical detector samples, for instance 6 interleaved on/off samples, 2) a set number of motion sensor samples, for instance 3 samples (one for each on/off optical sample), and 3) a time delay. The time delay may be adjusted to generate the desired batch rate or batch frequency. The 6 on/off optical samples may be input to a multi-tap filter, for instance an M-tap weighted sum filter, and the output may be defined as 1 output per batch for the interference filter. If the optical on/off samples are extended to fill the whole batch period by “N” samples, then the decimation factor is “N”, and the effective sample rate is N*batch rate. The parameters for adjustment in this filter may then be N and M, where M is the number of taps in the

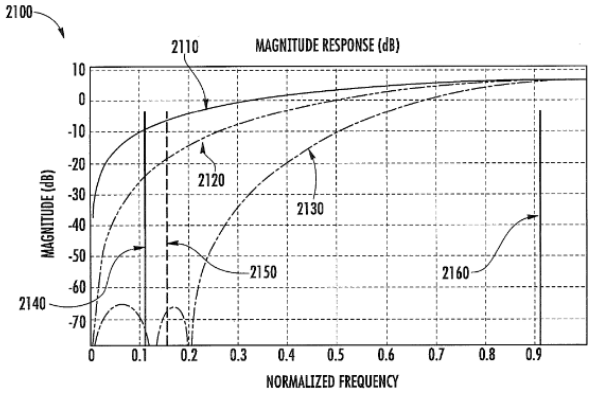
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	filter. The batch rate may be chosen to avoid aliasing of interfering harmonics from the desired physical condition monitored, such as the heart rate. For example, batch rate may be chosen as 10*HRmax, where HRmax is the maximum heart rate to be measured. The batch rate may dominate the MIPS (million instructions per second) used by a signal processor, such as a DSP (digital signal processor), since it affects the spectral transform of the desired output signal. In this filtering embodiment, to minimize aliasing from interfering sunlight-shadow changes on the desired heart rate output signal (especially for running or cycling through shadows), a increasing the N and/or M may be preferred. Another example of a batch may include nine (9) optical segments per batch: off-on-off-on-off-on-off-on-off. Within a given batch, the average of the “off” samples may be subtracted from the average of the “on” samples, providing one output per batch. This would generate a decimation factor of nine (9). Additional batch configurations and on/off configurations may be used in this invention. Valencell at [0138]-[0142]. In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106

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	to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] An exemplary filter processes samples 1910, the off/on samples 1920/1930 respectively, taken from a digitized physiological sensor signal 1911 generated by a detector (e.g., 103, FIG. 1) as shown in FIGS. 19A-19B. A pulsed emitter (e.g., 102, FIG. 1) generates a pulsed beam of light such that some samples 1920 represent signal 1911 from a detector with the emitter turned off and other samples 1930 represent signal 1911 from the detector with the emitter turned on. Both types of samples 1920 and 1930 may contain environmental noise from environmental interferants, but only emitter-on samples 1930 contain physiological information generated by the emitter energy. The digitized samples taken from detector signal 1911, provided by an ADC (e.g., 105, FIG. 1), are processed by an interference filter (e.g., 106, FIG. 1) and the output of the interference filter may be directed for further processing (represented by 107, FIG. 1). Valencell at [0137]

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	 Valencell at Fig. 19A & 19B It should be noted that the modulated light 110 may be pulsed completely on or completely off, or it may be pulsed partially on or partially off. In some embodiments, for example, the modulated light may be sinusoidal. A benefit of complete on/off pulsing is that it may better-facilitate the signal processing methodologies outlined herein for attenuating environmental noise and motion-coupled environmental noise from one or more output signals. Valencell at [0143] A finite impulse response (FIR) version of an interference filter, according to some embodiments of the present invention, levering the pulsed-emitter on/off sampling rate, is presented in FIG. 20 and identified as 2000. The illustrated interference filter 2000 employs a delay of “n” samples according to Z−n. Coefficients in the filter “bn” allow multi-tap filtering. Pulsing an emitter (e.g., 102, FIG. 1) and selectively sampling on/off signals, as described herein, may modulate the physiological signal to a higher frequency. Thus, the output y(n) of the interference filter 2000 may be decimated to demodulate the output back into the baseband. A specific example of a decimation-by-2 algorithm may reject odd-numbered samples such that the decimated signal, w(m), may be described by even-numbered samples according to w(m)=y(2*m). Valencell at [0144] Examples of filters embodying the interference filter 2000, for removing sunlight interference from a PPG signal 1911 (FIGS. 19A, 19B) to extract heart rate, according to embodiments of the present invention, are illustrated in the plot 2100 of FIG. 21. The plot 2100 presents the magnitude response (in

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	dB) for each interference filter vs. normalized frequency (1=Nyquist). Also shown in FIG. 21 is a representation of the modulated heart rate 2160 modulated by the emitter on/off sample rate, the demodulated heart rate 2140 demodulated by decimation, and the interference frequency associated with dynamic sunlight noise 2150. As a specific example for the previously described “subtraction filter” 2110, the FIR coefficients may be [b1 b2]=[1 −1]. A filter 2120 for subtracting the temporally neighboring off-samples 1920, coming before and after a given on-sample 1930, may employ coefficients of [−0.05 1 −0.5]. A filter 2130 using multiple on/off samples may employ coefficients of [−0.07 0.3−0.6 0.6−0.3 0.07]. Valencell at [0145]  FIG. 21 Valencell at Fig. 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

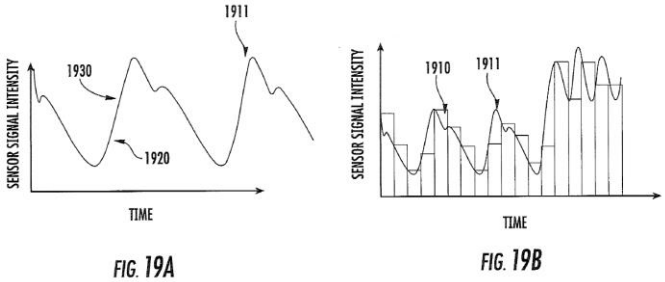
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1[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Valencell discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal; and. According to other embodiments of the present invention, a method of monitoring at least one physiological property of a subject includes directing pulsed energy at a target region of the subject via an energy emitter, obtaining a first energy response signal from the subject when the emitter is on, obtaining a second energy response signal from the subject when the emitter is off, and processing the first and second energy response signals via an interference filter to produce a processed energy response signal that is associated with a physiological condition (e.g., heart rate, pulse pressure, respiration rate, lactic threshold, blood pressure, volume of blood flow through a blood vessel, blood metabolite level, blood oxygen level, size of at least one blood vessel, etc.) of the subject, wherein the filter removes or attenuates time-varying environmental interference caused by one or more of the following: sunlight, ambient light, airflow, temperature, etc. Directing pulsed energy at a target region may include directing energy selected from the group consisting of optical energy, acoustic energy, ultrasonic energy, electromagnetic radiation, electrical energy, magnetic energy, mechanical energy, nuclear energy, etc. Valencell at [0033] In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical

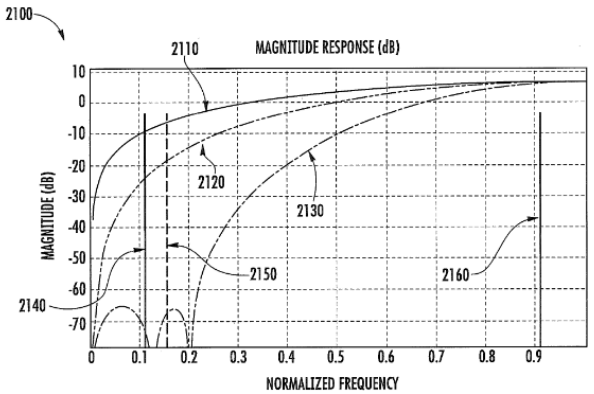
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	energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, 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

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	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 at [0130] An exemplary filter processes samples 1910, the off/on samples 1920/1930 respectively, taken from a digitized physiological sensor signal 1911 generated by a detector (e.g., 103, FIG. 1) as shown in FIGS. 19A-19B. A pulsed emitter (e.g., 102, FIG. 1) generates a pulsed beam of light such that some samples 1920 represent signal 1911 from a detector with the emitter turned off and other samples 1930 represent signal 1911 from the detector with the emitter turned on. Both types of samples 1920 and 1930 may contain environmental noise from environmental interferants, but only emitter-on samples 1930 contain physiological information generated by the emitter energy. The digitized samples taken from detector signal 1911, provided by an ADC (e.g., 105, FIG. 1), are processed by an interference filter (e.g., 106, FIG. 1) and the output of the interference filter may be directed for further processing (represented by 107, FIG. 1). Valencell at [0137] These operations are summarized in FIG. 18, which is a flow chart of operations for removing environmental noise from a sensor signal via an interference filter, according to some embodiments of the present invention. At Block 1800, at least one ADC sample is read when the emitter is on. At Block 1802, at least one ADC sample is read when the emitter is off. At Block 1804, relevant on/off samples are input to an interference filter. At Block 1806, at least one sample from the interference filter is output for further processing. An interference filter (e.g., 106, FIG. 1) utilized according to embodiments of the present invention, may vary in nature and complexity. For example, an interference filter may subtract temporally neighboring emitter-off samples 1920 (FIG. 19A) from temporally neighboring emitter-on samples 1930 (FIG. 19A) and output a “subtraction” signal for further processing. In this embodiment, the subtraction may involve subtracting temporally neighboring on/off samples, averaging temporally neighboring on samples and averaging temporally neighboring off samples and then subtracting the average off samples from the average on samples, or by other approaches to subtracting off signals 1920 from on signals 1930. When choosing a subtraction approach, it is important to consider the emitter pulsing frequency and sampling

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	approach. For example, choosing a frequency that is too low may result in unsatisfactory subtraction, as the dynamic environmental conditions between off-states 1920 and on-states 1930 may be too abrupt for the sampling frequency, such that the physiological state of interest is not properly characterized by the interference filter. Thus, the sampling frequency may need to be much higher than the Nyquist frequency required for characterizing the signal in a stationary environment. As a specific example, if an interference filter (e.g., 106, FIG. 1) is being used to remove sunlight interference (e.g., SL1, SL2, FIG. 3), from a photoplethysmogram 1911 (FIGS. 19A, 19B), and if the desired processed output from the final filtering is heart rate, then the Nyquist criteria for pulsing the emitter may be 2×fmax, where fmax is the maximum heart rate of interest, which is likely to be somewhere around 200 beats/minute (BPM) or 3.33 Hz. However, a person running through alternating shadows may generate a sunlight interference frequency greater than 10 Hz. In such case, it may be desirable to select a sampling frequency greater than twice the sunlight interference frequency, which in this case would be greater than 20 Hz. Samples that are temporally neighboring (located close to each other in time) may be averaged in this case to help remove noise associated with unintended transients. For example, the off samples 1920 (FIGS. 19A, 19B) that come before, and/or after, a given on sample 1930 (FIGS. 19A, 19B) may be averaged and then that average may be subtracted from the on sample 1930 (or average of the on samples), and this final result may be passed along for further processing. As another example, a batch of data may be defined to consist of: 1) a set number of on/off optical detector samples, for instance 6 interleaved on/off samples, 2) a set number of motion sensor samples, for instance 3 samples (one for each on/off optical sample), and 3) a time delay. The time delay may be adjusted to generate the desired batch rate or batch frequency. The 6 on/off optical samples may be input to a multi-tap filter, for instance an M-tap weighted sum filter, and the output may be defined as 1 output per batch for the interference filter. If the optical on/off samples are extended to fill the whole batch period by “N” samples, then the decimation factor is “N”, and the effective sample rate is N*batch rate. The parameters for adjustment in this filter may then be N and M, where M is the number of taps in the filter. The batch rate may be chosen to avoid aliasing of interfering harmonics from the desired physical condition monitored, such as the heart rate. For example, batch rate may be chosen as 10*HRmax, where HRmax is the maximum heart rate to be measured. The batch rate may dominate the MIPS (million instructions per second) used by a signal processor, such as a DSP (digital signal processor), since it affects the spectral transform of the desired output signal. In this filtering embodiment, to minimize

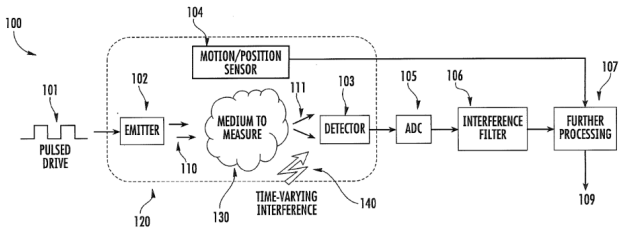
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	aliasing from interfering sunlight-shadow changes on the desired heart rate output signal (especially for running or cycling through shadows), a increasing the N and/or M may be preferred. Another example of a batch may include nine (9) optical segments per batch: off-on-off-on-off-on-off-on-off. Within a given batch, the average of the "off" samples may be subtracted from the average of the "on" samples, providing one output per batch. This would generate a decimation factor of nine (9). Additional batch configurations and on/off configurations may be used in this invention. Valencell at [0138]-[0142]  FIG. 19A FIG. 19B Valencell at Fig. 19A & 19B It should be noted that the modulated light 110 may be pulsed completely on or completely off, or it may be pulsed partially on or partially off. In some embodiments, for example, the modulated light may be sinusoidal. A benefit of complete on/off pulsing is that it may better-facilitate the signal processing methodologies outlined herein for attenuating environmental noise and motion-coupled environmental noise from one or more output signals. Valencell at [0143] A finite impulse response (FIR) version of an interference filter, according to some embodiments of the present invention, levering the pulsed-emitter on/off sampling rate, is presented in FIG. 20 and identified as 2000. The illustrated interference filter 2000 employs a delay of "n" samples according to Z−n. Coefficients in the filter "bn" allow multi-tap filtering. Pulsing an emitter (e.g., 102, FIG. 1) and selectively sampling on/off signals, as described herein, may modulate the physiological signal to a higher frequency. Thus, the output y(n) of the interference filter 2000 may be decimated to demodulate

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	the output back into the baseband. A specific example of a decimation-by-2 algorithm may reject odd-numbered samples such that the decimated signal, w(m), may be described by even-numbered samples according to w(m)=y(2*m). Valencell at [0144] Examples of filters embodying the interference filter 2000, for removing sunlight interference from a PPG signal 1911 (FIGS. 19A, 19B) to extract heart rate, according to embodiments of the present invention, are illustrated in the plot 2100 of FIG. 21. The plot 2100 presents the magnitude response (in dB) for each interference filter vs. normalized frequency (1=Nyquist). Also shown in FIG. 21 is a representation of the modulated heart rate 2160 modulated by the emitter on/off sample rate, the demodulated heart rate 2140 demodulated by decimation, and the interference frequency associated with dynamic sunlight noise 2150. As a specific example for the previously described “subtraction filter” 2110, the FIR coefficients may be [b1 b2]=[1 −1]. A filter 2120 for subtracting the temporally neighboring off-samples 1920, coming before and after a given on-sample 1930, may employ coefficients of [−0.05 1 −0.5]. A filter 2130 using multiple on/off samples may employ coefficients of [−0.07 0.3−0.6 0.6−0.3 0.07]. Valencell at [0145]  FIG. 21 Valencell at Fig. 21

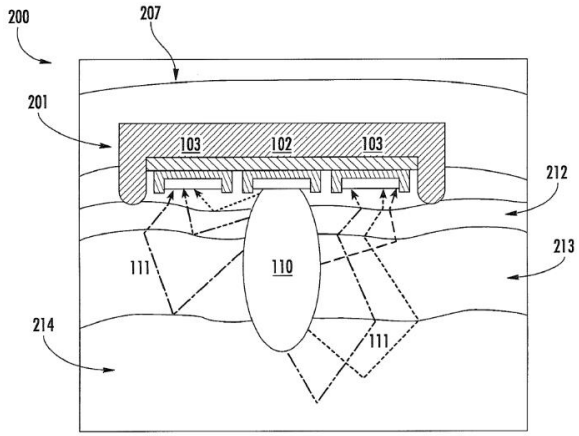
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Valencell discloses or renders obvious wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then

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	processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108] FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, 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 at [0130]

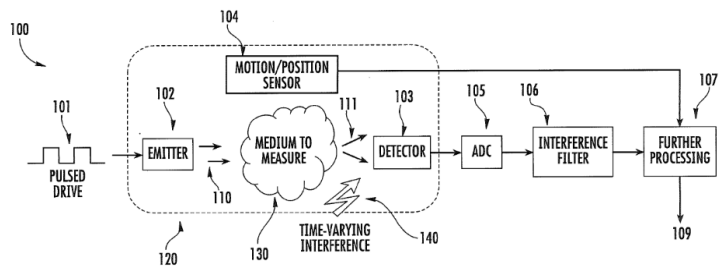
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	 FIG. 1 Valencell at Fig. 1 Embodiments of the present invention are not limited to headsets that communicate wirelessly. In some embodiments of the present invention, headsets configured to monitor an individual's physiology and/or environment may be wired to a device that stores and/or processes data or there may be a combination of wired and wireless communications. 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 invention may be employed around another part of the body, such as a digit, finger, toe, limb, wrist, ankle, around the nose or earlobe, or the like. In other embodiments, the invention may be integrated into a patch, such as a bandage that sticks on a person's body. Valencell at [0106] Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse

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	oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain 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. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109]

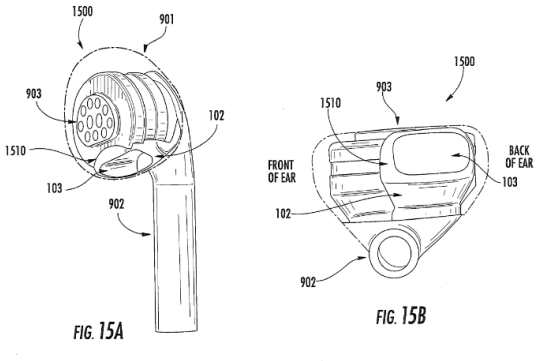
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	 FIG. 2 Valencell at Fig. 2 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors	See claim 1 above. Valencell discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. In some embodiments of the present invention, a monitoring apparatus is configured to be a wearable monitor for monitoring at least one physiological condition of the wearer. In such an embodiment, pulsed

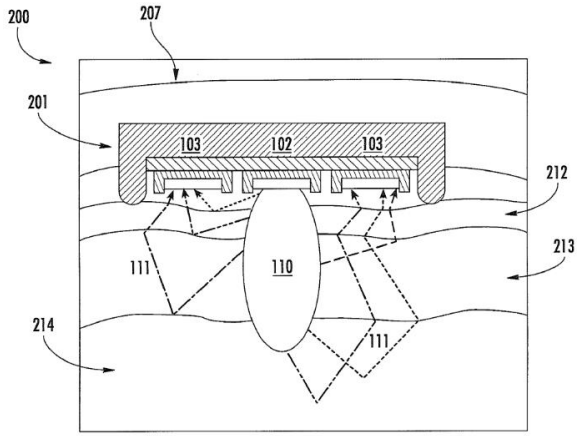
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are located on one or more arcs.	electromagnetic energy 110 from at least one electromagnetic emitter 102, typically an optical emitter, is directed towards at least one physiological region 130, typically the ear region, of a subject. Examples of optical emitters include light-emitting diodes (LEDs), laser diodes (LDs), lamps, organic emitters (such as OLEDs), and the like. The sensor components (102, 103, and 104) may be integrated within the ear region 120 in the form-factor of an earbud or other ear-worn form-factor such that the measurement medium 130 comprises blood vessels and/or blood flow within the ear region. The intensity of the pulsed optical energy 110 is modulated by at least one pulsed driving circuit 101 such that the intensity is time-varying with at least two states, preferably an on state and an off state. This time-varying energy generates a time-varying energy response, typically an optical interaction response, such as optical absorption, modulation, scatter, transmission, luminescence, or the like, from the physiological region 130. A first optical interaction response is obtained by at least one detector 103, typically an optical detector, when the pulsed optical energy 110 is in the on state. A second energy response, in this case a second optical interaction response, is obtained by the optical detector 103 when the pulsed optical energy 110 is in the off state. (In some cases, other optical interaction responses may be collected in other modulated states of the pulsed energy 110.) The first and second energy response signals are digitized by at least one ADC 105 and the digitized signals are processed via an interference filter 106 to produce a processed energy response signal that is associated with a physiological condition of the subject, wherein the filter removes time-varying environmental interference caused by an interferant, such as sunlight, ambient light, airflow, temperature, etc. The output of the interference filter 106 is then processed by a signal extraction filter 107 to accurately extract at least one physiological property of the subject. A motion/position sensor 104 may be configured to measure the motion/position between the medium 130 and the emitter 102, the detector 103, and/or the time-varying interference 140, for example, caused by motion of the subject. The output signal of the motion sensor 104 may provide a motion artifact reference to the signal extraction filter 107 such that the motion/position information may be selectively removed from the desired signal output. Incorporating a motion sensor in embodiments of the present invention may be particularly important because time-varying interference, such as sunlight hitting an earbud, is often modulated by motion, and monitoring and subtracting this motion from the desired output may be critical to generating an accurate physiological signal in the midst of daily life activities of the subject. Valencell at [0108]

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	 FIG. 1 Valencell at Fig. 1 Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain 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. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical

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	motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109] FIGS. 15A-15B show a multi-detector earbud 1500, where two separate optical detectors 103 are covered by two separate optical lenses, at least one optical emitter is covered by at least one optical lens, and where the emitter 102 and detector 103 configuration is oriented perpendicularly to the antitragus (as that shown in FIG. 11). In FIGS. 15A-15B, the optical detectors 103, emitters 102, and lenses are not readily visible as they are surrounded, at least in part, by an optical coupling area 1510. The lenses (not shown) may cover each separate emitter 102 and detector 103 as shown in FIGS. 7 and 8. Note that in this configuration, the emitter- detector module 700, 800 of FIGS. 7 and 8 is oriented towards the back of the ear (near the back of the head). This arrangement may serve two purposes: 1) sunlight may be further blocked from reaching the detectors 103, as the back of the ear may serve as a shield and 2) there may be less motion artifacts convoluting the desired blood flow signals, as the detectors 103 may be oriented away from mouth-motion-prone areas located near the front of the ear. Another feature of the earbud 1500 of FIGS. 15A and 15B is that an optical coupling area 1510 is located on top of the optical emitter 102 and surrounding (but not covering) the optical detector 103. This optical coupling area 1510 may help diffuse, scatter, and/or guide light from the optical emitter to couple with a broader area of the ear region. Having a broader coupling area may help excite more regions of the ear with optical energy 110 (FIG. 1) and reduce the chance that the optical energy may miss important blood vessels, which may be located in different regions for different persons. Thus, such a design may promote a more universal design for a biometric earbud. Without an optical coupling area 1510, the optical energy 110 from the optical emitter(s) 102 may miss blood vessels in different persons due to physiological differences that may exist between different people. Alternatively, the optical coupling area 1510 may be configured to cover the optical detector 103 area and not the optical emitter 102 area, such that more light is guided from different regions of the ear and coupled into the detector 103. Alternatively, a plurality of optical diffusion areas may be configured to cover the emitter 102 and detector 103 separately. Valencell at [0131]

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	 Valencell at Fig. 15A &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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	See claim 2 above. Valencell discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.

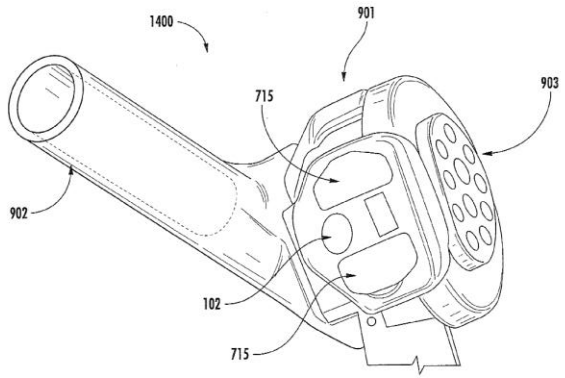
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	 FIG. 2 Valencell at Fig. 2 Various forms of energy 110 can be used to interrogate one or more mediums 130 and to characterize those mediums by detectors 103 configured to detect the energy responses caused by the interaction of the energy 110 with the medium 130. For example, optical energy 110 can be used to interrogate a target region of skin and blood 130 to provide information regarding a physiological condition of a subject, such as a measure of blood oxygen levels of the subject by pulse oximetry. A specific example of the opto-physiological interaction between light and a physiological medium 130 comprising the skin, blood vessels, and blood of a subject is shown in the reflective optical detection configuration 200 of FIG. 2. At least one sensor module 207, disposed within at least one housing configured to be attached to a body of a subject, may be in physical proximity to the skin of the subject, as shown in the reflective pulse oximetry setup 200 where reflected optical wavelengths 111 are measured, as opposed to measuring transmitted optical wavelengths. Optical emitter and optical detector wavelengths for pulse oximetry and photoplethysmography may include virtually any wavelength of electromagnetic radiation, but particularly useful are UV, visible, and IR wavelengths. In the illustrated embodiment, an optical source-detector assembly 201, including an optical emitter 102 and optical detectors 103, is integrated into sensor module 207 to generate optical wavelengths 110 and monitor the resulting scattered optical energy 111. The optical source-detector assembly 201 may contain one or more optical sources emitting one or

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	more optical wavelengths, as well as one or more optical detectors detecting one or more optical wavelengths. The epidermis 212, dermis 213, and subcutaneous 214 layers of skin tissue of a human are shown in FIG. 2 for reference. The scattered optical energy 111 may be modulated in intensity by changes in physiological condition, such as: changes in blood flow in the blood vessels, changes in physical motion of the body, changes in blood metabolite levels (such as blood gases, bilirubin, glucose, lactic acid, and the like), respiration, heart rate, pulse pressure, blood pressure, and other physiological changes. In some cases, the scattered optical energy 111 may be luminescent or preferentially polarized energy from the skin, blood, blood metabolites, drugs, or other materials in the body. Thus, the energy response signal 111 may contain information associated with at least one physiological condition of the subject. Valencell at [0109] An experiment was performed by the Applicant to address the magnitude of the aforementioned sunlight convolution problem for an earbud physiological monitor. In this experiment, an optical spectrometer was optically coupled to a light guide embedded within an earbud worn by a subject in an outdoor sunlight environment. The only light reaching the spectrometer was light guided by an earbud-embedded light guide, positioned in the same basic region as the sensor module 207 shown in FIGS. 4 and 5. Thus, the light guide was guiding light from the ear region on one end towards the input of the spectrometer at the other end. Because the light guide was covered at one end by the spectrometer and at another end by the ear of the subject, the only significant light reaching the light guide was light generated by external light EL1 passing through the ear, as shown in FIG. 5. With the earbud worn by the subject, a first spectrogram was taken of this indirect external sunlight scattered through the ear. The earbud was then removed and pointed directly at the sun, and a second spectrogram was taken of direct sunlight hitting the ear with the earbud directly facing the sun to provide a comparison graph 600, as shown in FIG. 6. The comparison graph 600 shows that sunlight at wavelengths shorter than 600 nm is greatly attenuated through the subject's ear, whereas sunlight at wavelengths longer than 650 nm is minimally absorbed through the subject's ear. In light of the comparative graph 600 of FIG. 6, one approach to reducing the effects of sunlight on the optical response signal 111 (FIG. 1) is to choose an optical emitter 102 (FIG. 1) that emits light at wavelengths shorter than 600 nm and to choose an optical detector 103 (FIG. 1) having an optical filter that blocks light having wavelengths longer than 600 nm or that passes light within an optical bandwidth provided by the optical emitter 102 (FIG. 1). For example, a 400 to 500 nm optical emitter 102 (FIG. 1)

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	may provide 400-500 nm optical excitation 110 (FIG. 1) to the ear region 130 (FIG. 1), and an optical detector 103 (FIG. 1) having a 400-500 nm optical filter may be used to detect the energy response signal 111 (FIG. 1) with low interference 140 (FIG. 1) from sunlight. While this method may be employed, the apparent benefits may be deceiving because the intensity of the optical scatter signal associated with physiological information may be orders of magnitude smaller than the sunlight interference—even with the combined attenuation effects of the optical filtering method and the strategic sensor module placement between the earbud housing and ear region (as shown in FIGS. 4 & 5). A better approach for attenuating the optical interference signal may be to employ optical filters within the optical detectors 103 such that the only wavelengths passing into an optical detection window may be wavelengths that are naturally attenuated by the earth's atmosphere. For example, there are several attenuation bands for sunlight well-known in the art due to the absorption of sunlight by O2, O3, CO2, and H2O in the atmosphere. The sharp absorption peak near 763 nm in FIG. 6 is just one example. Thus, a novel design for rejecting sunlight interference may incorporate at least one optical emitter that generates optical wavelengths within at least one sunlight attenuation band combined with at least one bandpass-filtered optical detector, incorporating at least one optical bandpass filter to pass only wavelengths falling within this attenuation band. Valencell at [0113]-[0114] In some embodiments of the present invention, an optical filter for the emitter 102 and detector 103 may be the same filter, such as may be the case for optical scatter 111 (FIG. 1) detection by the detector 103 where all light other than the emitter light of interest may be blocked by the filter 710. According to some embodiments of the present invention, the optical filter 710 covering the detector 103 is configured to block unwanted sunlight but still allow wavelengths from the optical emitter 102 to pass therethrough. In some embodiments of the present invention, the optical filter 710 over the detector 103 is configured to pass wavelengths centered around 930 nm, and the optical emitter 102 is configured to emit wavelengths centered around 930 nm. According to some embodiments of the present invention, the optical filter 710 may have a surface area greater than a surface area of the optical detector 103. In some embodiments of the present invention, the optical filter 710 overlies the optical detector 103 such that a periphery of the optical filter 710 overlaps a periphery of the optical detector 103, as shown in FIG. 7 and FIG. 8. Valencell at [0117]

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	FIG. 14 illustrates a multi-detector earbud 1400, similar to the earbud 1300 of FIGS. 13A-13C, but where two separate optical detectors (not shown) are covered by two separate optical lenses 715. An optical emitter 102 is located between the two optical lenses 715. Employing multiple optical detectors may provide several benefits: 1) more scattered light collection, providing stronger signal strength, 2) additional information on scattered light collection for improving physiological assessments, 3) light collection at different wavelengths for measuring blood constituents, pulse pressure, skin, color, and the like, and 4) other benefits. For example, light entering the ear may scatter throughout several blood vessels, and without multiple detectors, signal information may be lost. Additionally, blood flow scatter collected from the front of the ear may be more indicative of blood flow through the carotid artery system, whereas blood flow scatter collected from the back of the ear may be more indicative of the capillary or venous system. The difference between these two signals may be processed with algorithms to generate an assessment of pulse pressure, blood pressure, cardiac output, and the like. Lastly, 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 at [0130]  FIG. 14

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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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Valencell discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a wearable device adapted to be placed on a wrist or an ear of a user,	Valencell discloses or renders obvious a wearable device adapted to be placed on a wrist or an ear of a user. See above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Valencell discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. the 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;	Valencell discloses or renders obvious the 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. See above at claim 1[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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. the wearable device further comprising a detection system configured to receive at least a portion of the lens output light reflected from the tissue and	Valencell discloses or renders obvious the wearable device further comprising 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. See above at claim 1[d].

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to generate an output signal having a signal-to-noise ratio,	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. wherein the detection system is configured to be synchronized to the light source;	Valencell discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. 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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. 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 spatially separated detectors;	Valencell 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 spatially separated detectors. See above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Valencell discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; See above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Valencell discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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8[i]. 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; and	Valencell discloses or renders obvious 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. See above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Valencell 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 above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Valencell discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. See above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Valencell discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Valencell discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. See above 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and	See claim 8 above.

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the plurality of spatially separated detectors are located on one or more arcs.	Valencell discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	See claim 9 above. Valencell discloses or renders obvious the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. See above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Valencell discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet.

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phone or tablet, the system 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Valencell discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, See above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Valencell discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;, See above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[c]. the 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;	Valencell discloses or renders obvious the 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. See above at claim 1[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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[d]. the wearable device further comprising 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,	Valencell discloses or renders obvious the wearable device further comprising 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,. 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[e]. wherein the detection system is configured to be synchronized to the light source;	Valencell discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. See above at claim 1[e].

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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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[f]. 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 spatially separated detectors;	Valencell discloses 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 spatially separated detectors. See above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal; wherein the smart phone or tablet is configured to store and display the processed output	Valencell discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link See above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of 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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signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link	incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Valencell discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[i]. 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; and	Valencell discloses or renders obvious 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. See above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Valencell 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 above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Valencell discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on;and See above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal;	Valencell discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal.

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	See above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes,	Valencell discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, See above 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[n]. wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Valencell discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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

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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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[o]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Valencell discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. See above at claim 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 Valencell, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Valencell, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT E15

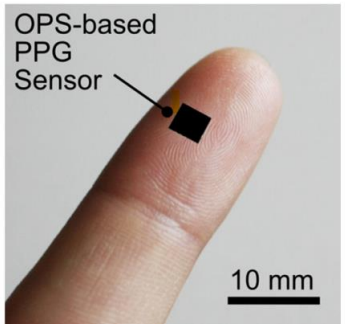
U.S. Pat. No. 11,160,455 in view of "Plug-and-Play, Single-Chip Photoplethysmography" to Deepak Chandrasekar et al. ("Chandrasekar2012")

As described in detail below, Chandrasekar2012 (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 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 E1-E14 and E16-E18, 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 '455 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 Chandrasekar2012. The cited portions of Chandrasekar2012 are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Chandrasekar2012. 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 Chandrasekar2012 "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Chandrasekar2012 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 Chandrasekar2012 (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 Chandrasekar2012 anticipates and/or renders obvious the Asserted Claims of the '455 Patent.

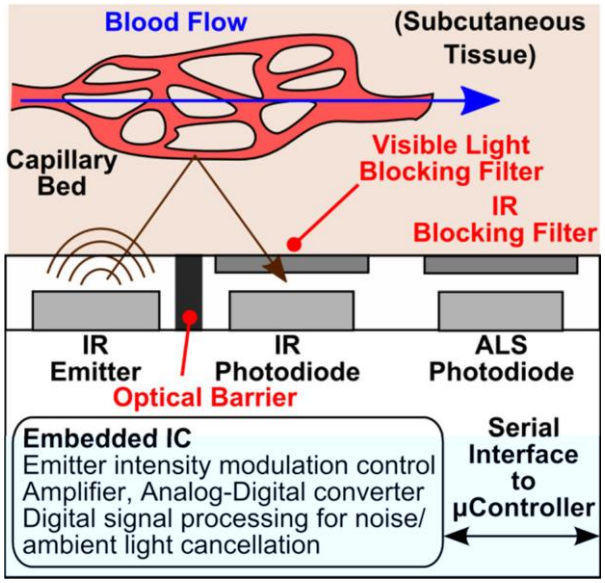
This chart is subject to all reservations, objections, and disclaimers in Defendants' Invalidity Contentions and any amendment, supplement, or modification thereof, which are incorporated herein by reference in their entirety. Nothing stated herein shall be treated as an admission or suggestion that 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.

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Claim 1	
1[pre] A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Chandrasekar2012 discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for “plug- and-play” PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. 

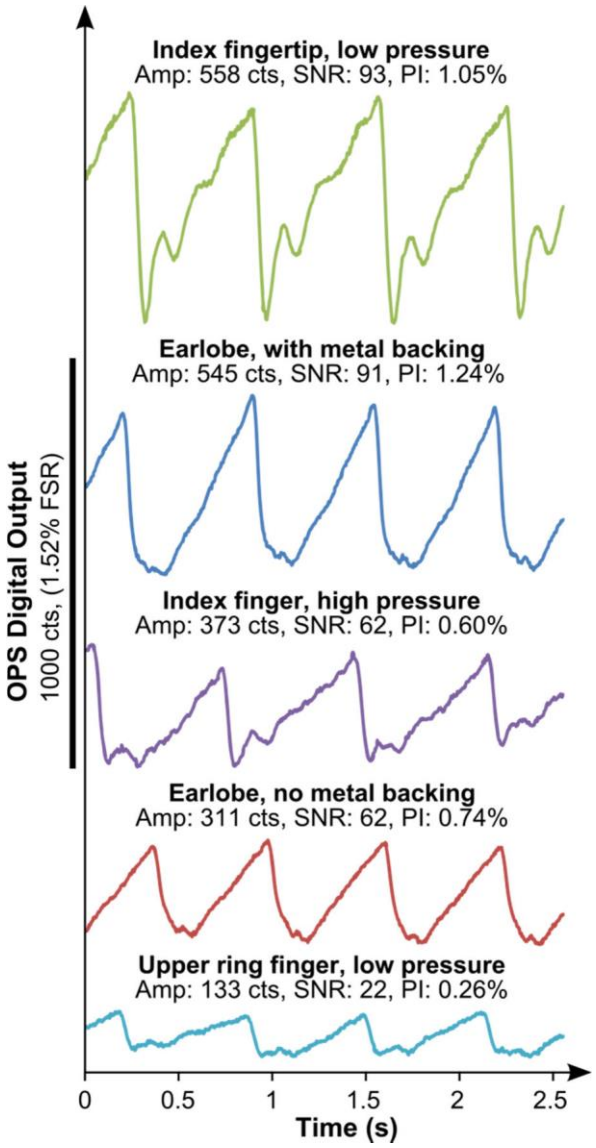
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	Chandrasekar2012 at Fig. 1. Photoplethsymography (PPG) is a ubiquitous monitoring technique for measuring heart rate and oxygen saturation. PPG sensors detect blood volume pulsations by time- resolved analysis of optical radiation either absorbed or scattered by a capillary bed [3]. 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). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. As a result, designing a robust PPG sensor requires a engineering effort and investment. Chandrasekar2012 at pg. 3243 right column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column.

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	 Chandrasekar2012 at Fig. 2. PPGs are obtained by placing the sensor at a fixed pressure with the skin at multiple locations, including the index finger, earlobe, and upper ring finger. In the earlobe measurements, a metal backing is placed on the opposite side to improve the reflectance signal. Before performing the measurement, the current for the IR emitter is manually set to a value approximately 75% of the dynamic range of the sensor. This maintains a large reflected light signal while minimizing the likelihood of detector saturation. The SNR is found to scale proportionally with the reflected light. The ideal current setting is found to be between 80-130 mA, depending on the anatomical location and the individual being tested. Chandrasekar2012 at pg. 3245 left and right columns. Experiments show that the OPS sensor can produce high quality PPGs in multiple anatomical locations (Figure 4). The signal amplitude ranges from 130-560 counts within a full scale range of 216. Pulsation

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	indices (PIs) vary from 0.26-1.25%, which is typical for reflectance pulse oximetry, and is well within the resolution of the 16 bit ADC. The SNR varies between 20-90 depending on the location and the applied pressure. This is comparable or better than existing PPG sensors, which typically have SNR between 30-50. The index fingertip provides the largest overall signal amplitude and SNR, while the earlobe with metal backing gives the largest PI. Heart rate can be easily calculated from the PPG waveforms using computationally inexpensive signal processing algorithms such as time derivatives, averaging windows, or infinite impulse response (IIR) filters implemented on the microcontroller [3]. Chandrasekar2012 at pg. 3245 right column and 3246 left column.

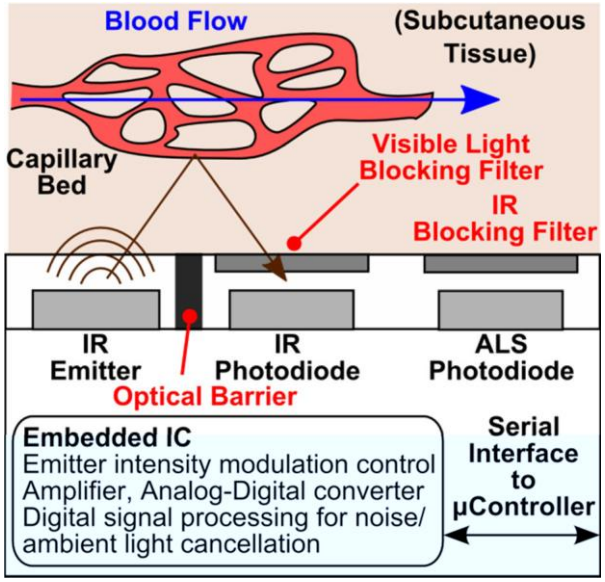
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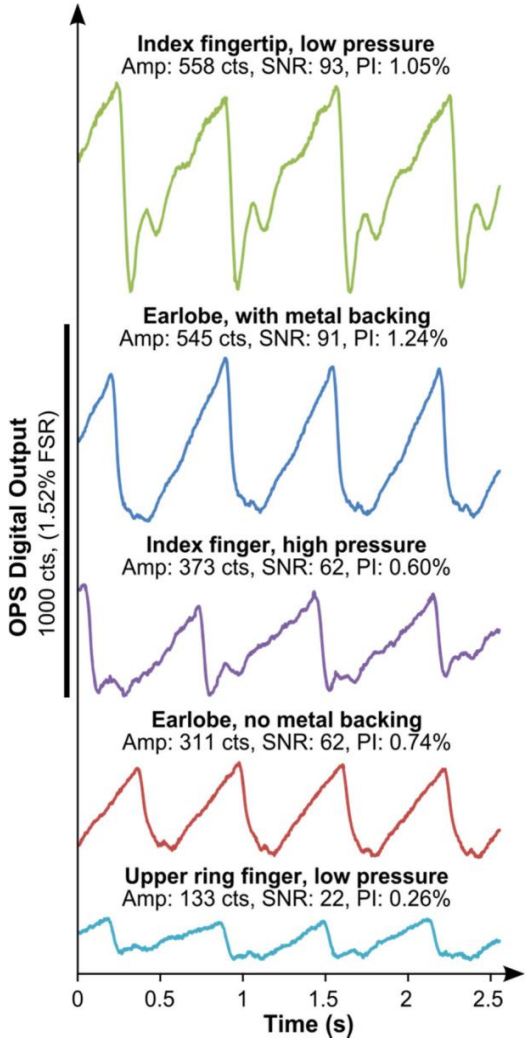
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	Chandrasekar2012 at Fig. 4. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art 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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[a] a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Chandrasekar2012 discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for "plug- and-play" PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 μW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors' knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety

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	of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column. In this paper, we show how a digital OPS can be used as a high-performance, reflectance-mode PPG sensor (Figure 2). The OPS is placed in direct contact with the skin near a capillary bed, such as the fingertip, earlobe, or forehead. A transparent protective overlay can be added if desired. The IR LED emits light into the tissue, where it experiences diffuse reflection from the tissue and capillary bed. This establishes a baseline reflectance signal which is detected at the PD. When a pulse wave propagates through the capillary bed, the reflectance signal falls slightly (0.5-5%) due to light scattering. The change is detected by the PD and processed by embedded amplification and signal processing circuitry. Chandrasekar2012 at pg. 3244 left and right columns.

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	 Chandrasekar2012 at Fig. 2. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. The sensor includes an I2C serial interface, and the cost is <$2 USD. The sensor data is recorded using a Silicon Labs microcontroller connected to a laptop via USB.

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	Chandrasekar2012 at pg. 3245 left column. column. Experiments show that the OPS sensor can produce high quality PPGs in multiple anatomical locations (Figure 4). The signal amplitude ranges from 130-560 counts within a full scale range of 216. Pulsation indices (PIs) vary from 0.26-1.25%, which is typical for reflectance pulse oximetry, and is well within the resolution of the 16 bit ADC. The SNR varies between 20-90 depending on the location and the applied pressure. This is comparable or better than existing PPG sensors, which typically have SNR between 30-50. The index fingertip provides the largest overall signal amplitude and SNR, while the earlobe with metal backing gives the largest PI. Heart rate can be easily calculated from the PPG waveforms using computationally inexpensive signal processing algorithms such as time derivatives, averaging windows, or infinite impulse response (IIR) filters implemented on the microcontroller [3]. Chandrasekar2012 at pg. 3245 right column and 3246 left column.

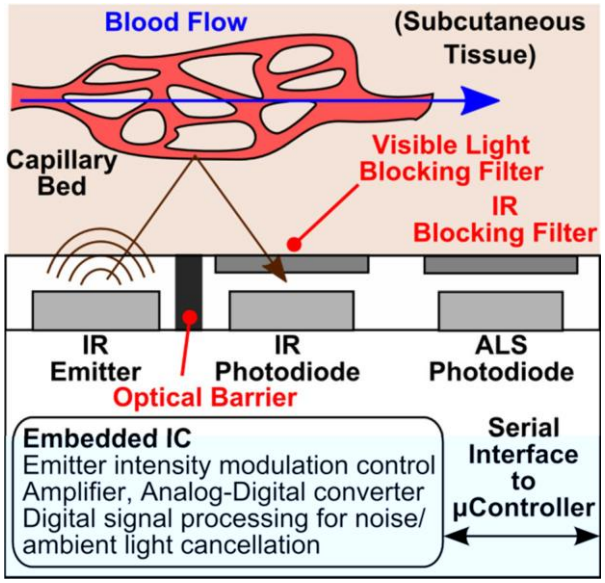
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	 Chandrasekar2012 at Fig. 4. It is notable that the OPS-based device provides better performance in most categories, particularly those of interest in wearable sensors. These include substantial improvements in power (10X), size (12X), cost

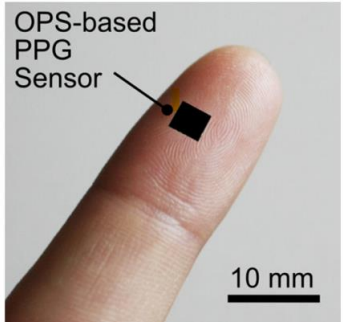
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	(5-10X), and signal to noise ratio (2-3X). To the authors' knowledge, this is the smallest and lowest power single-wavelength PPG sensor currently available. Another advantage is that the sensor provides an industry standard I2C digital interface to a microcontroller. This link allows for device configuration and data transfer, thus making it simple to integrate a high performance, single-chip PPG sensor into a microcontroller- based embedded system. Chandrasekar2012 at pg. 3246 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b] including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	Chandrasekar2012 discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for "plug- and-play" PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 μW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered,

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	wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column.

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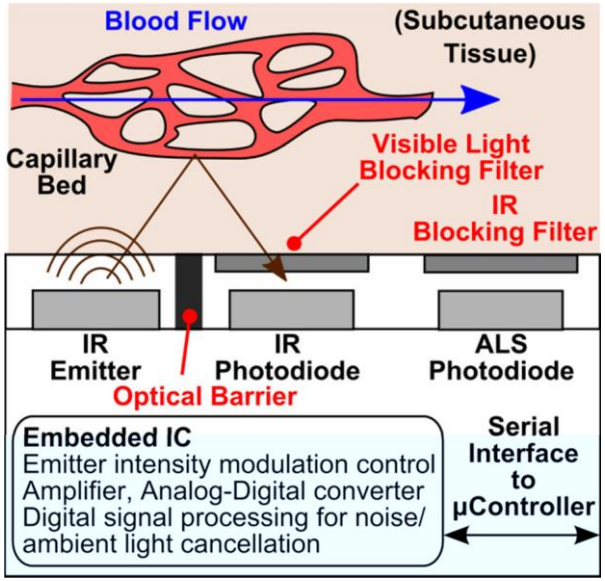
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	 Chandrasekar2012 at Fig. 2. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. The sensor includes an I2C serial interface, and the cost is <$2 USD. The sensor data is recorded using a Silicon Labs microcontroller connected to a laptop via USB.

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	Chandrasekar2012 at pg. 3245 left column. It is notable that the OPS-based device provides better performance in most categories, particularly those of interest in wearable sensors. These include substantial improvements in power (10X), size (12X), cost (5-10X), and signal to noise ratio (2-3X). To the authors' knowledge, this is the smallest and lowest power single-wavelength PPG sensor currently available. Another advantage is that the sensor provides an industry standard I2C digital interface to a microcontroller. This link allows for device configuration and data transfer, thus making it simple to integrate a high performance, single-chip PPG sensor into a microcontroller- based embedded system. Chandrasekar2012 at pg. 3246 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c] the wearable device comprising one or more lenses configured to receive at least a portion of the output optical light and to	Chandrasekar2012 discloses or renders obvious the 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 Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10

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deliver a lens output light to tissue;	components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for “plug- and-play” PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column.  Chandrasekar2012 at Fig. 1. Photoplethsymography (PPG) is a ubiquitous monitoring technique for measuring heart rate and oxygen saturation. PPG sensors detect blood volume pulsations by time- resolved analysis of optical radiation either absorbed or scattered by a capillary bed [3]. 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

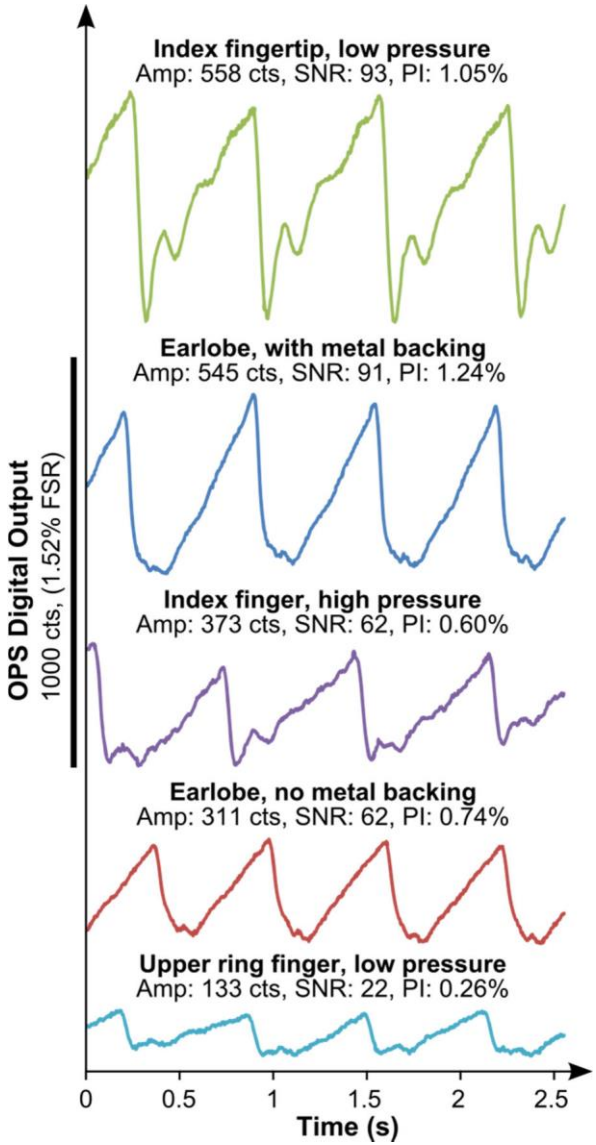
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	 Chandrasekar2012 at Fig. 2. PPGs are obtained by placing the sensor at a fixed pressure with the skin at multiple locations, including the index finger, earlobe, and upper ring finger. In the earlobe measurements, a metal backing is placed on the opposite side to improve the reflectance signal. Before performing the measurement, the current for the IR emitter is manually set to a value approximately 75% of the dynamic range of the sensor. This maintains a large reflected light signal while minimizing the likelihood of detector saturation. The SNR is found to scale proportionally with the reflected light. The ideal current setting is found to be between 80-130 mA, depending on the anatomical location and the individual being tested. Chandrasekar2012 at pg. 3245 left and right columns. Experiments show that the OPS sensor can produce high quality PPGs in multiple anatomical locations (Figure 4). The signal amplitude ranges from 130-560 counts within a full scale range of 216. Pulsation indices (PIs) vary from 0.26-1.25%, which is typical for reflectance pulse oximetry, and is well within

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	the resolution of the 16 bit ADC. The SNR varies between 20-90 depending on the location and the applied pressure. This is comparable or better than existing PPG sensors, which typically have SNR between 30-50. The index fingertip provides the largest overall signal amplitude and SNR, while the earlobe with metal backing gives the largest PI. Heart rate can be easily calculated from the PPG waveforms using computationally inexpensive signal processing algorithms such as time derivatives, averaging windows, or infinite impulse response (IIR) filters implemented on the microcontroller [3]. Chandrasekar2012 at pg. 3245 right column and 3246 left column.

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	 Chandrasekar2012 at Fig. 4.

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1[d] the wearable device further comprising 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,	Chandrasekar2012 discloses or renders obvious the wearable device further comprising 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 exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors' knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. 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). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. As a result, designing a robust PPG sensor requires a engineering effort and investment. A complete sensor typically requires 10-20 components, 1.5-10mW power, and costs >$20 USD. Chandrasekar2012 at pg. 3243 right column.

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	Improved sensitivity due to small PD-LED spacing. One of the challenges in reflectance mode PPG is that <5% of the light is backscattered to the detector. The intensity of the backscattered light, which forms a concentric ring around the excitation LED [4,8], falls off as the square of the distance (Figure 3). Therefore, it is critical to maintain a small distance between the LED and PD. In a digital OPS, the distance is <1-2 mm, compared to >5mm in a typical PPG [9-10]. This increases the reflected light (and therefore, signal to noise ratio) by a factor of 5-25x. Chandrasekar2012 at pg. 3244 right column. Intensity control. To maximize the signal to noise ratio in PPG, the LED intensity should be made as large as possible without saturating the detector. In a digital OPS, the LED intensity is programmable through the serial interface, allowing closed loop control to prevent detector saturation. Chandrasekar2012 at pg. 3245 left column. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. Chandrasekar2012 at pg. 3245 left column. Table 1 further compares the performance of the digital OPS reported in this paper with state-of-the art PPG sensors reported in both the research and commercial sectors. It is notable that the OPS-based device provides better performance in most categories, particularly those of interest in wearable sensors. These include substantial improvements in power (10X), size (12X), cost (5-10X), and signal to noise ratio (2-3X). To the authors' knowledge, this is the smallest and lowest power single-wavelength PPG sensor currently available. Another advantage is that the sensor provides an industry standard I2C digital

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	interface to a microcontroller. This link allows for device configuration and data transfer, thus making it simple to integrate a high performance, single-chip PPG sensor into a microcontroller- based embedded system. These features, along with the low cost ($2 USD), make the sensor well-suited for wearable and mobile health monitoring. TABLE I. COMPARISON OF DIGITAL OPTICAL PROXIMITY SENSOR-BASED PPG SENSOR WITH CONVENTIONAL PPG TECHNOLOGY **Performance Parameter** / **Existing PPGs (best case)** [3–4],[8], [12-13] / **OPS-based PPG** # of Components / >10 / 1 PCB Area / 200 mm^2 / 16 mm^2 Power Consumption / 1.5-10 mW / 200 µW (100mA, 10 Hz) Cost: / $15-20 USD / $2 USD Supply Voltage / 3V/5V / 3V Sensor Output / Analog / Digital (I^2C serial) Max. Data Rate / 200 Hz / 1000 Hz LED, PD spacing / 4-6 mm / 1-2 mm Noise rejection features / Bandpass filter: 0.5-5 Hz / Electronic noise cancellation @3.125 MHz IR filter / Not included / Integrated SNR / 20-30 / Up to 95 Wavelength / 650-950 nm / 895 nm (can be changed) Chandrasekar2012 at pg. 3246 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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1[e] wherein the detection system is configured to be synchronized to the light source;	Chandrasekar2012 discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. Photoplethsymography (PPG) is a ubiquitous monitoring technique for measuring heart rate and oxygen saturation. PPG sensors detect blood volume pulsations by time- resolved analysis of optical radiation either absorbed or scattered by a capillary bed [3]. 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). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. Chandrasekar2012 at pg. 3243 right column. Electronic noise and offset cancellation. Conventional PPGs require a bandpass filter to avoid 60/120 Hz noise from ambient light. This can limits the bandwidth of the sensor, making it difficult to resolve high frequency features of the pressure pulse. In a digital OPS, the LED emitter is pulsed at a high frequency (>1 MHz) which is an integer multiple of 60 Hz. The signal processing circuitry utilizes a demodulation scheme, similar to lock-in-detection [11], which eliminates ambient light artifacts and 1/f noise. This enables fast measurement rates while maintaining low noise. Chandrasekar2012 at pg. 3245 left column. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate.

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	Chandrasekar2012 at pg. 3245 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f] 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 spatially separated detectors;	Chandrasekar2012 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 spatially separated detectors. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. The sensor includes an I2C serial interface, and the cost is <$2 USD. The sensor data is recorded using a Silicon Labs microcontroller connected to a laptop via USB. Chandrasekar2012 at pg. 3244 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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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1[g] the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Chandrasekar2012 discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for "plug- and-play" PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors' knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. In other words, the ideal sensor should function out of the box without additional components, provide a digital interface to a microcontroller for configuration and data transfer. It should also be small and

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	low cost. The most successful recent example is the microaccelerometer, which has seen rapid, pervasive growth in the smartphone, automotive safety, and home entertainment markets. Chandrasekar2012 at pg. 3243 right column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. Chandrasekar2012 at pg. 3244 left column. Digital Interface. Many digital OPS include an industry standard I^2C serial bus, which provides a bidirectional link to a microcontroller for data transmission and configuration. The digital output is inherently more noise immune than an analog interface, and allows multiple sensors on a single bus. Chandrasekar2012 at pg. 3245 left column. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 μs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. The sensor includes an I2C serial interface, and the cost is <$2 USD. The sensor data is recorded using a Silicon Labs microcontroller connected to a laptop via USB. Chandrasekar2012 at pg. 3245 left column.

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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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, 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 one or more of the physiological parameters;	Chandrasekar2012 discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for “plug- and-play” PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. Remote patient monitoring (RPM), a rapidly emerging paradigm in chronic disease management [1], relies on ambulatory biosensors to assess patients’ physiological indicators on a continual basis.

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	Chandrasekar2012 at pg. 3243 left column. Photoplethsymography (PPG) is a ubiquitous monitoring technique for measuring heart rate and oxygen saturation. PPG sensors detect blood volume pulsations by time- resolved analysis of optical radiation either absorbed or scattered by a capillary bed [3]. Chandrasekar2012 at pg. 3243 right column. In other words, the ideal sensor should function out of the box without additional components, provide a digital interface to a microcontroller for configuration and data transfer. It should also be small and low cost. The most successful recent example is the microaccelerometer, which has seen rapid, pervasive growth in the smartphone, automotive safety, and home entertainment markets. Chandrasekar2012 at pg. 3243 right column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. Chandrasekar2012 at pg. 3244 left column. Heart rate can be easily calculated from the PPG waveforms using computationally inexpensive signal processing algorithms such as time derivatives, averaging windows, or infinite impulse response (IIR) filters implemented on the microcontroller [3]. Chandrasekar2012 at pg. 3245 right column and 3246 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of 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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1[i] 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;	Chandrasekar2012 discloses or renders obvious 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. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 μW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. 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). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. As a result, designing a robust PPG sensor requires a engineering effort and investment. A complete sensor typically requires 10-20 components, 1.5-10mW power, and costs >$20 USD. Chandrasekar2012 at pg. 3243 right column. Improved sensitivity due to small PD-LED spacing. One of the challenges in reflectance mode PPG is that <5% of the light is backscattered to the detector. The intensity of the backscattered light, which forms a concentric ring around the excitation LED [4,8], falls off as the square of the distance (Figure 3). Therefore, it is critical to maintain a small distance between the LED and PD. In a digital OPS, the

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	distance is <1-2 mm, compared to >5mm in a typical PPG [9-10]. This increases the reflected light (and therefore, signal to noise ratio) by a factor of 5-25x. Chandrasekar2012 at pg. 3244 right column. Intensity control. To maximize the signal to noise ratio in PPG, the LED intensity should be made as large as possible without saturating the detector. In a digital OPS, the LED intensity is programmable through the serial interface, allowing closed loop control to prevent detector saturation. Chandrasekar2012 at pg. 3245 left column. Table 1 further compares the performance of the digital OPS reported in this paper with state-of-the art PPG sensors reported in both the research and commercial sectors. It is notable that the OPS-based device provides better performance in most categories, particularly those of interest in wearable sensors. These include substantial improvements in power (10X), size (12X), cost (5-10X), and signal to noise ratio (2-3X). To the authors’ knowledge, this is the smallest and lowest power single-wavelength PPG sensor currently available. Another advantage is that the sensor provides an industry standard I2C digital interface to a microcontroller. This link allows for device configuration and data transfer, thus making it simple to integrate a high performance, single-chip PPG sensor into a microcontroller- based embedded system. These features, along with the low cost ($2 USD), make the sensor well-suited for wearable and mobile health monitoring.

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<table>
<tr><th>’455 Patent</th><th>Chandrasekar2012</th></tr>
<tr><td></td><td>
TABLE I. COMPARISON OF DIGITAL OPTICAL PROXIMITY SENSOR-BASED PPG SENSOR WITH CONVENTIONAL PPG TECHNOLOGY
<table>
<tr><th>Performance Parameter</th><th>Existing PPGs (best case) [3–4],[8], [12-13]</th><th>OPS-based PPG</th></tr>
<tr><td># of Components</td><td>>10</td><td>1</td></tr>
<tr><td>PCB Area</td><td>200 mm^2</td><td>16 mm^2</td></tr>
<tr><td>Power Consumption</td><td>1.5-10 mW</td><td>200 µW (100mA, 10 Hz)</td></tr>
<tr><td>Cost:</td><td>$15-20 USD</td><td>$2 USD</td></tr>
<tr><td>Supply Voltage</td><td>3V/5V</td><td>3V</td></tr>
<tr><td>Sensor Output</td><td>Analog</td><td>Digital (I^2C serial)</td></tr>
<tr><td>Max. Data Rate</td><td>200 Hz</td><td>1000 Hz</td></tr>
<tr><td>LED, PD spacing</td><td>4-6 mm</td><td>1-2 mm</td></tr>
<tr><td>Noise rejection features</td><td>Bandpass filter: 0.5-5 Hz</td><td>Electronic noise cancellation @3.125 MHz</td></tr>
<tr><td>IR filter</td><td>Not included</td><td>Integrated</td></tr>
<tr><td>SNR</td><td>20-30</td><td>Up to 95</td></tr>
<tr><td>Wavelength</td><td>650-950 nm</td><td>895 nm (can be changed)</td></tr>
</table>

Chandrasekar2012 at pg. 3246 right column.

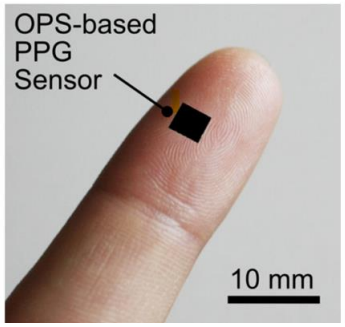
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</td></tr>
<tr><td>1[j] the detection system further configured to:
generate a first signal responsive to light received while the semiconductor sources are off,</td><td>Chandrasekar2012 discloses or renders obvious the detection system further configured to:
generate a first signal responsive to light received while the semiconductor sources are off.

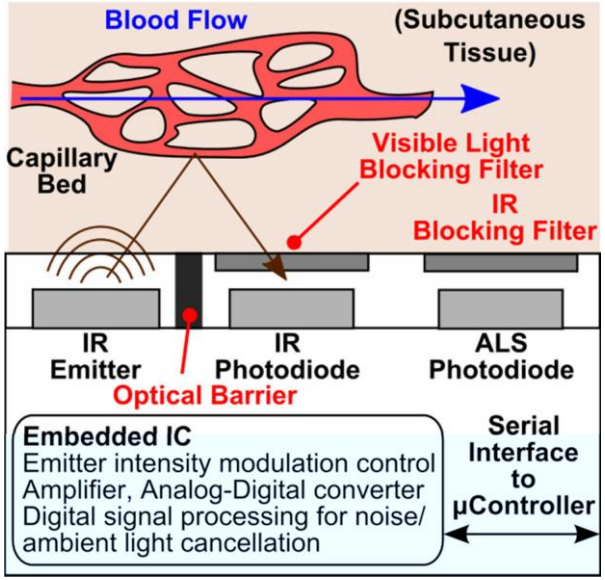
Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control),</td></tr>
</table>

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	lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column. Electronic noise and offset cancellation. Conventional PPGs require a bandpass filter to avoid 60/120 Hz noise from ambient light. This can limits the bandwidth of the sensor, making it difficult to resolve high frequency features of the pressure pulse. In a digital OPS, the LED emitter is pulsed at a high frequency (>1 MHz) which is an integer multiple of 60 Hz. The signal processing circuitry utilizes a demodulation scheme, similar to lock-in-detection [11], which eliminates ambient light artifacts and 1/f noise. This enables fast measurement rates while maintaining low noise. Chandrasekar2012 at pg. 3245 left column. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I^2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Chandrasekar2012 at pg. 3245 left column. One of ordinary skill would find this limitation disclosed either expressly 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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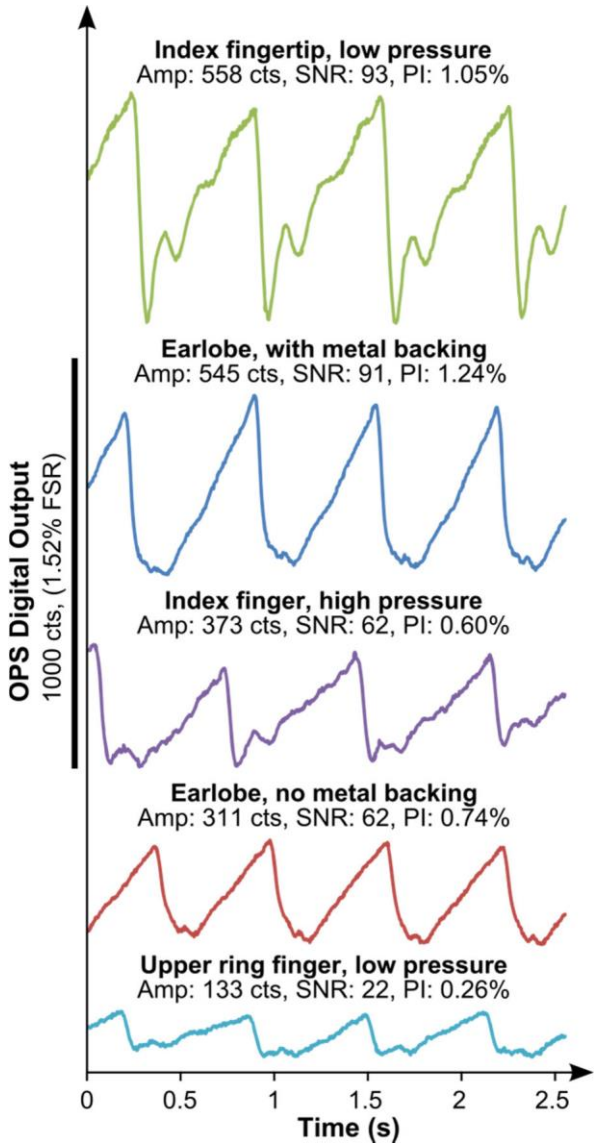
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	art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, 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 semiconductor sources is on; and	Chandrasekar2012 discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on; and. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for "plug- and-play" PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 μW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors' knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column.

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	 Chandrasekar2012 at Fig. 1. Photoplethsymography (PPG) is a ubiquitous monitoring technique for measuring heart rate and oxygen saturation. PPG sensors detect blood volume pulsations by time- resolved analysis of optical radiation either absorbed or scattered by a capillary bed [3]. 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). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. As a result, designing a robust PPG sensor requires a engineering effort and investment. Chandrasekar2012 at pg. 3243 right column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also

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	provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column.  Chandrasekar2012 at Fig. 2. PPGs are obtained by placing the sensor at a fixed pressure with the skin at multiple locations, including the index finger, earlobe, and upper ring finger. In the earlobe measurements, a metal backing is placed on the opposite side to improve the reflectance signal. Before performing the measurement, the current for the IR emitter is manually set to a value approximately 75% of the dynamic range of the sensor. This maintains a large reflected light signal while minimizing the likelihood of detector saturation. The SNR is found to scale proportionally with the reflected light. The ideal current setting is found to be between 80-130 mA, depending on the anatomical location and the individual being tested. Chandrasekar2012 at pg. 3245 left and right columns.

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	Experiments show that the OPS sensor can produce high quality PPGs in multiple anatomical locations (Figure 4). The signal amplitude ranges from 130-560 counts within a full scale range of 216. Pulsation indices (PIs) vary from 0.26-1.25%, which is typical for reflectance pulse oximetry, and is well within the resolution of the 16 bit ADC. The SNR varies between 20-90 depending on the location and the applied pressure. This is comparable or better than existing PPG sensors, which typically have SNR between 30-50. The index fingertip provides the largest overall signal amplitude and SNR, while the earlobe with metal backing gives the largest PI. Heart rate can be easily calculated from the PPG waveforms using computationally inexpensive signal processing algorithms such as time derivatives, averaging windows, or infinite impulse response (IIR) filters implemented on the microcontroller [3]. Chandrasekar2012 at pg. 3245 right column and 3246 left column.

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	Chandrasekar2012 at Fig. 4. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. Chandrasekar2012 at pg. 3245 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, 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	Chandrasekar2012 discloses the detection system further configured to: increase the signal-to-noise ratio by comparing the first signal and the second signal. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors’ knowledge, this is the smallest and lowest power PPG sensor reported to date.

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	Chandrasekar2012 at pg. 3243 left column. 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). A robust PPG sensor must also consider power consumption, ambient light rejection, sensitivity, dynamic range, signal to noise ratio, motion artifacts, calibration, size, and cost [4]. As a result, designing a robust PPG sensor requires a engineering effort and investment. A complete sensor typically requires 10-20 components, 1.5-10mW power, and costs >$20 USD. Chandrasekar2012 at pg. 3243 right column. Improved sensitivity due to small PD-LED spacing. One of the challenges in reflectance mode PPG is that <5% of the light is backscattered to the detector. The intensity of the backscattered light, which forms a concentric ring around the excitation LED [4,8], falls off as the square of the distance (Figure 3). Therefore, it is critical to maintain a small distance between the LED and PD. In a digital OPS, the distance is <1-2 mm, compared to >5mm in a typical PPG [9-10]. This increases the reflected light (and therefore, signal to noise ratio) by a factor of 5-25x. Chandrasekar2012 at pg. 3244 right column. Intensity control. To maximize the signal to noise ratio in PPG, the LED intensity should be made as large as possible without saturating the detector. In a digital OPS, the LED intensity is programmable through the serial interface, allowing closed loop control to prevent detector saturation. Chandrasekar2012 at pg. 3245 left column. Table 1 further compares the performance of the digital OPS reported in this paper with state-of-the art PPG sensors reported in both the research and commercial sectors. It is notable that the OPS-based device provides better performance in most categories, particularly those of interest in wearable sensors. These include substantial improvements in power (10X), size (12X), cost (5-10X), and signal to noise ratio (2-3X). To the authors’ knowledge, this is the smallest and lowest power single-wavelength PPG sensor currently available. Another advantage is that the sensor provides an industry standard I2C digital

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interface to a microcontroller. This link allows for device configuration and data transfer, thus making it simple to integrate a high performance, single-chip PPG sensor into a microcontroller- based embedded system. These features, along with the low cost ($2 USD), make the sensor well-suited for wearable and mobile health monitoring.

TABLE I. COMPARISON OF DIGITAL OPTICAL PROXIMITY SENSOR-BASED PPG SENSOR WITH CONVENTIONAL PPG TECHNOLOGY

Performance Parameter	**Existing PPGs (best case)** [3–4],[8], [12-13]	**OPS-based PPG**
# of Components	>10	1
PCB Area	200 mm^2	16 mm^2
Power Consumption	1.5-10 mW	200 µW (100mA, 10 Hz)
Cost:	$15-20 USD	$2 USD
Supply Voltage	3V/5V	3V
Sensor Output	Analog	Digital (I^2C serial)
Max. Data Rate	200 Hz	1000 Hz
LED, PD spacing	4-6 mm	1-2 mm
Noise rejection features	Bandpass filter: 0.5-5 Hz	Electronic noise cancellation @3.125 MHz
IR filter	Not included	Integrated
SNR	20-30	Up to 95
Wavelength	650-950 nm	895 nm (can be changed)

Chandrasekar2012 at pg. 3246 left column.

One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, 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 plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Chandrasekar2012 discloses or renders obvious wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. Abstract—Remote patient monitoring (RPM) relies on low- cost, low-power, wearable sensors for continuous physiological assessment. Photoplethysmographic (PPG) sensors generally require >10 components, occupy an area>300 mm2, consume >10 mW power, and cost >$20 USD. Although the principle of PPG sensing is straightforward, in practice, a robust implementation requires a careful design including optical alignment, analog circuits, ambient light cancellation, and power management. This paper reports the first use of digital optical proximity sensors (OPS) for "plug- and-play" PPG. OPS have traditionally been used for distance sensing in smartphones and factory automation. Here we show that a digital OPS can perform PPG functions in a single 4x4 mm package which also provides a direct digital interface to a microcontroller. By exploiting its key features, a digital OPS can provide substantial performance advantages over existing state-of-the-art PPGs, including: i) 10X lower power consumption (200 µW) due to pulse operation; ii) high signal to noise ratio (>90), as a result of built-in optical barriers, filters, and ambient light cancellation; iii) 10X lower cost ($2 USD); and iv) 12X smaller area. We show single wavelength PPG measurements in multiple anatomical locations, including fingertips and earlobes. The results suggest that a digital OPS can provide an elegant solution for battery-powered, wearable physiological monitors. To the authors' knowledge, this is the smallest and lowest power PPG sensor reported to date. Chandrasekar2012 at pg. 3243 left column. Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also

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	provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column. Integrated IR LED and visible light blocking filter. OPS LEDs typically emit at near infrared wavelengths (850-950 nm), which is ideal for PPG [3]. The integrated visible light filter reduces the impact of ambient light. Chandrasekar2012 at pg. 3244 right column. integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. The sensor includes an I2C serial interface, and the cost is <$2 USD. The sensor data is recorded using a Silicon Labs microcontroller connected to a laptop via USB. Chandrasekar2012 at pg. 3245 left column. column. It is notable that the OPS-based device provides better performance in most categories, particularly those of interest in wearable sensors. These include substantial improvements in power (10X), size (12X), cost (5-10X), and signal to noise ratio (2-3X). To the authors’ knowledge, this is the smallest and lowest power single-wavelength PPG sensor currently available. Another advantage is that the sensor provides an industry standard I2C digital interface to a microcontroller. This link allows for device configuration and data transfer, thus making it simple to integrate a high performance, single-chip PPG sensor into a microcontroller- based embedded system. Chandrasekar2012 at pg. 3246 left column.

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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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 1 above. Chandrasekar2012 discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 μs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. The sensor includes an I2C serial interface, and the cost is <$2 USD. The sensor data is recorded using a Silicon Labs microcontroller connected to a laptop via USB. Chandrasekar2012 at pg. 3244 left column.

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	Optical proximity sensors, also called light beam sensors, detect distance by measuring the magnitude of light reflected from an object. They are widely used for non-contact distance measurement in a variety of applications, including smartphones (touch screen dimming), factory robotics (motion control), lavatories (touchless switches), vending machines, and home entertainment. Recent studies have also used OPS for the recognition of hand and tongue gestures [5-7]. An OPS consists of an infrared light emitting diode (IR LED), a photodiode (PD), a visible light blocking filter, an optical barrier for reducing lateral light leakage, and an integrated circuit for amplification, signal conditioning, and digitization. Some OPS systems also include a 2nd photodiode for visible light detection and ambient noise cancellation. Digital OPS, which have recently become available, are highly integrated devices which include all the above components in a surface mount package typically a few mm in size. They also provide a bidirectional digital interface to a microcontroller for data transmission and device configuration. Chandrasekar2012 at pg. 3244 left column. Improved sensitivity due to small PD-LED spacing. One of the challenges in reflectance mode PPG is that <5% of the light is backscattered to the detector. The intensity of the backscattered light, which forms a concentric ring around the excitation LED [4,8], falls off as the square of the distance (Figure 3). Therefore, it is critical to maintain a small distance between the LED and PD. In a digital OPS, the distance is <1-2 mm, compared to >5mm in a typical PPG [9-10]. This increases the reflected light (and therefore, signal to noise ratio) by a factor of 5-25x. Reduced background due to optical barrier. A drawback of a small LED-PD spacing is light leakage, which increases the baseline PPG signal. Digital OPS include an optical barrier between the LED and PD which substantially reduces light leakage [9] and thereby improves SNR. This is particularly important in “zero-distance detection” where the skin is in direct contact with the sensor [10]. Chandrasekar2012 at pg. 3244 right column. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I2C

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	bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. The 3V supply voltage is well suited for operation from a coin cell battery. The LED is placed on a separate supply to reduce digital switching noise. Chandrasekar2012 at pg. 3245 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	See claim 2 above. Chandrasekar2012 discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. Integrated IR LED and visible light blocking filter. OPS LEDs typically emit at near infrared wavelengths (850-950 nm), which is ideal for PPG [3]. The integrated visible light filter reduces the impact of ambient light. Chandrasekar2012 at pg. 3244 right column. We used the VCNL4000 (Vishay Semiconductor), a fully integrated digital proximity and ambient light sensor with 16-bit resolution in a 4x4 mm leadless surface mount package (Figure 1). It includes an 895 nm IR LED and a PD with an integrated visible light blocking filter. The LED-PD spacing is ~2 mm, and the LED is embedded in a recessed region which serves as an optical barrier. The integrated signal processing IC handles LED modulation, current control (10-200 mA in 10 mA steps), photodetector

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	amplification and signal conditioning, ambient light cancellation, 16-bit ADC, and I^2C bus communication. The LED can be modulated at frequencies up to 3.125 MHz (user selectable) for electronic noise cancellation. Each measurement is completed in 75 µs, and the LED remains off until the next measurement cycle. This allows one to use a large current (100 mA) while consuming <200 uW power at a 100 Hz measurement rate. Chandrasekar2012 at pg. 3245 left column. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre] A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Chandrasekar2012 discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, 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 wearable device adapted to be placed on a wrist or an ear of a user,	Chandrasekar2012 discloses or renders obvious a wearable device adapted to be placed on a wrist or an ear of a user. *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b] including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Chandrasekar2012 discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c] the wearable device comprising one or more lenses configured to receive at least a portion of the output optical light and to	Chandrasekar2012 discloses or renders obvious the 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. *See* above at claim 1[c].

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deliver a lens output light to tissue;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d] the wearable device further comprising 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,	Chandrasekar2012 discloses or renders obvious the wearable device further comprising 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. *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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e] wherein the detection system is configured to be synchronized to the light source;	Chandrasekar2012 discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. *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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f] 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 spatially separated detectors;	Chandrasekar2012 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g] the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a	Chandrasekar2012 discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the

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portion of the processed output signal is configured to be transmitted over a wireless transmission link;	teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[h] wherein the output signal is indicative of one or more of the physiological parameters;	Chandrasekar2012 discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[i] 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; and	Chandrasekar2012 discloses or renders obvious 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. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[j] the detection system further configured to:	Chandrasekar2012 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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'455 Patent	Chandrasekar2012
generate a first signal responsive to light received while the light emitting diodes are off,	*See* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[k] generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Chandrasekar2012 discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[l] increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Chandrasekar2012 discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of 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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[m] wherein the plurality of semiconductor sources comprises six light emitting diodes.	Chandrasekar2012 discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. *See* above 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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 8 above. Chandrasekar2012 discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 10	

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10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	See claim 9 above. Chandrasekar2012 discloses or renders obvious the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. *See* above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 15	
15[pre] A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Chandrasekar2012 discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[a] a wearable device adapted to be placed on	Chandrasekar2012 discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user.

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teeth, a wrist, or an ear of a user,	*See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[b]including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Chandrasekar2012 discloses or renders obvious the wearable device including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[c] the 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;	Chandrasekar2012 discloses or renders obvious the 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. *See* above at claim 1[c].

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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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[d] the wearable device further comprising 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,	Chandrasekar2012 discloses or renders obvious the wearable device further comprising 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. *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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[e] wherein the detection system is configured to be synchronized to the light source;	Chandrasekar2012 discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. *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 incorporated by reference into this chart. To the extent this limitation is not disclosed by

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	Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[f] 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 spatially separated detectors;	Chandrasekar2012 discloses 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[g] the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured	Chandrasekar2012 discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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’455 Patent	Chandrasekar2012
to be transmitted over a wireless transmission link;	
15[h] wherein the output signal is indicative of one or more of the physiological parameters;	Chandrasekar2012 discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[i] 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; and	Chandrasekar2012 discloses or renders obvious 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. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[j] the detection system further configured to: generate a first signal responsive to light received	Chandrasekar2012 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* above at claim 1[j].

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while the light emitting diodes are off,	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[k] generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Chandrasekar2012 discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on;and See above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[l] increase the signal-to-noise ratio by comparing the first signal and the second signal;	Chandrasekar2012 discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the

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	teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[m] wherein the plurality of semiconductor sources comprises six light emitting diodes,	Chandrasekar2012 discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. *See* above 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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[n] wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and	Chandrasekar2012 discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[o] wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Chandrasekar2012 discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. *See* above at claim 3.

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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 Chandrasekar2012, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Chandrasekar2012, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT E16

U.S. Pat. No. 11,160,455 in view of U.S. Patent No. 7,507,207 to Kazuhiro Sakai ("Sakai")

As described in detail below, Sakai (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 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 E1-E15 and E17-E18, 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 '455 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 Sakai. The cited portions of Sakai are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Sakai. 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 Sakai "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Sakai 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 Sakai (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 Sakai anticipates and/or renders obvious the Asserted Claims of the '455 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.

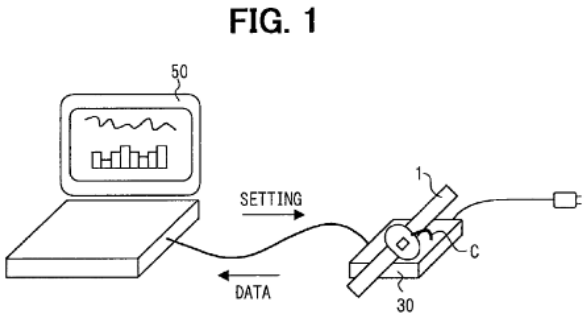
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’455 Patent	Sakai
Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Sakai discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] **The present invention relates to a portable biological information monitor apparatus used in a status where it is attached to a test subject's body,** and to an information management apparatus to process and display information generated by the monitor apparatus. Sakai at 1:15-18 **To solve the above problems, it is an object of the present invention to provide a portable biological information monitor apparatus which always monitors biological information without attachment and removal of apparatuses, and an information management apparatus which processes and displays information generated by the monitor apparatus**. Sakai at 1:65-2:03

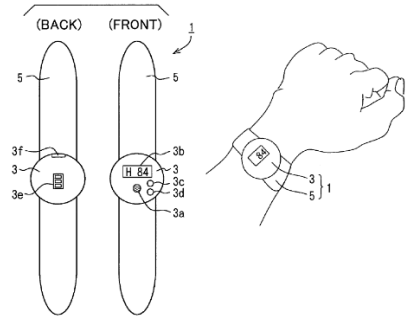
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	In the portable biological information monitor apparatus according to the present invention made to attain the above object, biological information detection means repeatedly detects a test subject's biological information reflecting pulse, body motion, and autonomic nervous system function. Then, barometer generation means includes multiple generation modes corresponding to the test subject's actions and operates in any of generation modes based on the detected biological information. Here, the generation modes include at least a first generation mode to generate sleep evaluation barometers for evaluation of the test subject's status in sleep and a second generation mode to generate wake evaluation barometers for evaluation of the test subject's status in wake. Storage means stores the generated barometers. “Barometer” is used to mean an “indicator. Sakai at 2:04-18 **In this manner, the portable biological information monitor apparatus according to the present invention, as a single apparatus, monitors biological information in sleep and biological information in wake.** Then, a comprehensive evaluation of the test subject's status (e.g., life rhythm, activity amount (consumed calories), physical condition, and sleep quality) can be made based on sleep evaluation barometers and wake evaluation barometers generated from these pieces of biological information. Further, accurate advice can be dispensed to the test subject based on the result of evaluation. Sakai at 2:19-28 **Further, according to the present invention, as barometers for evaluation of different actions (sleep evaluation barometers and wake evaluation barometers) are generated from the same biological information, attachment and removal of apparatuses by action is not necessary.** Further, as the apparatus itself is a portable type apparatus which does not limit the test subject's actions, biological information in normal living conditions can be easily obtained without the test subject's consciousness of measurement. Sakai at 2:29-37

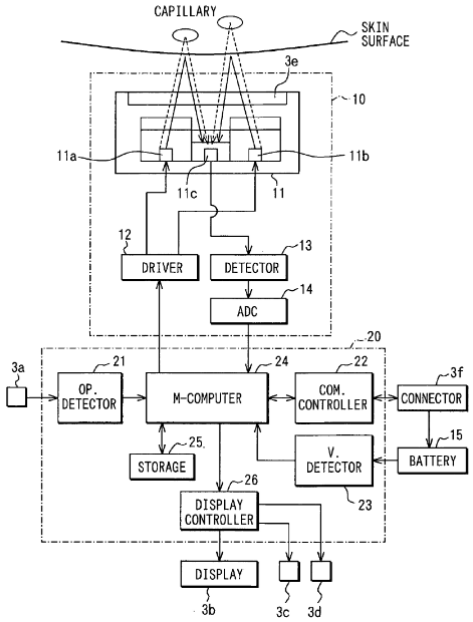
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’455 Patent	Sakai
	FIG. 1 is a perspective view showing the entire arrangement of a physical condition management system according to a first embodiment of the present invention; Sakai at 2:53-55  Sakai at Fig. 1 **FIGS. 2A and 2B are explanatory views showing the arrangement of a portable biological information monitor apparatus and the monitor apparatus in use;** Sakai at 2:56-58

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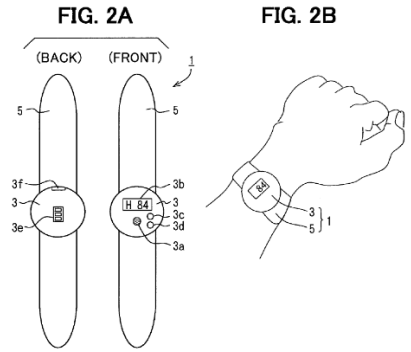
’455 Patent	Sakai
	FIG. 2A FIG. 2B  Sakai at Fig. 2A & 2B **FIG. 3 is a block diagram showing the construction of the portable biological information monitor apparatus;** Sakai at 2:59-60

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	FIG. 3  Sakai at Fig. 3 **FIG. 4 is a flowchart showing the contents of main processing performed by a microcomputer of the portable biological information monitor apparatus;** Sakai at 2:61-63 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 art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are

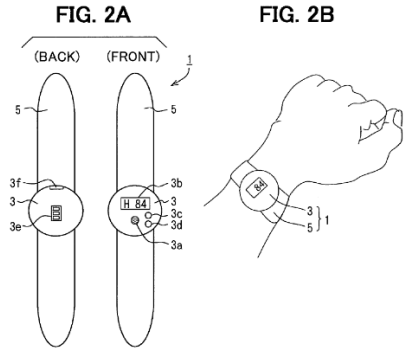
’455 Patent	Sakai
	incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Sakai discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] **The present invention relates to a portable biological information monitor apparatus used in a status where it is attached to a test subject's body,** and to an information management apparatus to process and display information generated by the monitor apparatus. Sakai at 1:15-18 **FIGS. 2A and 2B are explanatory views showing the arrangement of a portable biological information monitor apparatus and the monitor apparatus in use;** Sakai at 2:56-58

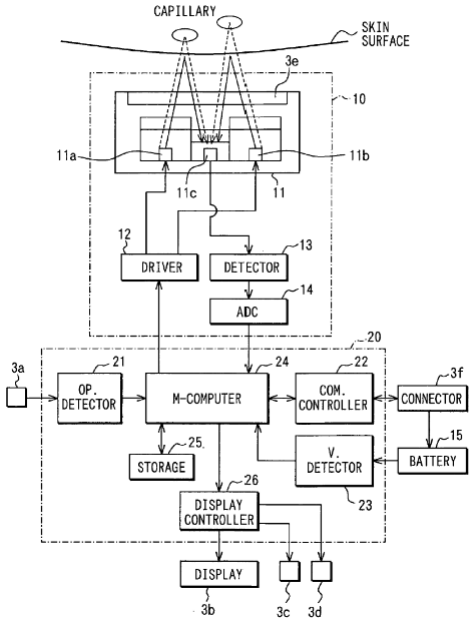
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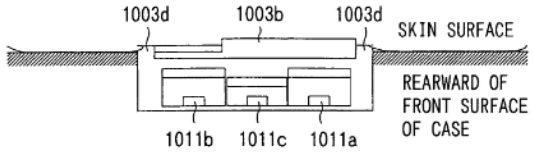
’455 Patent	Sakai
	 Sakai at Fig. 2A & 2B **As shown in FIG. 2B, the monitor 1 is fixed around the test subject's wrist or ankle with the attachment portion 5 when the monitor apparatus is used such that the detection window 3 e on the back surface of the main body 3 is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from a finger tip to a root of all limbs. Further, the attachment portion 5 may be a supporter member in place of the belt.** Sakai at 4:63-5:03 An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3. **Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1.** Sakai at 4:54-4:62

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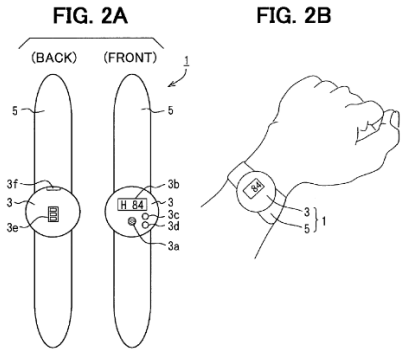
’455 Patent	Sakai
	When the biological status detection apparatus 1001 is used, as shown in FIG. 12B, the apparatus is fixed around a test subject's wrist or ankle with the attachment portion 1005 such that the back surface of the main body 1003 where the light transmitting plate 1003 b is formed is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from finger tip to root of all limbs. Further, the attachment portion 1005 may be a supporter member in place of the belt. Sakai at 16:50-58 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	Sakai discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract]

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	An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. **A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3.** Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1. Sakai at 4:54-4:62  Sakai at Fig. 2A & 2B FIG. 3 is a block diagram showing the construction of the monitor 1. As shown in FIG. 3, the monitor 1 has an information detection unit 10 which emits light via the detection window 3 e and **receives reflected light to thereby detect biological information**; an information processor 20 which processes the biological information detected by the information detection unit 10; and a battery 15 chargeable via the cable connected to the connector 3 f, which supplies power to the respective elements of the apparatus. **The information detection unit 10 has an optical pulse wave and body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about**

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	950 nm), and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b**; a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20;** a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. **Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body,** a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:04-30 FIG. 3 

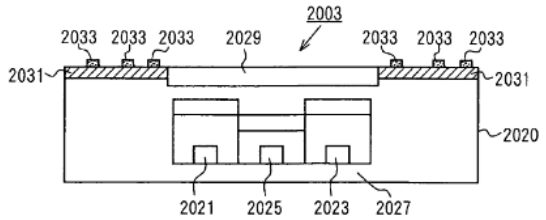
’455 Patent	Sakai
	Sakai at Fig. 3 **That is, upon light emission from the green LED 11 a, the pulse wave and body motion sensor 11 operates as a pulse wave sensor which outputs a pulse wave detection signal including pulse component and body motion component, while upon light emission from the infrared LED 11 b,** operates as a body motion sensor which outputs a body motion detection signal including body motion component. **When the driver 12 is started in accordance with a command from the information processor 20, the driver 12 drives the LEDs 11 a and 11 b alternately at different timings,** by preset sampling interval (50 msec in the present embodiment). Further, the 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 5:59-6:09 **FIG. 14 is a cross-sectional view explaining the structure of a case and a light transmitting plate constructing a pulse wave sensor and the sensor in use;** Sakai at 03:20-22 FIG. 14  Sakai at Fig. 14

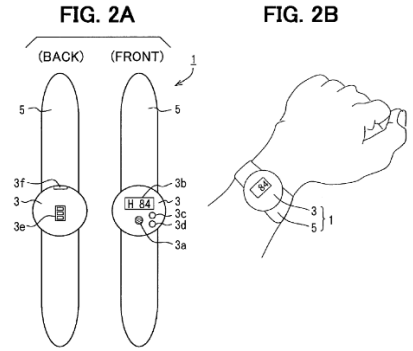
’455 Patent	Sakai
	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. the 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;	Sakai discloses or renders obvious the 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 **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] **The present invention relates to a portable biological information monitor apparatus used in a status where it is attached to a test subject's body,** and to an information management apparatus to process and display information generated by the monitor apparatus. Sakai at 1:15-18 **FIGS. 2A and 2B are explanatory views showing the arrangement of a portable biological information monitor apparatus and the monitor apparatus in use;**

’455 Patent	Sakai
	Sakai at 2:56-58  Sakai at Fig. 2A & 2B **As shown in FIG. 2B, the monitor 1 is fixed around the test subject's wrist or ankle with the attachment portion 5 when the monitor apparatus is used such that the detection window 3 e on the back surface of the main body 3 is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from a finger tip to a root of all limbs. Further, the attachment portion 5 may be a supporter member in place of the belt.** Sakai at 4:63-5:03 An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3. **Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1.**

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	Sakai at 4:54-4:62 **Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery,** and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:25-30 **When the biological status detection apparatus 1001 is used, as shown in FIG. 12B, the apparatus is fixed around a test subject's wrist or ankle with the attachment portion 1005 such that the back surface of the main body 1003 where the light transmitting plate 1003 b is formed is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from finger tip to root of all limbs. Further, the attachment portion 1005 may be a supporter member in place of the belt.** Sakai at 16:50-58 **Further, in the light transmitting plate 1003 b, a portion opposite to the green LED 1011 a and the photo diode 1011 c (hereinbelow, referred to as a “first portion”), i.e., a portion as a path of light emitted from the green LED 1011 a and its reflected light, is projected further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm). By contrast, a portion opposite to the infrared LED 1011 b (hereinbelow, referred to as a “second portion”), i.e., a portion as a path of light emitted from the infrared LED 1011 b, has a shape dented further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm).** Suppose the degree of adhesion to the test subject's skin when the apparatus 1001 is attached to the test subject, as shown in FIG. 14. Here, the degree of adhesion to the test subject's skin is high in the portion as a path of light emitted from the green LED 1011 a (green light) and its reflected light. **By contrast, the degree of adhesion to the test subject's skin is low (or the portion is not in close contact with the skin) in the portion as a path of light emitted from the infrared LED 1011 b (infrared light).**

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	Sakai at 17:25-51 **Further, the green light emitted via the first portion of the light transmitting plate 1003 b easily arrives at the capillary artery running through the test subject's body and reflected light from the capillary artery is easily received**. Accordingly, the sensitivity of pulse component detection in the pulse wave detection signal is improved. **On the other hand, the infrared light emitted via the second portion of the light transmitting plate 3 b is easily reflected on the skin surface and its irradiation position is easily moved in accordance with body motion.** Accordingly, the sensitivity of pulse component detection in the body motion detection signal is degraded but the sensitivity of body motion detection is improved. Sakai at 18:12-23 **Note that in the light emitted from the infrared LED 2021 and the green LED 2023 to the human body, a part of the light arrives at small artery and arteriole (capillary artery) running through the human body and is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered.** At this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin is also changed in an undulating manner. That is, the amount of light reflected from the capillary artery and detected by the PD 2025 changes in correspondence with the blood pulsation. Sakai at 29:19-30

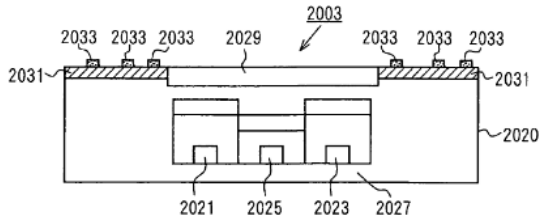
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	FIG. 32A  Sakai at Fig. 32 A One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. the wearable device further comprising 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,	Sakai discloses or renders obvious the wearable device further comprising 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 a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test

’455 Patent	Sakai
	subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] **The present invention relates to a portable biological information monitor apparatus used in a status where it is attached to a test subject's body,** and to an information management apparatus to process and display information generated by the monitor apparatus. Sakai at 1:15-18 **FIGS. 2A and 2B are explanatory views showing the arrangement of a portable biological information monitor apparatus and the monitor apparatus in use;** Sakai at 2:56-58  Sakai at Fig. 2A & 2B

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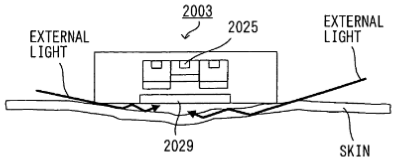
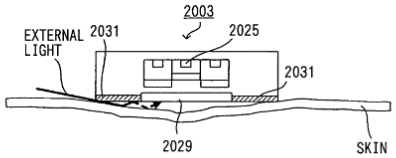
’455 Patent	Sakai
	As shown in FIG. 2B, the monitor 1 is fixed around the test subject's wrist or ankle with the attachment portion 5 when the monitor apparatus is used such that the detection window 3 e on the back surface of the main body 3 is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from a finger tip to a root of all limbs. Further, the attachment portion 5 may be a supporter member in place of the belt. Sakai at 4:63-5:03 An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3. **Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1.** Sakai at 4:54-4:62 **Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery,** and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:25-30 **When the biological status detection apparatus 1001 is used, as shown in FIG. 12B, the apparatus is fixed around a test subject's wrist or ankle with the attachment portion 1005 such that the back surface of the main body 1003 where the light transmitting plate 1003 b is formed is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from finger tip to root of all limbs. Further, the attachment portion 1005 may be a supporter member in place of the belt.**

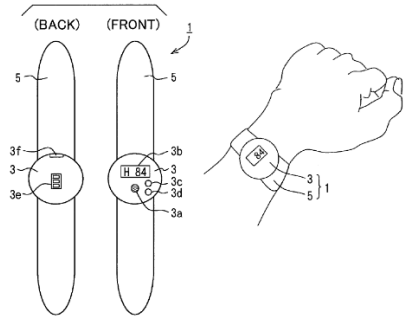
’455 Patent	Sakai
	Sakai at 16:50-58 **Further, in the light transmitting plate 1003 b, a portion opposite to the green LED 1011 a and the photo diode 1011 c (hereinbelow, referred to as a “first portion”), i.e., a portion as a path of light emitted from the green LED 1011 a and its reflected light, is projected further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm). By contrast, a portion opposite to the infrared LED 1011 b (hereinbelow, referred to as a “second portion”), i.e., a portion as a path of light emitted from the infrared LED 1011 b, has a shape dented further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm).** Suppose the degree of adhesion to the test subject's skin when the apparatus 1001 is attached to the test subject, as shown in FIG. 14. Here, the degree of adhesion to the test subject's skin is high in the portion as a path of light emitted from the green LED 1011 a (green light) and its reflected light. **By contrast, the degree of adhesion to the test subject's skin is low (or the portion is not in close contact with the skin) in the portion as a path of light emitted from the infrared LED 1011 b (infrared light).** Sakai at 17:25-51 **Further, the green light emitted via the first portion of the light transmitting plate 1003 b easily arrives at the capillary artery running through the test subject's body and reflected light from the capillary artery is easily received**. Accordingly, the sensitivity of pulse component detection in the pulse wave detection signal is improved. **On the other hand, the infrared light emitted via the second portion of the light transmitting plate 3 b is easily reflected on the skin surface and its irradiation position is easily moved in accordance with body motion.** Accordingly, the sensitivity of pulse component detection in the body motion detection signal is degraded but the sensitivity of body motion detection is improved. Sakai at 18:12-23 **Note that in the light emitted from the infrared LED 2021 and the green LED 2023 to the human body, a part of the light arrives at small artery and arteriole (capillary artery) running through**

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	the human body and is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. At this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin is also changed in an undulating manner. That is, the amount of light reflected from the capillary artery and detected by the PD 2025 changes in correspondence with the blood pulsation. Sakai at 29:19-30 FIG. 32A  Sakai at Fig. 32 A **Further, convex members 2033 are arranged on the light shielding plate 2031 so as to surround the light transmitting plate 2029 thrice.** The triple surrounding of the convex members 2033 may be changed to single, double or quadruple surrounding. Further, the height of the convex member 2033 is designed to be sufficient for causing appropriate depressed portions in the skin when the pulse wave sensor 2003 is fixed to the human body's arm or the like. **For example, the height of the convex member 2033 is about 0.3 mm. As described later, the convex members 2033 are provided to prevent reception of external light in the PD 2025.** Further, the convex members 2033 are multiple projection lines each having head and tail ends. A gap 2035 is formed between the both ends of each projection line for prevention of steaming. Further, the intervals among the triple layers of the convex members 2033 (e.g., see intervals S1 and S2 in FIG. 32B) are not equal but random intervals. Note that as the convex members 2033, a material having a flexible characteristic is used such that when the pulse

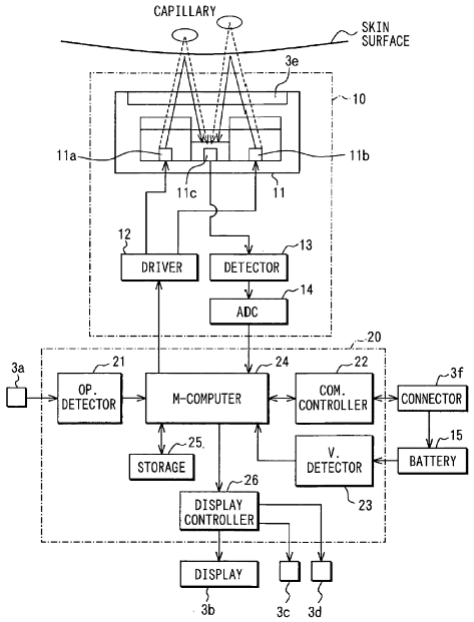
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	wave sensor 2003 is fixed to the human body's arm or the like, the convex members 2033 comes to make a contact with the human body's skin without gap. For example, silicon material is preferable. In the figure, the convex members 2033, the light shielding plate 2031 and the casing 2020 are separate members, but the casing 2020 may be processed to have the same functions as those of the convex member 2033 and the light shielding plate 2031. Sakai at 28:46-29:04 **The direct current component is based on the changes in light amount accompanied by blood stream changes due to as follows: expansion and contraction of blood vessel (hereinbelow, referred to as “noise A”); the change of amount of light scattered on the skin surface accompanied by shift of the pulse wave sensor 2003 (hereinbelow, referred to as “noise B”);** and the change of amount of light incident from the outside of the pulse wave sensor 2003 (e.g., sunlight) etc. The direct current component is cut with the detector 2011 using a method to be described later. Sakai at 29:49-58 **The light from the outside of the pulse wave sensor 2003 such as sunlight (hereinbelow, also referred to as “external light”) is generally propagated on the skin surface and the inside of the skin and inputted into the PD 2025**, as shown in FIG. 36A. As shown in **FIG. 36B, a part of the external light propagated on the skin surface is absorbed in the surface of the light shielding plate 2031 coated with light absorbing color.** Sakai at 30:11-18

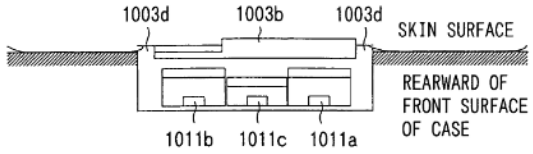
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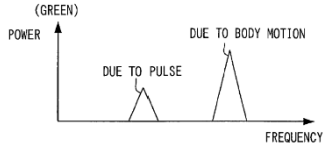
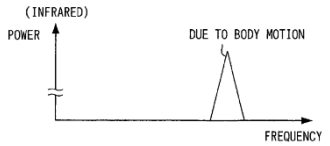
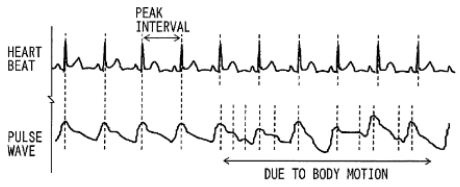
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	FIG. 36A  FIG. 36B  Sakai at Fig. 36A & 36B One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. wherein the detection system is configured to be synchronized to the light source;	Sakai discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers

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	for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. **A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3.** Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1. Sakai at 4:54-4:62 FIG. 2A FIG. 2B  Sakai at Fig. 2A & 2B **FIG. 3 is a block diagram showing the construction of the monitor 1. As shown in FIG. 3, the monitor 1 has an information detection unit 10 which emits light via the detection window 3 e and receives reflected light to thereby detect biological information**; an information processor 20 which

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	processes the biological information detected by the information detection unit 10; and a battery 15 chargeable via the cable connected to the connector 3 f, which supplies power to the respective elements of the apparatus. **The information detection unit 10 has an optical pulse wave and body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm),** and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b**; a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20;** a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. **Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body,** a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:04-30

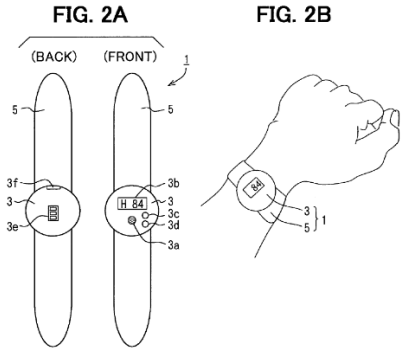
’455 Patent	Sakai
	FIG. 3  Sakai at Fig. 3 **That is, upon light emission from the green LED 11 a, the pulse wave and body motion sensor 11 operates as a pulse wave sensor which outputs a pulse wave detection signal including pulse component and body motion component, while upon light emission from the infrared LED 11 b,** operates as a body motion sensor which outputs a body motion detection signal including body motion component. **When the driver 12 is started in accordance with a command from the information processor 20, the driver 12 drives the LEDs 11 a and 11 b alternately at different timings,** by preset sampling interval (50 msec in the present embodiment). **Further, the A/D converter 14 operates in synchronization with the light emission timing of the driver 12,** to thereby convert the pulse wave

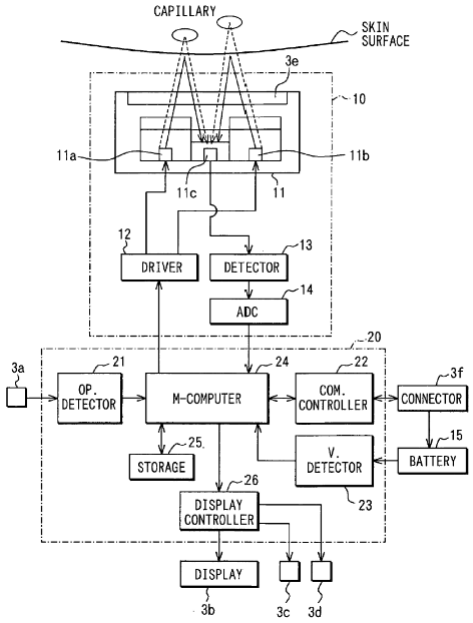
’455 Patent	Sakai
	detection signal detected upon light emission from the green LED 11 a and the body motion detection signal detected upon light emission from the infrared LED 11 b into digital data, and provides these digital data, as biological information, to the information processor 20. Sakai at 5:59-6:09 **FIG. 14 is a cross-sectional view explaining the structure of a case and a light transmitting plate constructing a pulse wave sensor and the sensor in use;** Sakai at 03:20-22 FIG. 14  Sakai at Fig. 14 **Note that infrared light has a low light absorption characteristic in comparison with green light. As shown in FIGS. 9A and 9B, in the detection signal obtained by the PD 11 c upon light emission from the green LED 11 a,** the pulse component and body motion component are detected at extractable signal levels (see FIG. 9A). On the other hand, in the detection signal obtained by the PD 11 c upon light emission from the infrared LED 11 b, the pulse component is at a very low level in comparison with the body motion component and only the body motion component is detected at an extractable signal level (see FIG. 9B). Note that FIGS. 9A and 9B are graphs showing frequency spectra of the detection signal. Sakai at 05:47-58

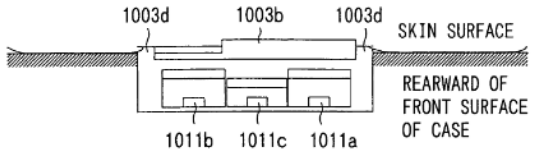
’455 Patent	Sakai
	FIG. 9A  FIG. 9B  Sakai at Fig. 9A & 9B **Note that as the blood stream is also influenced by body motion, the detection signal from the PD 11 c includes a body motion component synchronized with body motion as well as a pulse component synchronized with pulse (see FIG. 8).** Further, all the emitted light does not arrive at the capillary artery, and light reflected from the body surface (surface reflected light) is also received with the PD 11 c. The surface reflected light also includes a body motion component. Sakai at 05:39-46 FIG. 8  Sakai at Fig. 8

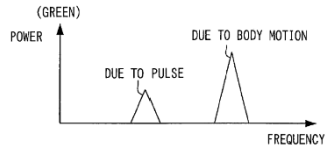
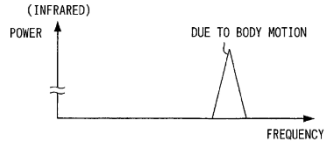
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	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. 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 spatially separated detectors;	Sakai 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 spatially separated detectors. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone. Sakai at [Abstract] An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. **A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3.** Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1.

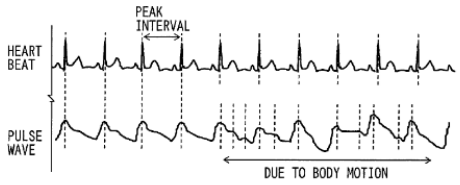
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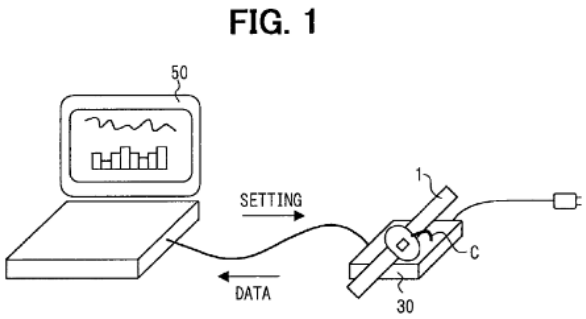
’455 Patent	Sakai
	Sakai at 4:54-4:62  Sakai at Fig. 2A & 2B **FIG. 3 is a block diagram showing the construction of the monitor 1. As shown in FIG. 3, the monitor 1 has an information detection unit 10 which emits light via the detection window 3 e and receives reflected light to thereby detect biological information**; an information processor 20 which processes the biological information detected by the information detection unit 10; and a battery 15 chargeable via the cable connected to the connector 3 f, which supplies power to the respective elements of the apparatus. **The information detection unit 10 has an optical pulse wave and body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm),** and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b**; a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20;** a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. **Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body,** a part of the light is absorbed in hemoglobin in blood flowing through

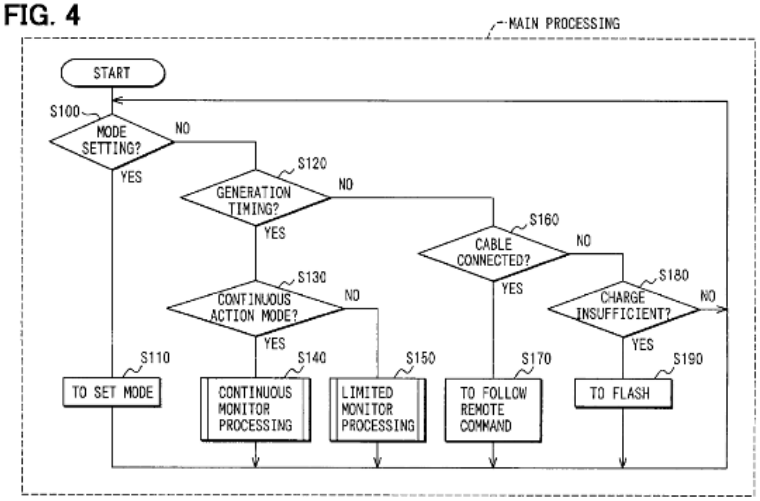
’455 Patent	Sakai
	the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:04-30 FIG. 3  Sakai at Fig. 3 **That is, upon light emission from the green LED 11 a, the pulse wave and body motion sensor 11 operates as a pulse wave sensor which outputs a pulse wave detection signal including pulse component and body motion component, while upon light emission from the infrared LED 11 b,**

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	operates as a body motion sensor which outputs a body motion detection signal including body motion component. **When the driver 12 is started in accordance with a command from the information processor 20, the driver 12 drives the LEDs 11 a and 11 b alternately at different timings,** by preset sampling interval (50 msec in the present embodiment). **Further, the 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 5:59-6:09 **FIG. 14 is a cross-sectional view explaining the structure of a case and a light transmitting plate constructing a pulse wave sensor and the sensor in use;** Sakai at 03:20-22 FIG. 14  Sakai at Fig. 14 **Note that infrared light has a low light absorption characteristic in comparison with green light. As shown in FIGS. 9A and 9B, in the detection signal obtained by the PD 11 c upon light emission from the green LED 11 a,** the pulse component and body motion component are detected at extractable signal levels (see FIG. 9A). On the other hand, in the detection signal obtained by the PD 11 c upon light emission from the infrared LED 11 b, the pulse component is at a very low level in comparison with the

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	body motion component and only the body motion component is detected at an extractable signal level (see FIG. 9B). Note that FIGS. 9A and 9B are graphs showing frequency spectra of the detection signal. Sakai at 05:47-58 FIG. 9A  FIG. 9B  Sakai at Fig. 9A & 9B **Note that as the blood stream is also influenced by body motion, the detection signal from the PD 11 c includes a body motion component synchronized with body motion as well as a pulse component synchronized with pulse (see FIG. 8).** Further, all the emitted light does not arrive at the capillary artery, and light reflected from the body surface (surface reflected light) is also received with the PD 11 c. The surface reflected light also includes a body motion component. Sakai at 05:39-46

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	FIG. 8  Sakai 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at	Sakai discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test

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least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] **FIG. 1 is a perspective view showing the entire arrangement of a physical condition management system according to a first embodiment of the present invention;** Sakai at 2:53-55  Sakai at Fig. 1 **FIG. 4 is a flowchart showing the contents of main processing performed by a microcomputer of the portable biological information monitor apparatus;** Sakai at 2:61-63

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	FIG. 4  Sakai at Fig. 4 **Note that the information management unit 50 includes a well-known personal computer having a keyboard, a display, a CPU, a ROM, a RAM, a hard disk, a communication interface, and the like. The communication interface is connected to a cable from the charger 30.** A management database is formed on the hard disk. The management database is generated by accumulating data obtained from the monitor 1 via the communication interface and the charger 30, with separately-inputted various data (data on the test subject which cannot be inputted with the monitor 1, data on other test subjects, and the like). **The CPU analyzes and evaluates the data accumulated in the management database, and performs processings for displaying the results of analysis and evaluation and the data accumulated in the management database on the display in various formats.** Further, a management database server may be constructed through the Internet or the like so that a third person can also manage many data. In this case, the management of data may be performed via the information management apparatus or may be directly performed with the monitor. Further, data transmission and data reception are possible. Sakai at 4:28-48

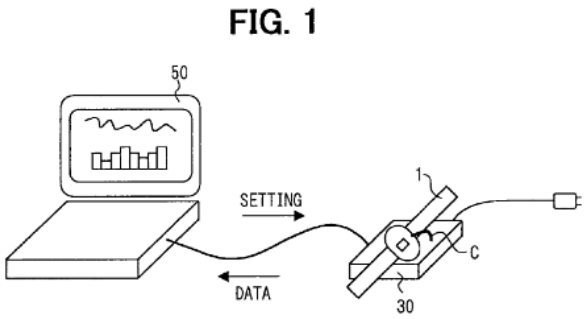
’455 Patent	Sakai
	When the driver 12 is started in accordance with a command from the information processor 20, the driver 12 drives the LEDs 11 a and 11 b alternately at different timings, by preset sampling interval (50 msec in the present embodiment). Further, the A/D converter 14 operates in synchronization 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.** **The information processor 20 has an operation detector 21 which detects an operation made with an operation button 3 a; a communication controller 22 which detects cable connection with and disconnection from the connector 3 f and controls communication with an external device via the cable connected to the connector 3 f; a voltage detector 23 which detects a voltage of the battery 15; a microcomputer 24 which performs processing for generating barometers from biological information detected by the information detection unit 10, monitoring of battery voltage via the voltage detector 23,** communication processing for communication with the external device via the communication controller 22; a storage unit 25 which holds the biological information detected by the information detection unit 10 and various information generated by the microcomputer 24 based on the biological information; and a display controller 26 which displays characters and figures on the display panel 3 b and turns on and off the LEDs 3 c and 3 d in accordance with instructions from the microcomputer 24. **Note that at least a buffer area is ensured in the storage unit 25 for storing the biological information supplied from the information detection unit 10**. The buffer area has a capacity to store data for a preset period (in the present embodiment, past 25 seconds or longer, i.e., 500 data or more by detection signal). **The microcomputer 24 is a well-known computer mainly having a CPU, a ROM, and a RAM.** The microcomputer 24 performs timekeeping processing for obtaining time, data update processing for updating data in the buffer area ensured in the storage unit 25 when biological information is supplied from the information detection unit 10, **and display processing for causing the display controller 26 to perform display on the display panel 3 b, in addition to main processing to be described later.** Next, the main processing performed by the microcomputer 24 will be described in accordance with the flowchart of FIG. 4. When the power is turned on and the present processing is started, first, it is

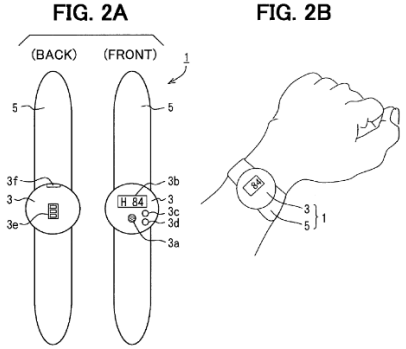
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	determined based on an input from the operation detector 21 whether or not a mode setting operation has been made via the operation button 3 a (Step S100); then it is determined **whether or not it is generation timing to analyze biological information detected by the information detection unit 10 and generate barometers (Step S120);** then it is determined based on an input from the communication controller 22 whether or not the cable is connected to the connector 3 f (Step S160); and it is determined based on an input from the voltage detector 23 whether or not the charging amount of the battery 15 is insufficient (Step S180). When the determinations are all negative (NO), these determinations are repeatedly performed as a stand-by status. Then, when it is determined at Step S100 that the mode setting operation has been performed, various settings are performed to operate the monitor 1 in the mode set by the setting operation (Step S110), and the process returns to Step S100. **Note that in the mode setting operation, an action mode to designate a period for performing biological information monitoring (gathering and analysis),** a generation mode to designate barometers generated from the biological information, and a display mode to designate contents to be displayed on the display panel 3 b are set. Sakai at 5:66-7:03 **In the remote command processing, for example, processing for transferring a part or all the information stored in the storage unit 25 to the information management unit 50, processing for updating programs executed at Step S140 (continuous monitor processing) and Step S150 (limited monitor processing),** processing for changing the respective parameters and settings for generation timing, and the like can be performed. Further, it is determined via the cable C whether or not charging has been performed. When it is determined that charging has been performed, the charging check LED 3 d is turned off. Sakai at 8:14-24 **Further, in the above embodiment, the communication controller 22 performs cable communication via the cable C connected to the connector 3 f; however, wireless communication may be performed.** In this case, it may be further arranged such that the operation button 3 a is omitted

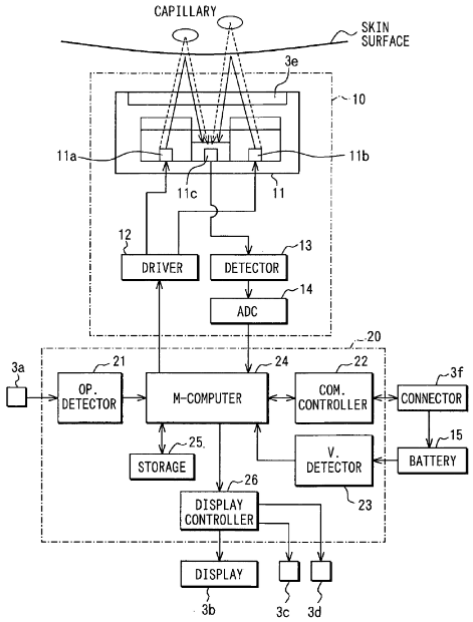
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	and a separately prepared remote controller is used, and various mode settings are performed via the communication controller 22. Sakai at 14:44-52 53. **The information management apparatus according to claim 52, further comprising a remote controller, for controlling operation of the portable biological information monitor apparatus via the first communication means.** Sakai at claim 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, 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 one or more of the physiological parameters;	Sakai discloses or renders obvious wherein the output signal is indicative of one or more of the physiological parameters. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.

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	Sakai at [Abstract] **The present invention relates to a portable biological information monitor apparatus used in a status where it is attached to a test subject's body,** and to an information management apparatus to process and display information generated by the monitor apparatus. Sakai at 1:15-18 To solve the above problems, **it is an object of the present invention to provide a portable biological information monitor apparatus which always monitors biological information without attachment and removal of apparatuses, and an information management apparatus which processes and displays information generated by the monitor apparatus**. Sakai at 1:65-2:03 **In the portable biological information monitor apparatus according to the present invention made to attain the above object, biological information detection means repeatedly detects a test subject's biological information reflecting pulse, body motion, and autonomic nervous system function.** Then, barometer generation means includes multiple generation modes corresponding to the test subject's actions and operates in any of generation modes based on the detected biological information. Here, the generation modes include at least a first generation mode to generate sleep evaluation barometers for evaluation of the test subject's status in sleep and a second generation mode to generate wake evaluation barometers for evaluation of the test subject's status in wake. Storage means stores the generated barometers. “Barometer” is used to mean an “indicator. Sakai at 2:04-18 **In this manner, the portable biological information monitor apparatus according to the present invention, as a single apparatus, monitors biological information in sleep and biological information in wake. Then, a comprehensive evaluation of the test subject's status (e.g., life rhythm, activity amount (consumed calories), physical condition, and sleep quality) can be made based on sleep evaluation barometers and wake evaluation barometers generated from these pieces**

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	of biological information. Further, accurate advice can be dispensed to the test subject based on the result of evaluation. Sakai at 2:19-28 **Further, according to the present invention, as barometers for evaluation of different actions (sleep evaluation barometers and wake evaluation barometers) are generated from the same biological information, attachment and removal of apparatuses by action is not necessary.** Further, as **the apparatus itself is a portable type apparatus which does not limit the test subject's actions, biological information in normal living conditions can be easily obtained without the test subject's consciousness of measurement**. Sakai at 2:29-37 **FIG. 1 is a perspective view showing the entire arrangement of a physical condition management system according to a first embodiment of the present invention;** Sakai at 2:53-55  Sakai at Fig. 1

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	FIGS. 2A and 2B are explanatory views showing the arrangement of a portable biological information monitor apparatus and the monitor apparatus in use; Sakai at 2:56-58  Sakai at Fig. 2A & 2B **FIG. 3 is a block diagram showing the construction of the portable biological information monitor apparatus;** Sakai at 2:59-60

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	FIG. 3  Sakai at Fig. 3 **FIG. 4 is a flowchart showing the contents of main processing performed by a microcomputer of the portable biological information monitor apparatus;** Sakai at 2:61-63 **As shown in FIG. 1, the physical condition management system of the present embodiment has a portable biological information monitor apparatus 1** (hereinbelow, simply referred to as a “monitor”) which is attached to a test subject as the subject of management when the apparatus is used; a charger 30

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	which charges the monitor 1 and interfaces communication with the monitor 1 via a cable C attachable to and removable from the monitor 1; and an information management unit 50 which performs communication with the monitor 1 via the charger 30 to thereby change internal settings of the monitor 1, and performs various processings based on data obtained from the monitor 1. Sakai at 4:16-27 **Note that the information management unit 50 includes a well-known personal computer having a keyboard, a display, a CPU, a ROM, a RAM, a hard disk, a communication interface, and the like. The communication interface is connected to a cable from the charger 30.** A management database is formed on the hard disk. The management database is generated by accumulating data obtained from the monitor 1 via the communication interface and the charger 30, with separately-inputted various data (data on the test subject which cannot be inputted with the monitor 1, data on other test subjects, and the like). **The CPU analyzes and evaluates the data accumulated in the management database, and performs processings for displaying the results of analysis and evaluation and the data accumulated in the management database on the display in various formats.** Further, a management database server may be constructed through the Internet or the like so that a third person can also manage many data. In this case, the management of data may be performed via the information management apparatus or may be directly performed with the monitor. Further, data transmission and data reception are possible. Sakai at 4:28-48 **As shown in FIG. 2B, the monitor 1 is fixed around the test subject's wrist or ankle with the attachment portion 5 when the monitor apparatus is used such that the detection window 3 e on the back surface of the main body 3 is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from a finger tip to a root of all limbs. Further, the attachment portion 5 may be a supporter member in place of the belt.** Sakai at 4:63-5:03

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	FIG. 3 is a block diagram showing the construction of the monitor 1. As shown in FIG. 3, the monitor 1 has an information detection unit 10 which emits light via the detection window 3 e and receives reflected light to thereby detect biological information; an information processor 20 which processes the biological information detected by the information detection unit 10; and a battery 15 chargeable via the cable connected to the connector 3 f, which supplies power to the respective elements of the apparatus. Sakai at 5:04-12 **The information detection unit 10 has an optical pulse wave and body motion sensor** 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm), and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b; a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20; a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. Sakai at 5:13-24 **Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered.** Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:25-30 **At this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin also changes in an undulating manner.** Further, as the amount of received light (signal level of the detection signal) reflected with the capillary artery and detected by the PD 11 c also changes, information on pulse wave can be obtained from the detection signal.

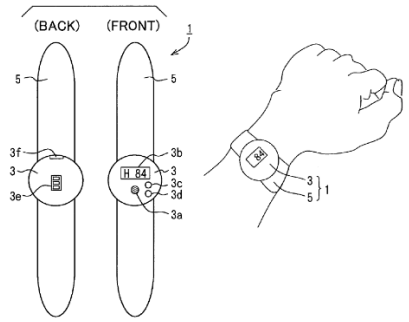
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	Sakai at 5:31-38 **Note that as the blood stream is also influenced by body motion, the detection signal from the PD 11 c includes a body motion component synchronized with body motion as well as a pulse component synchronized with pulse (see FIG. 8). Further, all the emitted light does not arrive at the capillary artery, and light reflected from the body surface (surface reflected light) is also received with the PD 11 c.** The surface reflected light also includes a body motion component. Sakai at 5:39-46 **Note that infrared light has a low light absorption characteristic in comparison with green light.** As shown in FIGS. 9A and 9B, in the detection signal obtained by the PD 11 c upon light emission from the green LED 11 a, the pulse component and body motion component are detected at extractable signal levels (see FIG. 9A). On the other hand, in the detection signal obtained by the PD 11 c upon light emission from the infrared LED 11 b, the pulse component is at a very low level in comparison with the body motion component and only the body motion component is detected at an extractable signal level (see FIG. 9B). Note that FIGS. 9A and 9B are graphs showing frequency spectra of the detection signal. Sakai at 5:47-58 **That is, upon light emission from the green LED 11 a, the pulse wave and body motion sensor 11 operates as a pulse wave sensor which outputs a pulse wave detection signal including pulse component and body motion component, while upon light emission from the infrared LED 11 b, operates as a body motion sensor which outputs a body motion detection signal including body motion component.** Sakai at 5:59-65 When **the driver 12 is started in accordance with a command from the information processor 20, the driver 12 drives the LEDs 11 a and 11 b alternately at different timings, by preset sampling interval (50 msec in the present embodiment). Further, the A/D converter 14 operates in**

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	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.** **The information processor 20 has an operation detector 21 which detects an operation made with an operation button 3 a; a communication controller 22 which detects cable connection with and disconnection from the connector 3 f and controls communication with an external device via the cable connected to the connector 3 f; a voltage detector 23 which detects a voltage of the battery 15; a microcomputer 24 which performs processing for generating barometers from biological information detected by the information detection unit 10, monitoring of battery voltage via the voltage detector 23,** communication processing for communication with the external device via the communication controller 22; a storage unit 25 which holds the biological information detected by the information detection unit 10 and various information generated by the microcomputer 24 based on the biological information; and a display controller 26 which displays characters and figures on the display panel 3 b and turns on and off the LEDs 3 c and 3 d in accordance with instructions from the microcomputer 24. **Note that at least a buffer area is ensured in the storage unit 25 for storing the biological information supplied from the information detection unit 10**. The buffer area has a capacity to store data for a preset period (in the present embodiment, past 25 seconds or longer, i.e., 500 data or more by detection signal). **The microcomputer 24 is a well-known computer mainly having a CPU, a ROM, and a RAM.** The microcomputer 24 performs timekeeping processing for obtaining time, data update processing for updating data in the buffer area ensured in the storage unit 25 when biological information is supplied from the information detection unit 10, **and display processing for causing the display controller 26 to perform display on the display panel 3 b, in addition to main processing to be described later.** Next, the main processing performed by the microcomputer 24 will be described in accordance with the flowchart of FIG. 4. When the power is turned on and the present processing is started, first, it is determined based on an input from the operation detector 21 whether or not a mode setting operation has been made via the operation button 3 a (Step S100); then it is determined **whether or not it is generation timing to analyze biological information detected by the information detection unit 10 and generate**

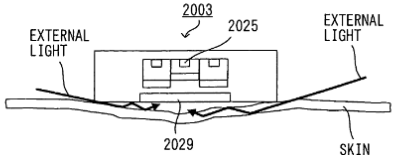
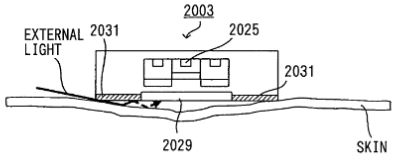
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	barometers (Step S120); then it is determined based on an input from the communication controller 22 whether or not the cable is connected to the connector 3 f (Step S160); and it is determined based on an input from the voltage detector 23 whether or not the charging amount of the battery 15 is insufficient (Step S180). When the determinations are all negative (NO), these determinations are repeatedly performed as a stand-by status. Then, when it is determined at Step S100 that the mode setting operation has been performed, various settings are performed to operate the monitor 1 in the mode set by the setting operation (Step S110), and the process returns to Step S100. **Note that in the mode setting operation, an action mode to designate a period for performing biological information monitoring (gathering and analysis), a generation mode to designate barometers generated from the biological information, and a display mode to designate contents to be displayed on the display panel 3 b are set**. Sakai at 5:66-7:03 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. 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;	Sakai discloses or renders obvious 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. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers

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	for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone. Sakai at [Abstract] **The present invention relates to a portable biological information monitor apparatus used in a status where it is attached to a test subject's body,** and to an information management apparatus to process and display information generated by the monitor apparatus. Sakai at 1:15-18 **FIGS. 2A and 2B are explanatory views showing the arrangement of a portable biological information monitor apparatus and the monitor apparatus in use;** Sakai at 2:56-58 FIG. 2A FIG. 2B  Sakai at Fig. 2A & 2B

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	As shown in FIG. 2B, the monitor 1 is fixed around the test subject's wrist or ankle with the attachment portion 5 when the monitor apparatus is used such that the detection window 3 e on the back surface of the main body 3 is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from a finger tip to a root of all limbs. Further, the attachment portion 5 may be a supporter member in place of the belt. Sakai at 4:63-5:03 An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3. **Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1.** Sakai at 4:54-4:62 **When the biological status detection apparatus 1001 is used, as shown in FIG. 12B, the apparatus is fixed around a test subject's wrist or ankle with the attachment portion 1005** such that the back surface of the main body 1003 where the light transmitting plate 1003 b is formed is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from finger tip to root of all limbs. Further, the attachment portion 1005 may be a supporter member in place of the belt. Sakai at 16:50-58 **The direct current component is based on the changes in light amount accompanied by blood stream changes due to as follows: expansion and contraction of blood vessel (hereinbelow, referred to as “noise A”); the change of amount of light scattered on the skin surface accompanied by shift of the pulse wave sensor 2003 (hereinbelow, referred to as “noise B”);** and the change of amount of

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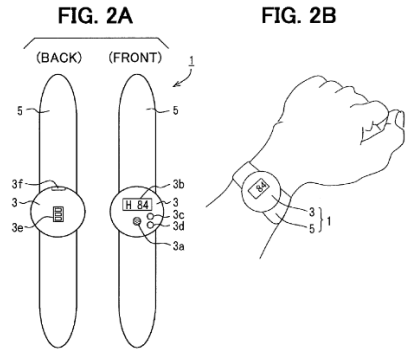
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	light incident from the outside of the pulse wave sensor 2003 (e.g., sunlight) etc. The direct current component is cut with the detector 2011 using a method to be described later. Sakai at 29:49-58 **The light from the outside of the pulse wave sensor 2003 such as sunlight (hereinbelow, also referred to as “external light”) is generally propagated on the skin surface and the inside of the skin and inputted into the PD 2025**, as shown in FIG. 36A. As shown in **FIG. 36B, a part of the external light propagated on the skin surface is absorbed in the surface of the light shielding plate 2031 coated with light absorbing color.** Sakai at 30:11-18 FIG. 36A  FIG. 36B  Sakai at Fig. 36A & 36B Hereinbelow, the details of the analysis processing and the barometer generation processing according to the present embodiment will be described. FIG. 16 is a flowchart showing the contents of the analysis processing. Note that when the information detection unit 1010 has been started, the analysis processing

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	is started by a preset time interval (in the present embodiment, 1 second). **Further, upon starting of the information detection unit 1010, the driver 1012 is initialized to a setting to cause light emission from the LEDs 1011 a and 1011 b at a maximum intensity.** Sakai at 19:32-42 **In the body motion determination processing, as shown in FIG. 19, first, a peak frequency component G1 having a maximum intensity and a peak frequency component G2 having a next maximum intensity are extracted within a frequency range including the fundamental wave of the pulse wave (in the present embodiment, 0.5 to 3.3 Hz),** from the result of analysis of the pulse wave detection signal (Step S1300). Further, a frequency component IR1 having the same frequency as that of the peak frequency component G1 is extracted from the result of analysis of the body motion detection signal (Step S1310). Sakai at 20:49-59 26. **A portable biological information monitor apparatus which is adapted to be attached to a body of a test subject** when it is used, comprising: **biological information detection means for repeatedly detecting biological information reflecting at least one of pulse, body motion, and autonomic nervous function of the test subject;** **barometer generation means that has a plurality of generation modes corresponding to the test subject's actions and operates in any of the generation modes, wherein the generation modes include at least a first generation mode to generate a sleep evaluation barometer as a barometer for evaluation of a test subject's status in sleep based on the biological information detected by the biological information detection means and a second generation mode to generate a wake evaluation barometer as a barometer for evaluation of a test subject's status in wake based on the biological information detected by the biological information detection means**; and storage means for storing the barometer generated by the barometer generation means, wherein the biological information detection means includes a biological status detection apparatus including: a pulse wave sensor including a light emission unit to generate light being emitted to the test subject and a photoreception unit to receive reflected light from the test subject, wherein the pulse wave sensor

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	outputs a pulse wave detection signal and a body motion detection signal, wherein the pulse wave detection signal includes a pulse component synchronized with pulse and a body motion component synchronized with body motion while the body motion detection signal includes the body motion component emphasized in comparison with the pulse wave detection signal; analysis means for frequency-analyzing the pulse wave detection signal and the body motion detection signal outputted from the pulse wave sensor; **body motion determination means for determining occurrence and nonoccurrence of body motion based on at least a detection signal from the pulse wave sensor or the result of analysis by the analysis means;** **steady state determination means for, when the body motion determination means determines that body motion occurs, determining a steady state of the body motion based on a result of analysis by the analysis means; and** pulse component extraction means for extracting the pulse component from the pulse wave detection signal, based on the result of analysis by the analysis means, a result of determination by the body motion determination means, and a result of determination by the steady state determination means, wherein the body motion determination means includes third body motion determination means for, **when intensity of the highest peak frequency component in the pulse wave detection signal, within the frequency area including the fundamental wave of the pulse component, is equal to or less than that of a peak frequency component in the body motion detection signal including the same frequency as that of the highest peak frequency component, determining occurrence of body motion.** Sakai 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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1[j]. the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off,	Sakai discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] **The present invention relates to a portable biological information monitor apparatus used in a status where it is attached to a test subject's body,** and to an information management apparatus to process and display information generated by the monitor apparatus. Sakai at 1:15-18 **FIGS. 2A and 2B are explanatory views showing the arrangement of a portable biological information monitor apparatus and the monitor apparatus in use;** Sakai at 2:56-58

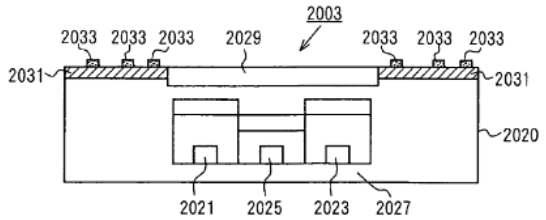
’455 Patent	Sakai
	 Sakai at Fig. 2A & 2B **As shown in FIG. 2B, the monitor 1 is fixed around the test subject's wrist or ankle with the attachment portion 5 when the monitor apparatus is used such that the detection window 3 e on the back surface of the main body 3 is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from a finger tip to a root of all limbs. Further, the attachment portion 5 may be a supporter member in place of the belt.** Sakai at 4:63-5:03 An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3. **Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1.** Sakai at 4:54-4:62

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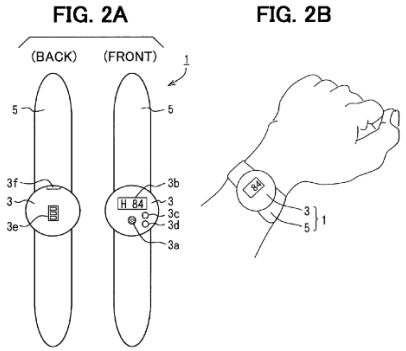
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	Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:25-30 **When the biological status detection apparatus 1001 is used, as shown in FIG. 12B, the apparatus is fixed around a test subject's wrist or ankle with the attachment portion 1005 such that the back surface of the main body 1003 where the light transmitting plate 1003 b is formed is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from finger tip to root of all limbs. Further, the attachment portion 1005 may be a supporter member in place of the belt.** Sakai at 16:50-58 **Further, in the light transmitting plate 1003 b, a portion opposite to the green LED 1011 a and the photo diode 1011 c (hereinbelow, referred to as a "first portion"), i.e., a portion as a path of light emitted from the green LED 1011 a and its reflected light, is projected further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm). By contrast, a portion opposite to the infrared LED 1011 b (hereinbelow, referred to as a "second portion"), i.e., a portion as a path of light emitted from the infrared LED 1011 b, has a shape dented further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm).** Suppose the degree of adhesion to the test subject's skin when the apparatus 1001 is attached to the test subject, as shown in FIG. 14. Here, the degree of adhesion to the test subject's skin is high in the portion as a path of light emitted from the green LED 1011 a (green light) and its reflected light. **By contrast, the degree of adhesion to the test subject's skin is low (or the portion is not in close contact with the skin) in the portion as a path of light emitted from the infrared LED 1011 b (infrared light).** Sakai at 17:25-51

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	Further, the green light emitted via the first portion of the light transmitting plate 1003 b easily arrives at the capillary artery running through the test subject's body and reflected light from the capillary artery is easily received. Accordingly, the sensitivity of pulse component detection in the pulse wave detection signal is improved. **On the other hand, the infrared light emitted via the second portion of the light transmitting plate 3 b is easily reflected on the skin surface and its irradiation position is easily moved in accordance with body motion.** Accordingly, the sensitivity of pulse component detection in the body motion detection signal is degraded but the sensitivity of body motion detection is improved. Sakai at 18:12-23 **Note that in the light emitted from the infrared LED 2021 and the green LED 2023 to the human body, a part of the light arrives at small artery and arteriole (capillary artery) running through the human body and is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered.** At this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin is also changed in an undulating manner. That is, the amount of light reflected from the capillary artery and detected by the PD 2025 changes in correspondence with the blood pulsation. Sakai at 29:19-30

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	FIG. 32A  Sakai at Fig. 32 A The information processor 20 has an operation detector 21 which detects an operation made with an operation button 3 a; a communication controller 22 which detects cable connection with and disconnection from the connector 3 f and controls communication with an external device via the cable connected to the connector 3 f; a voltage detector 23 which detects a voltage of the battery 15; a microcomputer 24 which performs processing for generating barometers from biological information detected by the information detection unit 10, monitoring of battery voltage via the voltage detector 23, communication processing for communication with the external device via the communication controller 22; a storage unit 25 which holds the biological information detected by the information detection unit 10 and various information generated by the microcomputer 24 based on the biological information; **and a display controller 26 which displays characters and figures on the display panel 3 b and turns on and off the LEDs 3 c and 3 d in accordance with instructions from the microcomputer 24.** Sakai at 06:10-28 In the remote command processing, for example, processing for transferring a part or all the information stored in the storage unit 25 to the information management unit 50, processing for updating programs executed at Step S140 (continuous monitor processing) and Step S150 (limited monitor processing), processing for changing the respective parameters and settings for generation timing, and the like can be performed. Further, it is determined via the cable C whether or not charging has been performed. **When it is determined that charging has been performed, the charging check LED 3 d is turned off.**

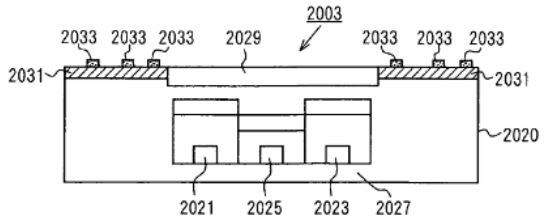
’455 Patent	Sakai
	Sakai at 08:14-24 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, 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 semiconductor sources is on; and	Sakai discloses or renders obvious the detection system further configured to: generate a second signal responsive to light received while at least one of the semiconductor sources is on; and. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] **The present invention relates to a portable biological information monitor apparatus used in a status where it is attached to a test subject's body,** and to an information management apparatus to process and display information generated by the monitor apparatus. Sakai at 1:15-18

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	FIGS. 2A and 2B are explanatory views showing the arrangement of a portable biological information monitor apparatus and the monitor apparatus in use; Sakai at 2:56-58  Sakai at Fig. 2A & 2B **As shown in FIG. 2B, the monitor 1 is fixed around the test subject's wrist or ankle with the attachment portion 5 when the monitor apparatus is used such that the detection window 3 e on the back surface of the main body 3 is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from a finger tip to a root of all limbs. Further, the attachment portion 5 may be a supporter member in place of the belt.** Sakai at 4:63-5:03 An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3. **Further,**

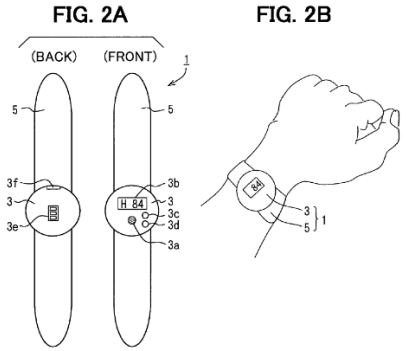
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	the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1. Sakai at 4:54-4:62 **Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery,** and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:25-30 **When the biological status detection apparatus 1001 is used, as shown in FIG. 12B, the apparatus is fixed around a test subject's wrist or ankle with the attachment portion 1005 such that the back surface of the main body 1003 where the light transmitting plate 1003 b is formed is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from finger tip to root of all limbs. Further, the attachment portion 1005 may be a supporter member in place of the belt.** Sakai at 16:50-58 **Further, in the light transmitting plate 1003 b, a portion opposite to the green LED 1011 a and the photo diode 1011 c (hereinbelow, referred to as a “first portion”), i.e., a portion as a path of light emitted from the green LED 1011 a and its reflected light, is projected further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm). By contrast, a portion opposite to the infrared LED 1011 b (hereinbelow, referred to as a “second portion”), i.e., a portion as a path of light emitted from the infrared LED 1011 b, has a shape dented further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm).** Suppose the degree of adhesion to the test subject's skin when the apparatus 1001 is attached to the test subject, as shown in FIG. 14. Here, the degree of adhesion to the test subject's skin is high in the portion as a path of light emitted from the green LED 1011 a (green light)

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	and its reflected light. **By contrast, the degree of adhesion to the test subject's skin is low (or the portion is not in close contact with the skin) in the portion as a path of light emitted from the infrared LED 1011 b (infrared light).** Sakai at 17:25-51 **Further, the green light emitted via the first portion of the light transmitting plate 1003 b easily arrives at the capillary artery running through the test subject's body and reflected light from the capillary artery is easily received**. Accordingly, the sensitivity of pulse component detection in the pulse wave detection signal is improved. **On the other hand, the infrared light emitted via the second portion of the light transmitting plate 3 b is easily reflected on the skin surface and its irradiation position is easily moved in accordance with body motion.** Accordingly, the sensitivity of pulse component detection in the body motion detection signal is degraded but the sensitivity of body motion detection is improved. Sakai at 18:12-23 **Note that in the light emitted from the infrared LED 2021 and the green LED 2023 to the human body, a part of the light arrives at small artery and arteriole (capillary artery) running through the human body and is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered.** At this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin is also changed in an undulating manner. That is, the amount of light reflected from the capillary artery and detected by the PD 2025 changes in correspondence with the blood pulsation. Sakai at 29:19-30

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	FIG. 32A  Sakai at Fig. 32 A The information processor 20 has an operation detector 21 which detects an operation made with an operation button 3 a; a communication controller 22 which detects cable connection with and disconnection from the connector 3 f and controls communication with an external device via the cable connected to the connector 3 f; a voltage detector 23 which detects a voltage of the battery 15; a microcomputer 24 which performs processing for generating barometers from biological information detected by the information detection unit 10, monitoring of battery voltage via the voltage detector 23, communication processing for communication with the external device via the communication controller 22; a storage unit 25 which holds the biological information detected by the information detection unit 10 and various information generated by the microcomputer 24 based on the biological information; **and a display controller 26 which displays characters and figures on the display panel 3 b and turns on and off the LEDs 3 c and 3 d in accordance with instructions from the microcomputer 24.** Sakai at 06:10-28 In the remote command processing, for example, processing for transferring a part or all the information stored in the storage unit 25 to the information management unit 50, processing for updating programs executed at Step S140 (continuous monitor processing) and Step S150 (limited monitor processing), processing for changing the respective parameters and settings for generation timing, and the like can be performed. Further, it is determined via the cable C whether or not charging has been performed. **When it is determined that charging has been performed, the charging check LED 3 d is turned off.**

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	Sakai at 08:14-24 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, 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	Sakai discloses or renders obvious the detection system further configured to: increase the signal-to-noise ratio by comparing the first signal and the second signal. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] **The present invention relates to a portable biological information monitor apparatus used in a status where it is attached to a test subject's body,** and to an information management apparatus to process and display information generated by the monitor apparatus. Sakai at 1:15-18

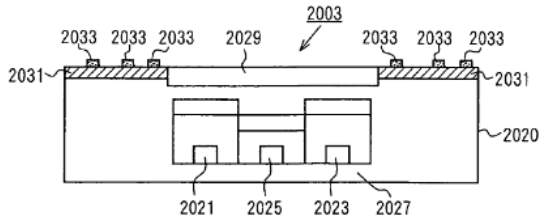
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	FIGS. 2A and 2B are explanatory views showing the arrangement of a portable biological information monitor apparatus and the monitor apparatus in use; Sakai at 2:56-58  Sakai at Fig. 2A & 2B **As shown in FIG. 2B, the monitor 1 is fixed around the test subject's wrist or ankle with the attachment portion 5 when the monitor apparatus is used such that the detection window 3 e on the back surface of the main body 3 is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from a finger tip to a root of all limbs. Further, the attachment portion 5 may be a supporter member in place of the belt.** Sakai at 4:63-5:03 An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3. **Further,**

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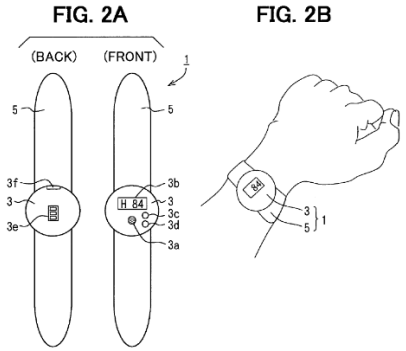
’455 Patent	Sakai
	the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1. Sakai at 4:54-4:62 **Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery,** and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:25-30 **When the biological status detection apparatus 1001 is used, as shown in FIG. 12B, the apparatus is fixed around a test subject's wrist or ankle with the attachment portion 1005 such that the back surface of the main body 1003 where the light transmitting plate 1003 b is formed is in contact with the test subject's skin. The attachment position is not limited to the wrist or ankle but may be set in any position from finger tip to root of all limbs. Further, the attachment portion 1005 may be a supporter member in place of the belt.** Sakai at 16:50-58 **Further, in the light transmitting plate 1003 b, a portion opposite to the green LED 1011 a and the photo diode 1011 c (hereinbelow, referred to as a “first portion”), i.e., a portion as a path of light emitted from the green LED 1011 a and its reflected light, is projected further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm). By contrast, a portion opposite to the infrared LED 1011 b (hereinbelow, referred to as a “second portion”), i.e., a portion as a path of light emitted from the infrared LED 1011 b, has a shape dented further than the peripheral portion 1003 d of the light transmitting plate 1003 b (in the present embodiment, by 0.2 mm).** Suppose the degree of adhesion to the test subject's skin when the apparatus 1001 is attached to the test subject, as shown in FIG. 14. Here, the degree of adhesion to the test subject's skin is high in the portion as a path of light emitted from the green LED 1011 a (green light)

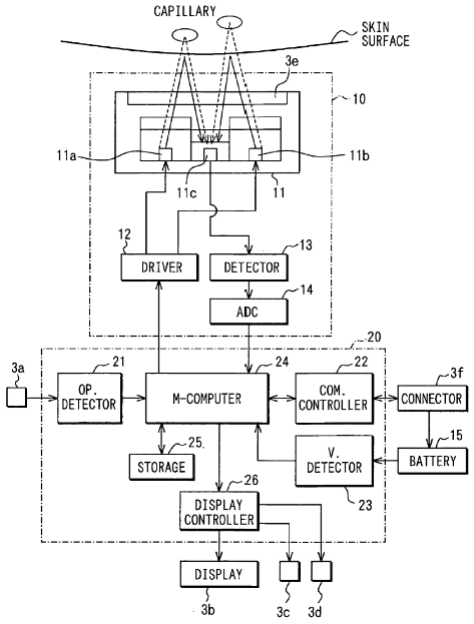
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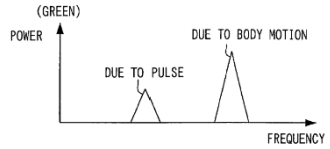
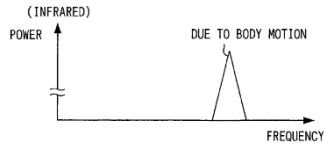
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	and its reflected light. **By contrast, the degree of adhesion to the test subject's skin is low (or the portion is not in close contact with the skin) in the portion as a path of light emitted from the infrared LED 1011 b (infrared light).** Sakai at 17:25-51 **Further, the green light emitted via the first portion of the light transmitting plate 1003 b easily arrives at the capillary artery running through the test subject's body and reflected light from the capillary artery is easily received**. Accordingly, the sensitivity of pulse component detection in the pulse wave detection signal is improved. **On the other hand, the infrared light emitted via the second portion of the light transmitting plate 3 b is easily reflected on the skin surface and its irradiation position is easily moved in accordance with body motion.** Accordingly, the sensitivity of pulse component detection in the body motion detection signal is degraded but the sensitivity of body motion detection is improved. Sakai at 18:12-23 **Note that in the light emitted from the infrared LED 2021 and the green LED 2023 to the human body, a part of the light arrives at small artery and arteriole (capillary artery) running through the human body and is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered.** At this time, as the amount of hemoglobin in the capillary artery changes in an undulating manner due to blood pulsation, the light absorbed into the hemoglobin is also changed in an undulating manner. That is, the amount of light reflected from the capillary artery and detected by the PD 2025 changes in correspondence with the blood pulsation. Sakai at 29:19-30

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	FIG. 32A  Sakai at Fig. 32 A The information processor 20 has an operation detector 21 which detects an operation made with an operation button 3 a; a communication controller 22 which detects cable connection with and disconnection from the connector 3 f and controls communication with an external device via the cable connected to the connector 3 f; a voltage detector 23 which detects a voltage of the battery 15; a microcomputer 24 which performs processing for generating barometers from biological information detected by the information detection unit 10, monitoring of battery voltage via the voltage detector 23, communication processing for communication with the external device via the communication controller 22; a storage unit 25 which holds the biological information detected by the information detection unit 10 and various information generated by the microcomputer 24 based on the biological information; **and a display controller 26 which displays characters and figures on the display panel 3 b and turns on and off the LEDs 3 c and 3 d in accordance with instructions from the microcomputer 24.** Sakai at 06:10-28 In the remote command processing, for example, processing for transferring a part or all the information stored in the storage unit 25 to the information management unit 50, processing for updating programs executed at Step S140 (continuous monitor processing) and Step S150 (limited monitor processing), processing for changing the respective parameters and settings for generation timing, and the like can be performed. Further, it is determined via the cable C whether or not charging has been performed. **When it is determined that charging has been performed, the charging check LED 3 d is turned off.**

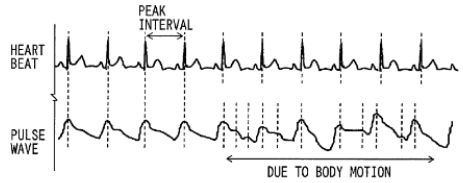
’455 Patent	Sakai
	Sakai at 08:14-24 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Sakai discloses or renders obvious wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract] An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. **A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body**

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	3. Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1. Sakai at 4:54-4:62  Sakai at Fig. 2A & 2B **FIG. 3 is a block diagram showing the construction of the monitor 1. As shown in FIG. 3, the monitor 1 has an information detection unit 10 which emits light via the detection window 3 e and receives reflected light to thereby detect biological information**; an information processor 20 which processes the biological information detected by the information detection unit 10; and a battery 15 chargeable via the cable connected to the connector 3 f, which supplies power to the respective elements of the apparatus. **The information detection unit 10 has an optical pulse wave and body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm),** and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b**; a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20;** a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data.

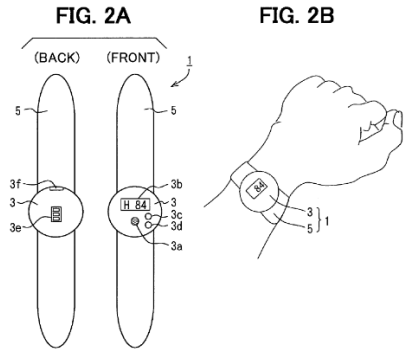
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	Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:04-30 FIG. 3  Sakai at Fig. 3 **That is, upon light emission from the green LED 11 a, the pulse wave and body motion sensor 11 operates as a pulse wave sensor which outputs a pulse wave detection signal including pulse**

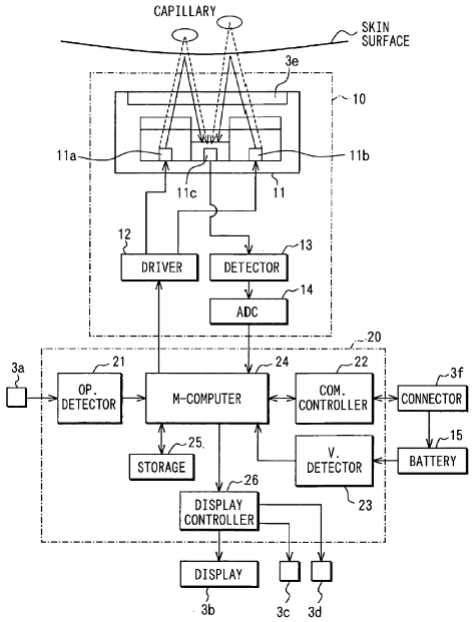
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	component and body motion component, while upon light emission from the infrared LED 11 b, operates as a body motion sensor which outputs a body motion detection signal including body motion component. **When the driver 12 is started in accordance with a command from the information processor 20, the driver 12 drives the LEDs 11 a and 11 b alternately at different timings,** by preset sampling interval (50 msec in the present embodiment). **Further, the 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 5:59-6:09 FIG. 9A  FIG. 9B  Sakai at Fig. 9A & 9B

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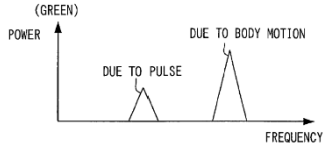
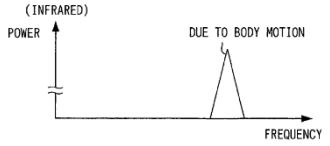
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	Note that infrared light has a low light absorption characteristic in comparison with green light. As shown in FIGS. 9A and 9B, in the detection signal obtained by the PD 11 c upon light emission from the green LED 11 a, the pulse component and body motion component are detected at extractable signal levels (see FIG. 9A). On the other hand, in the detection signal obtained by the PD 11 c upon light emission from the infrared LED 11 b, the pulse component is at a very low level in comparison with the body motion component and only the body motion component is detected at an extractable signal level (see FIG. 9B). Note that FIGS. 9A and 9B are graphs showing frequency spectra of the detection signal. Sakai at 05:47-58 FIG. 8  Sakai at Fig. 8 **Note that as the blood stream is also influenced by body motion, the detection signal from the PD 11 c includes a body motion component synchronized with body motion as well as a pulse component synchronized with pulse (see FIG. 8).** Further, all the emitted light does not arrive at the capillary artery, and light reflected from the body surface (surface reflected light) is also received with the PD 11 c. The surface reflected light also includes a body motion component. Sakai at 05:39-46 **The pulse wave sensor 2003 is fixed to human body's arm or the like when it is used. As shown in FIG. 32A, the pulse wave sensor is an optical reflective type sensor having the infrared LED 2021 to emit infrared light having a wavelength of about 940 nm**, the green LED 2023 to emit green light

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	having a wavelength of about 520 nm, and the PD 2025 to receive light and output a signal corresponding to the amount of received light (photoreception signal). Sakai at 28:18-26 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 1 above. Sakai discloses or renders obvious the system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. **In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone. Sakai at [Abstract]

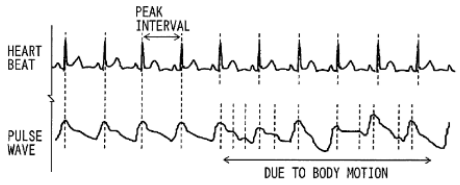
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	 Sakai at Fig. 2A & 2B An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. **A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body 3.** Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1. Sakai at 4:54-4:62

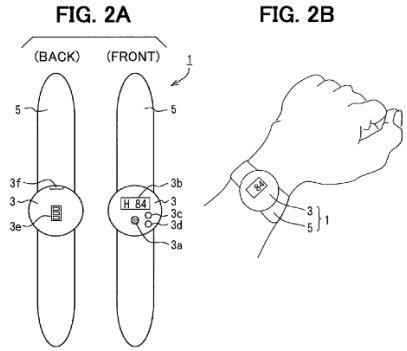
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	FIG. 3  Sakai at Fig. 3 **FIG. 3 is a block diagram showing the construction of the monitor 1. As shown in FIG. 3, the monitor 1 has an information detection unit 10 which emits light via the detection window 3 e and receives reflected light to thereby detect biological information**; an information processor 20 which processes the biological information detected by the information detection unit 10; and a battery 15 chargeable via the cable connected to the connector 3 f, which supplies power to the respective elements of the apparatus. **The information detection unit 10 has an optical pulse wave and body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about**

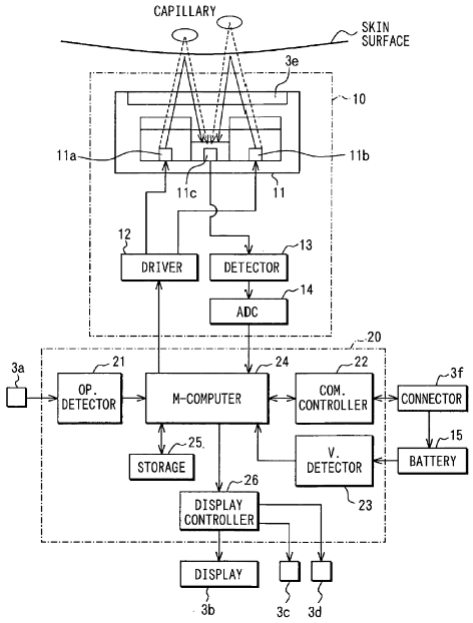
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	950 nm), and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b**; a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20;** a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. **Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body,** a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery, and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:04-30 **That is, upon light emission from the green LED 11 a, the pulse wave and body motion sensor 11 operates as a pulse wave sensor which outputs a pulse wave detection signal including pulse component and body motion component, while upon light emission from the infrared LED 11 b,** operates as a body motion sensor which outputs a body motion detection signal including body motion component. **When the driver 12 is started in accordance with a command from the information processor 20, the driver 12 drives the LEDs 11 a and 11 b alternately at different timings,** by preset sampling interval (50 msec in the present embodiment). **Further, the 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 5:59-6:09

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	FIG. 9A  FIG. 9B  Sakai at Fig. 9A & 9B **Note that infrared light has a low light absorption characteristic in comparison with green light. As shown in FIGS. 9A and 9B, in the detection signal obtained by the PD 11 c upon light emission from the green LED 11 a,** the pulse component and body motion component are detected at extractable signal levels (see FIG. 9A). On the other hand, in the detection signal obtained by the PD 11 c upon light emission from the infrared LED 11 b, the pulse component is at a very low level in comparison with the body motion component and only the body motion component is detected at an extractable signal level (see FIG. 9B). Note that FIGS. 9A and 9B are graphs showing frequency spectra of the detection signal. Sakai at 05:47-58

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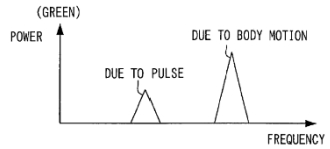
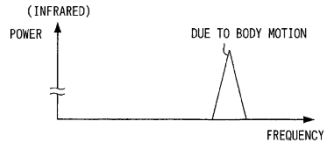
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	FIG. 8  Sakai at Fig. 8 **Note that as the blood stream is also influenced by body motion, the detection signal from the PD 11 c includes a body motion component synchronized with body motion as well as a pulse component synchronized with pulse (see FIG. 8).** Further, all the emitted light does not arrive at the capillary artery, and light reflected from the body surface (surface reflected light) is also received with the PD 11 c. The surface reflected light also includes a body motion component. Sakai at 05:39-46 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of	See claim 2 above. Sakai discloses or renders obvious the system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.

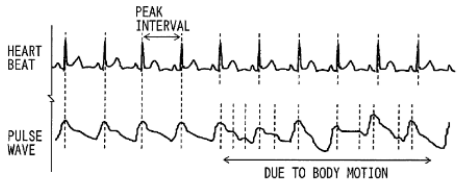
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oxy-hemoglobin and deoxy-hemoglobin.	**In a portable biological information monitor apparatus, a pulse wave detection signal obtained by light emission from a green LED and a body motion detection signal obtained by light emission from an infrared LED are detected as biological information.** This biological information is analyzed to compute various barometers. In a wake normal mode of a set generation mode, body motion and pulse are calculated as wake evaluation barometers for evaluation of a test subject's status in wake. In a wake steady state motion mode, body motion, pulse, and pitch are calculated as motion evaluation barometers for evaluation of the test subject's status in steady state motion. In a sleep mode, body motion, pulse, and autonomic nervous function are calculated as sleep evaluation barometers for evaluation of the test subject's status in sleep. **Necessary barometers are thereby generated regardless of the test subject's action using the portable monitor apparatus alone.** Sakai at [Abstract]  Sakai at Fig. 2A & 2B An operation button 3 a, a display panel 3 b, a light emission diode (LED) 3 c for operation check, and an LED 3 d for charging check are provided on the front surface of the main body 3. **A detection window 3 e for transmitting light used in biological information detection and a connector 3 f for connection with the cable C extended from the charger 30 are provided on the back surface of the main body**

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	3. Further, the main body 3 is water-proof coated such that the test subject can have a bath while wearing the monitor 1. Sakai at 4:54-4:62 FIG. 3  Sakai at Fig. 3 **FIG. 3 is a block diagram showing the construction of the monitor 1. As shown in FIG. 3, the monitor 1 has an information detection unit 10 which emits light via the detection window 3 e and receives reflected light to thereby detect biological information**; an information processor 20 which

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	processes the biological information detected by the information detection unit 10; and a battery 15 chargeable via the cable connected to the connector 3 f, which supplies power to the respective elements of the apparatus. **The information detection unit 10 has an optical pulse wave and body motion sensor 11 having a green LED 11 a to emit green light (in the present embodiment, the wavelength is about 520 nm), an infrared LED 11 b to emit infrared light (in the present embodiment, the wavelength is about 950 nm),** and a photo diode (PD) 11 c to receive reflected light from the LEDs 11 a and 11 b**; a driver 12 which drives the LEDs 11 a and 11 b in accordance with instructions from the information processor 20;** a detector 13 which drives the PD 11 c and generates a detection signal in correspondence with the intensity of reflected light; and an A/D converter 14 which converts the detection signal from the detector 13 into digital data. **Note that when light emitted from the LEDs 11 a and 11 b arrives at capillary artery running through the test subject's body, a part of the light is absorbed in hemoglobin in blood flowing through the capillary artery,** and the rest of the light is reflected with the capillary artery and scattered. Then a part of the scattered light enters the PD 11 c as reflected light. Sakai at 5:04-30 **That is, upon light emission from the green LED 11 a, the pulse wave and body motion sensor 11 operates as a pulse wave sensor which outputs a pulse wave detection signal including pulse component and body motion component, while upon light emission from the infrared LED 11 b,** operates as a body motion sensor which outputs a body motion detection signal including body motion component. **When the driver 12 is started in accordance with a command from the information processor 20, the driver 12 drives the LEDs 11 a and 11 b alternately at different timings,** by preset sampling interval (50 msec in the present embodiment). **Further, the 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 5:59-6:09

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	FIG. 9A  FIG. 9B  Sakai at Fig. 9A & 9B **Note that infrared light has a low light absorption characteristic in comparison with green light. As shown in FIGS. 9A and 9B, in the detection signal obtained by the PD 11 c upon light emission from the green LED 11 a,** the pulse component and body motion component are detected at extractable signal levels (see FIG. 9A). On the other hand, in the detection signal obtained by the PD 11 c upon light emission from the infrared LED 11 b, the pulse component is at a very low level in comparison with the body motion component and only the body motion component is detected at an extractable signal level (see FIG. 9B). Note that FIGS. 9A and 9B are graphs showing frequency spectra of the detection signal. Sakai at 05:47-58

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	FIG. 8  Sakai at Fig. 8 **Note that as the blood stream is also influenced by body motion, the detection signal from the PD 11 c includes a body motion component synchronized with body motion as well as a pulse component synchronized with pulse (see FIG. 8).** Further, all the emitted light does not arrive at the capillary artery, and light reflected from the body surface (surface reflected light) is also received with the PD 11 c. The surface reflected light also includes a body motion component. Sakai at 05:39-46 **The pulse wave sensor 2003 is fixed to human body's arm or the like when it is used. As shown in FIG. 32A, the pulse wave sensor is an optical reflective type sensor having the infrared LED 2021 to emit infrared light having a wavelength of about 940 nm**, the green LED 2023 to emit green light having a wavelength of about 520 nm, and the PD 2025 to receive light and output a signal corresponding to the amount of received light (photoreception signal). Sakai at 28:18-26 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 Sakai, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Sakai discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. The wearable device adapted to be placed on a wrist or an ear of a user,	Sakai discloses or renders obvious the wearable device adapted to be placed on a wrist or an ear of a user. See above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. including a light source comprising a driver and a plurality of semiconductor	Sakai discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths.

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sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	See above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. the 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;	Sakai discloses or renders obvious the 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. See above at claim 1[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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. the wearable device further comprising 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	Sakai discloses or renders obvious the wearable device further comprising 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. See above at claim 1[d].

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having a signal-to-noise ratio, wherein the detection system is configured to be synchronized to the light 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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. wherein the detection system is configured to be synchronized to the light source;	Sakai discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. 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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. 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 spatially separated detectors;	Sakai 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 spatially separated detectors. See above at claim 1[f].

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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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Sakai discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; See above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Sakai discloses or renders obvious the output signal is indicative of one or more of the physiological parameters.

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	See above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[i]. 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; and	Sakai discloses or renders obvious 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. See above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Sakai 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 above at claim 1[j].

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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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Sakai discloses or renders obvious the detection system further configured to: generate a second signal responsive to light received while at least one of the light emitting diodes is on. See above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Sakai discloses or renders obvious the detection system further configured to: increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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8[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Sakai discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. See above 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 8 above. Sakai discloses or renders obvious the system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 10	

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10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	See claim 9 above. Sakai discloses or renders obvious the system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. See above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Sakai discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[a]. The wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Sakai discloses or renders obvious the wearable device adapted to be placed on teeth, a wrist, or an ear of a user. See above at claim 1[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[b].including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Sakai discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[c]. the wearable device comprising one or more lenses configured to receive at least a portion of the output optical light and to	Sakai discloses or renders obvious the 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. See above at claim 1[c]

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deliver a lens output light to tissue;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[d]. the wearable device further comprising 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,	Sakai discloses or renders obvious the wearable device further comprising 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. 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[e].wherein the detection system is configured to be synchronized to the light source;	Sakai discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. 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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[f]. 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 spatially separated detectors;	Sakai discloses 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 spatially separated detectors. See above at claim 1[f] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal; wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link	Sakai discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. See above at claim 1[g] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Sakai discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[i]. 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; and	Sakai discloses or renders obvious 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. See above at claim 1[i] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[j]. the detection system further configured to: generate a first signal responsive to light received	Sakai 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 above at claim 1[j]

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while the light emitting diodes are off,	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Sakai discloses or renders obvious the detection system further configured to: generate a second signal responsive to light received while at least one of the semiconductor sources is on;and See above at claim 1[k] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal;	Sakai discloses or renders obvious the detection system further configured to: increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l] One of ordinary skill would find this limitation disclosed either expressly 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes,	Sakai discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, See above 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[n]. wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Sakai discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[o]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Sakai discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. See above at claim 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 Sakai, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Sakai, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT E17

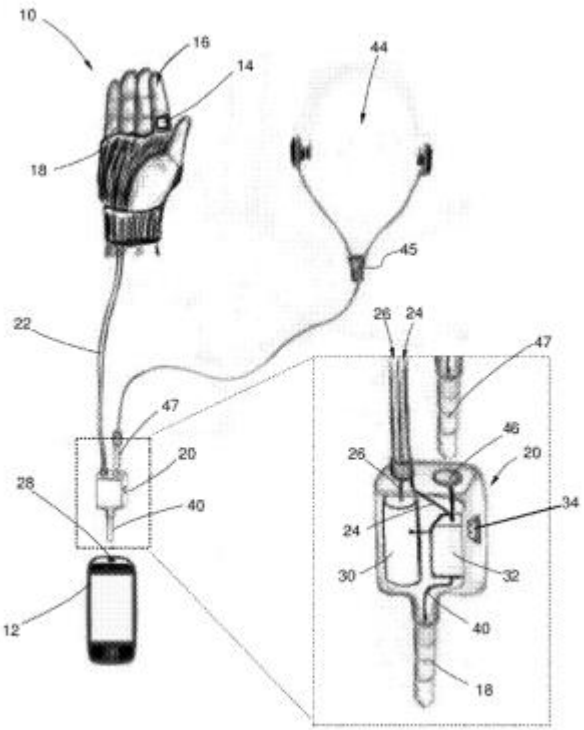
U.S. Pat. No. 11,160,455 in view of US Patent No. 8,923,918 to Kevin Kreger ("Kreger")

As described in detail below, Kreger (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 (the "'455 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 E1-E16 and E18, 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 '455 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 Kreger. The cited portions of Kreger are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Kreger. 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 Kreger "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Kreger 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 Kreger (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 Kreger anticipates and/or renders obvious the Asserted Claims of the '455 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.

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Claim 1	
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kreger discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet.  FIG. 1 Kreger at Fig.1 The present invention pertains to biosensors that connect to a mobile communications device (“mobile”). such as a smart phone or portable media player, and more particularly, the present invention pertains to improvements to interfacing one or more biosensors to a mobile using the mobile's existing connectors. Kreger at 1:8-13

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	Mobile device technology has continuously improved in terms of processing power, storage capabilities, data transmission, and so forth. For example, **modern smart phones are capable of providing complex application support for biosensors by allowing storage, display, calculation of health parameters, and communication of the biosensor data from remote locations.** Kreger at 1:51-57 **The present invention acts as an interface apparatus for various biosensors to utilize the electrical connectors of a mobile, such as a smart phone, so that the mobile becomes the heart of the biosensor monitoring system, either for sports/fitness or medical applications. Thus, the interface device receives at least one biosensor signal and has one or more mating connectors which mate with the mobile's electrical connectors. The electrical connector has a plurality of conductors with one or more of the conductors providing an input in communication with a mobile's processor. The interface device transforms the received biosensor signals to compatible electrical signals for the connectors' inputs.** Kreger at 1:58-2:2 Thus, it is one object of the apparatus to provide a simple, inexpensive device for monitoring biosensors that utilizes the smartphone and its associated capabilities including its processing power and the data input capabilities of its electrical connectors. Kreger at 2:16-20 In one aspect of another embodiment**, the biosensor interface apparatus further includes one or more biosensors. The biosensors may be electrodes including ECG electrodes, a photo plethysmograph (PPG), a pulse oximeter, a sphygmomanometer (inflatable blood pressure cuff), a thermometer/temperature sensor, a pedometer, a capnograph, a respiratory movement sensor, a respiratory flow sensor, a transdermal blood alcohol sensor, and a blood sugar sensor (glucometer). Thus it is an object to provide for a wide range of common medical and sport/fitness biosensors in a single compact interface apparatus**. Kreger at 3:24-34

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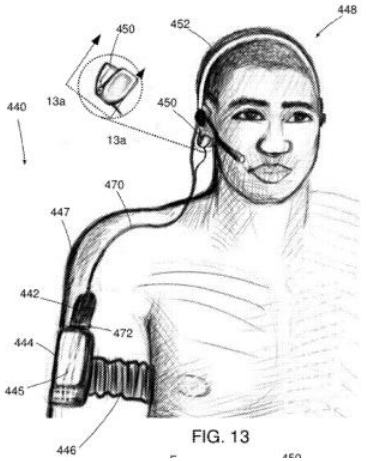
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	In one aspect of another embodiment, **the biosensor interface apparatus further includes one or more biosensor connectors capable of receiving a biosensor signal. Thus it is an object to provide an interface apparatus that supports biosensors' industry standard and manufacturer specified probe connectors, thereby improving the invention's usability and promoting reuse of existing biosensor probes**. Kreger at 3:35-41 In one aspect of another embodiment, **the biosensor interface apparatus further includes at least one connector capable of receiving a biosensor signal, wherein the biosensor signal is an electrical signal, a chemical signal, a gas signal, or a force signal. Thus, it is one object to provide for transmission of gas, chemical compounds, or force such as through a tube in order to measure, for example, end-tidal CO2 (ETCO2), respiratory rate (RR), or respiratory flow with a capnograph. It is another object to provide for the transmission of an electrical signal such as from an ECG or pulse oximeter. In addition vibrations and other audible and inaudible force may be detected by a force sensor that could be in communication with a stethoscope or accelerometer.** Kreger at 3:42-54 **With reference to FIG. 1, there is shown a first embodiment of the biosensor interface apparatus for use with a mobile communication device 10. The biosensor 14 produces one or more biosensor signals transmitted via cable 22 and received by interface device 20. The interface device transforms the biosensor signals so that they can be conducted via electrical connector 28 and compatibly received by the mobile communications device shown as smart phone 12.** Kreger at 5:40-47 **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

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	Continuing with FIG. 1, the biosensor is shown as a pulse oximeter 14 in communication with finger 16. The pulse oximeter may provide a pulse signal to calculate BPM, a SPO2 reading, or a diagnostic cardiac waveform. The pulse oximeter 14 may be retained against the base of finger 16 using a mounting device that may be worn on the finger or hand, shown as gauntlet 18. Alternatively, the pulse oximeter may be worn on the fingertip, ear, forehead, or nasal septum using various mounting devices such as rings, clips, elastic straps, and adhesive pads. Kreger at 5:54-63 Turning now to FIG. 3, a mobile communications device 12 of the present invention is shown as a block diagram. The biosensor signals may be received by one or more electrical connectors 28 on the mobile 12 and communicated to the processor 16 whereupon the microprocessor produces a biosensor measurement or a biosensor signal for analysis. Kreger at 6:55-60 The 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 trans ferred via a cable connected to USB connector 28c or docking connector 28b to another computer storage device, over a computer network, to a personal computer, and so forth. Kreger at 7:39-46 Continuing to refer to FIG. 3, the microprocessor 74 receives one or more biosensor signals and may transform the data into a biosensor measurement such as BPM, or an oth erwise useful signal such as a ECG signal suitable for medical diagnosis. The signals and measurements may be stored in memory 12 and may be used for plotting on display 94. The signals and measurements may also be used to provide infor mation such as a BPM via speaker 98 or via a headset or earpiece (not shown). In addition, biosensor data may be produced by the mobile's internal accelerometer 70 if it is in communication with a human body, thereby serving as a biosensor that may be used to determine the patient's position, respiratory movement, and so forth. Kreger at 7:26-38.

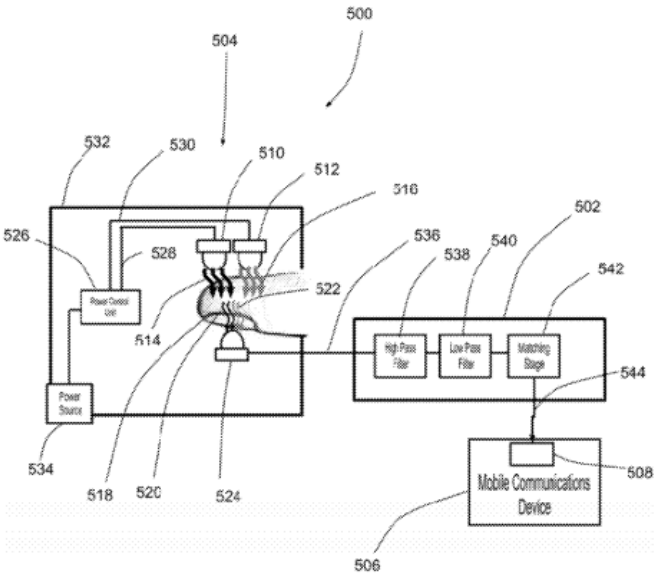
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	Referring now to FIG. 12, an embodiment of the interface apparatus 380 provides an interface device such as dock 382 that may connect multiple medical or other biosensors 384 to a mobile device such as smartphone 386. Kreger at 11:15-18 Referring now to FIG. 17, a block diagram of an embodiment of the interface apparatus 500 comprises an interface device 502 that may connect multiple medical or other bio sensors such as pulse oximeter 504 to a mobile device such as smartphone 506 via an electrical connector 508 in communication with interface device 502. Kreger at 13:30-35 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Kreger discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. **Continuing with FIG. 1, the biosensor is shown as a pulse oximeter 14 in communication with finger 16. The pulse oximeter may provide a pulse signal to calculate BPM, a SPO2 reading, or a diagnostic cardiac waveform. The pulse oximeter 14 may be retained against the base of finger 16 using a mounting device that may be worn on the finger or hand, shown as gauntlet 18. Alternatively, the pulse oximeter may be worn on the fingertip, ear, forehead, or nasal septum using various mounting devices such as rings, clips, elastic straps, and adhesive pads.** Kreger at 5:54-63

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	 FIG. 13 Kreger at Fig.13 Turning now to FIG. 13, an embodiment of the interface apparatus 440 comprises an interface device 442 that may connect multiple medical or other biosensors to a mobile device such as smart phone 444 via electrical connector, for example 472. **The biosensors may include a sphygmomanometer such as inflatable blood pressure cuff 446 to measure or monitor the user's blood pressure. The blood pressure cuff 446 may be in communication with the user's arm 447 and may also house or otherwise carry mobile 444. The embodiment of interface apparatus 440 may also have an integral headset 448 worn by user 452, and a PPG 450, for example, attached to the user's earlobe.** Mobile device smart phone 444 may derive measurements and display plots of the biosensor data on its display 445. Smart phone 444 may also transmit the patient's biosensor data and measurements using one or more internal RF transmitters, for example, over the mobile's data network, or as as modulated data, using frequency shift key (FSK), phase shift key (PSK) encoding or like modulation schemes over the mobile's voice network. In addition, the mobile 444 may transmit the data over a serial cable or an RF bluetooth channel, to a PC or other computing device, or via various other such wireless and wired interfaces, such as 3G, 4G, wired and wireless Ethernet and the like. Kreger at 12:5-28 Referring to FIGS. 1 and 2, the biosensor 14 may be in communication with the interface device 20 via cable 22. The cable may contain one or more conductors 24, 26**. The cable 22 may transmit power to**

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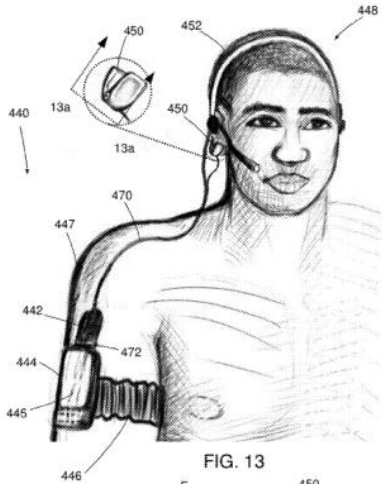
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	the pulse oximeter 14 via conductor 26, or may transmit biosensor signals, such as the two absorption light signals from the pulse oximeter 14, via conductor 24. Kreger at 5:64-6:3 **The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown).** Kreger at 8:9-25 **The pulse oximeter output signal 558 may be multiplexed with accelerometer signal 560 by multiplexer 562**. Recall that the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526. Similarly, power control unit 564 may supply a signal to the multiplexor 562 to time multiplex the accelerometer and pulse oximeter signals 566 into a combined signal 567. Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals combined in pulse ox output 558 and the accelerometer output 569 into their three individual components (and perhaps more for additional accelerometer outputs). The power control unit 564 may provide a synchronizing signal such as 568 to the mobile device 556 to demultiplex the pulse oximeter data and accelerometer data. The synchronizing signal 568 may be further combined with the sensor data by another multiplexer 576. Kreger at 14:33-48

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	 FIG. 17 Kreger at Fig.17 Continuing with FIG. 17, **the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502.** Kreger at 13:36-50

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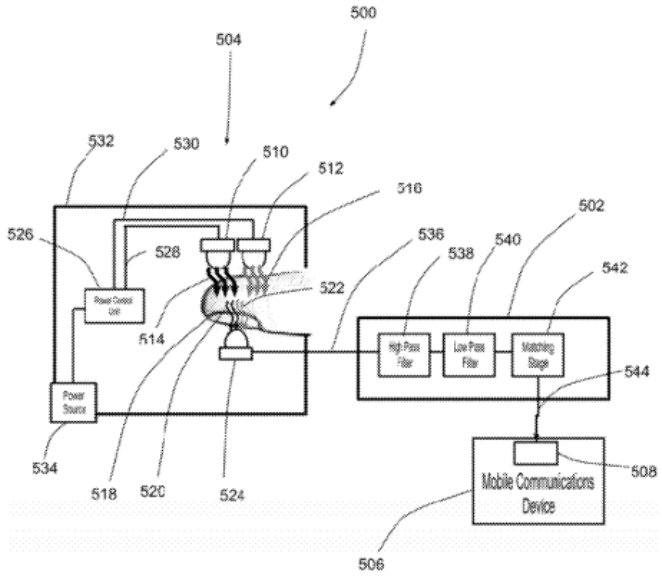
’455 Patent	Kreger
	Referring to FIGS. 17 and 18, **to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown in plots 523, 525. The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526.** Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525. The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506 to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below). Kreger at 13:51-64 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	Kreger discloses or renders obvious including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. **Continuing with FIG. 1, the biosensor is shown as a pulse oximeter 14 in communication with finger 16. The pulse oximeter may provide a pulse signal to calculate BPM, a SPO2 reading, or a diagnostic cardiac waveform. The pulse oximeter 14 may be retained against the base of finger 16 using a mounting device that may be worn on the finger or hand, shown as gauntlet 18. Alternatively, the pulse oximeter may be worn on the fingertip, ear, forehead, or nasal septum using various mounting devices such as rings, clips, elastic straps, and adhesive pads.** Kreger at 5:54-63

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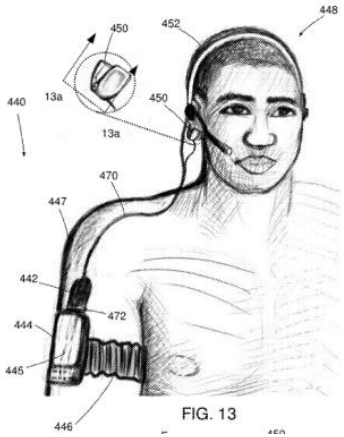
’455 Patent	Kreger
	 FIG. 13 Kreger at Fig.13 Turning now to FIG. 13, an embodiment of the interface apparatus 440 comprises an interface device 442 that may connect multiple medical or other biosensors to a mobile device such as smart phone 444 via electrical connector, for example 472. **The biosensors may include a sphygmomanometer such as inflatable blood pressure cuff 446 to measure or monitor the user's blood pressure. The blood pressure cuff 446 may be in communication with the user's arm 447 and may also house or otherwise carry mobile 444. The embodiment of interface apparatus 440 may also have an integral headset 448 worn by user 452, and a PPG 450, for example, attached to the user's earlobe.** Mobile device smart phone 444 may derive measurements and display plots of the biosensor data on its display 445. Smart phone 444 may also transmit the patient's biosensor data and measurements using one or more internal RF transmitters, for example, over the mobile's data network, or as as modulated data, using frequency shift key (FSK), phase shift key (PSK) encoding or like modulation schemes over the mobile's voice network. In addition, the mobile 444 may transmit the data over a serial cable or an RF bluetooth channel, to a PC or other computing device, or via various other such wireless and wired interfaces, such as 3G, 4G, wired and wireless Ethernet and the like. Kreger at 12:5-28

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	Referring to FIGS. 1 and 2, the biosensor 14 may be in communication with the interface device 20 via cable 22. The cable may contain one or more conductors 24, 26**. The cable 22 may transmit power to the pulse oximeter 14 via conductor 26, or may transmit biosensor signals, such as the two absorption light signals from the pulse oximeter 14, via conductor 24.** Kreger at 5:64-6:3 **The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown).** Kreger at 8:9-25 Turning now to FIG.13a, a cross section of photo plethysmograph 450 taken along axes 13a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal. In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47

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	The pulse oximeter output signal 558 may be multiplexed with accelerometer signal 560 by multiplexer 562. Recall that the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526. Similarly, power control unit 564 may supply a signal to the multiplexor 562 to time multiplex the accelerometer and pulse oximeter signals 566 into a combined signal 567. Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals combined in pulse ox output 558 and the accelerometer output 569 into their three individual components (and perhaps more for additional accelerometer outputs). The power control unit 564 may provide a synchronizing signal such as 568 to the mobile device 556 to demultiplex the pulse oximeter data and accelerometer data. The synchronizing signal 568 may be further combined with the sensor data by another multiplexer 576. Kreger at 14:33-48  FIG. 17 Kreger at Fig.17

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	Continuing with FIG. 17, **the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502.** Kreger at 13:36-50 Referring to FIGS. 17 and 18, **to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown in plots 523, 525. The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526.** Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525. The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506 to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below). Kreger at 13:51-64 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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1[c]. the 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;	Kreger discloses or renders obvious the 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 **Continuing with FIG. 1, the biosensor is shown as a pulse oximeter 14 in communication with finger 16. The pulse oximeter may provide a pulse signal to calculate BPM, a SPO2 reading, or a diagnostic cardiac waveform. The pulse oximeter 14 may be retained against the base of finger 16 using a mounting device that may be worn on the finger or hand, shown as gauntlet 18. Alternatively, the pulse oximeter may be worn on the fingertip, ear, forehead, or nasal septum using various mounting devices such as rings, clips, elastic straps, and adhesive pads.** Kreger at 5:54-63  FIG. 13 Kreger at Fig.13 Turning now to FIG. 13, an embodiment of the interface apparatus 440 comprises an interface device 442 that may connect multiple medical or other biosensors to a mobile device such as smart phone 444 via electrical connector, for example 472. **The biosensors may include a sphygmomanometer such as inflatable blood pressure cuff 446 to measure or monitor the user's blood pressure. The blood pressure cuff 446 may be in communication with the user's arm 447 and may also house or otherwise carry mobile 444. The embodiment of interface apparatus 440 may also have an integral headset 448 worn by user 452, and a PPG 450, for example, attached to the user's earlobe.** Mobile device smart phone 444 may derive measurements and display plots of the biosensor data on its display

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	445. Smart phone 444 may also transmit the patient's biosensor data and measurements using one or more internal RF transmitters, for example, over the mobile's data network, or as as modulated data, using frequency shift key (FSK), phase shift key (PSK) encoding or like modulation schemes over the mobile's voice network. In addition, the mobile 444 may transmit the data over a serial cable or an RF bluetooth channel, to a PC or other computing device, or via various other such wireless and wired interfaces, such as 3G, 4G, wired and wireless Ethernet and the like. Kreger at 12:5-28 **The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150.** The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Turning now to FIG. 13 a, **a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460.

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	Kreger at 12:29-47 Turning now to FIG. 15, **a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. **Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth**. Kreger at 13:4-29 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. the wearable device further comprising a detection system configured to receive at least a portion of the lens output light reflected from the tissue and	Kreger discloses or renders obvious the wearable device further comprising 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 sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both**

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to generate an output signal having a signal-to-noise ratio,	**sensors via power connection 27. The PPG 136 works as follows: first, an infrared ("IR") light emitting diode ("LED") 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150.** The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Turning now to FIG. 13 a, **a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47 Turning now to FIG. 15, **a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** Biosensors may also include a temperature sensor 497 to measure the

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	user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. **Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth**. Kreger at 13:4-29 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 drif**t, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth. Kreger at 3:17-23 The interface device 20 may also provide a sensors interface circuit 42 which receives biosensor signals on input conductor 24 and transforms the signals to output electrical signals 43 that are output on electrical connector 28. **The interface circuit provides output electrical signals 43 signals that are electrically compatible, for example, with respect to impedance, voltage amplitude, noise levels**, and so forth such that the signals can be received by the mobile's processor via connector 24. Kreger at 6:22-30 Still referring to FIGS. 17 and 18, **the interface device 502 may receive pulse oximeter and other sensors signals on conductors 536 and perform various transformations on the signals. For example, high frequency noise may be reduced with high pass filter538, DC offsets and baseline wander can may be reduced with a low pass filter 440, These filters may be instrumental in creating a signal which is usable for examples as a diagnostic display, an SPO2 calculation, a BPM calculation, and so forth**. Internal mobile device filters, for example such as an anti-aliasing filter for recording inputs or a CODEC filter may be used. Alternatively, internal filters can be reconfigured or disabled to allow, for example, the reception of lower frequency signals by the mobile 12 CODEC 76 or AtoD converter 78.

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	Kreger at 14:4-17 Still referring to FIG. 19, the interface device 552 may receive pulse oximeter, other sensors signals, and synchronizing signals on conductors 567, 568 and perform various transformations on the signals**. For example, high frequency noise, DC offsets and baseline wander may be reduced with a band pass filter570. In addition, proper matching of the electrical characteristics of mobile's electrical connector may provided by matching stage 572, for example, as provided by matching stage 542 above.** Kreger at 14:49-57 **The photo plethysmograph output signal and temperature sensor signal may be communicated from sensors assembly 587 by separate (i.e. parallel) conductors 588, 590 to interface device 582. High frequency noise, DC offsets and baseline wander may be reduced with anti-alias filters592, 593.** The filtered signals are received by the serial AtoD converter 594, which converts them to digital values that are serialized for transmission to serial electrical connector 588 on mobile 586. Kreger at 14:65-15:5 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. wherein the detection system is configured to be synchronized to the light source;	Kreger discloses or renders obvious, wherein the detection system is configured to be synchronized to the light source. In one aspect of this embodiment the interface device trans forms the received biosensor signals to compatible electrical signals for the connectors’ inputs by one or more of the following: DC voltage cancellation, filtration, attenuation, demodulation, modulation, compression, amplification, expansion,

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	digitization, serialization, demultiplex, multiplex, Switching, synchronization, electrical isolation, and impedance matching. Thus, it is another object to provide compatible signals to the mobile's electrical connectors which may involve trans forming 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 3:8-23 **The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150.** The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Turning now to FIG. 13 a, **a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460.

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	Kreger at 12:29-47 Turning now to FIG. 15, **a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. **Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth**. Kreger at 13:4-29 The interface device 20 may also provide a sensors interface circuit 42 which receives biosensor signals on input conductor 24 and transforms the signals to output electrical signals 43 that are output on electrical connector 28. **The interface circuit provides output electrical signals 43 signals that are electrically compatible, for example, with respect to impedance, voltage amplitude, noise levels**, and so forth such that the signals can be received by the mobile's processor via connector 24. Kreger at 6:22-30 Still referring to FIGS. 17 and 18, **the interface device 502 may receive pulse oximeter and other sensors signals on conductors 536 and perform various transformations on the signals. For example, high frequency noise may be reduced with high pass filter538, DC offsets and baseline**

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	wander can may be reduced with a low pass filter 440, These filters may be instrumental in creating a signal which is usable for examples as a diagnostic display, an SPO2 calculation, a BPM calculation, and so forth. Internal mobile device filters, for example such as an anti-aliasing filter for recording inputs or a CODEC filter may be used. Alternatively, internal filters can be reconfigured or disabled to allow, for example, the reception of lower frequency signals by the mobile 12 CODEC 76 or AtoD converter 78. Kreger at 14:4-17 The power control unit 564 may provide a synchronizing signal such as 568 to the mobile device 556 to demultiplex the pulse Oximeter data and accelerometer data. The synchronizing signal 568 may be further combined with the sensor data by another multiplexer 576. Kreger at 14:43-48. Still referring to FIG. 19, the interface device 552 may receive pulse oximeter, other sensors signals, and synchronizing signals on conductors 567, 568 and perform various transformations on the signals**. For example, high frequency noise, DC offsets and baseline wander may be reduced with a band pass filter570. In addition, proper matching of the electrical characteristics of mobile's electrical connector may provided by matching stage 572, for example, as provided by matching stage 542 above.** Kreger at 14:49-57 **The photo plethysmograph output signal and temperature sensor signal may be communicated from sensors assembly 587 by separate (i.e. parallel) conductors 588, 590 to interface device 582. High frequency noise, DC offsets and baseline wander may be reduced with anti-alias filters592, 593.** The filtered signals are received by the serial AtoD converter 594, which converts them to digital values that are serialized for transmission to serial electrical connector 588 on mobile 586. Kreger at 14:65-15:5 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

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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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. 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 spatially separated detectors;	Kreger 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 spatially separated detectors. In one aspect of another embodiment, **the biosensor interface apparatus further includes one or more biosensors. The biosensors may be electrodes including ECG electrodes, a photo plethysmograph (PPG), a pulse oximeter, a sphygmomanometer (inflatable blood pressure cuff), a thermometer/temperature sensor, a pedometer, a capnograph, a respiratory movement sensor, a respiratory flow sensor, a transdermal blood alcohol sensor, and a blood sugar sensor (glucometer). Thus it is an object to provide for a wide range of common medical and sport/fitness biosensors in a single compact interface apparatus** Kreger at 3:24-34 Continuing with FIG. 3, analog input signals received by mobile 12 are digitized and communicated to the processor 74. The headset inputs from the headset connector 28a, the USB connector 28c, and the docking connector 28b (not shown) may be filtered by microphone filter, undergo analog to digital conversion using analog to digital (“AtoD”) 76, and be communicated to the microprocessor 74. Kreger at 7:4-10 Referring now to FIG. 8, **an embodiment of the biosensor interface apparatus 190 may be integrated into an emergency or pre-hospital critical care monitor having multiple biosensors.** The biosensors are arranged so that the patient 192 may be wearing an ECG electrode retaining device such as garment 193 that holds cloth or textile ECG electrodes 192, 194, 196, 198 in communication with the patient's skin. **There also may be an thermal sensor 202 for measuring the patient's body temperature (shown under the patient's arm), and a movement sensor accelerometer 204, which is in communication with the patient's thorax 206 measuring thoracic movement as a respiratory monitor. The interface device 208 receives the biosensor signals via electrical cable 210, processes**

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	the signals, and outputs them to the mobile communication device 212 via one or more electrical connectors. Various sensor signals and measurements may be displayed on the mobile's screen 214 such as electrocardiogram (ECG) 216, heart rate (BPM) 218, respiratory movement 220, respiratory rate (RR) 224, and body temperature (degrees Fahrenheit or Centigrade) 222. In another embodiment the connection of cable 210 to interface device 208 may have releasable connectors either for a single electrical cable such as 210, or as individual sensor connectors. In another embodiment one or more sensors communicate with the interface device 208 wirelessly such as with bluetooth-capable sensors. In another alternative embodiment, the patient is using adhesive ECG electrodes, and there is no retaining garment 193. In yet another embodiment the accelerometer 204 can be used to determine periods of activity, rest, and cessation of patient movement, as well as patient position. The movement sensor 204 can also track user 192 position, velocity and acceleration, either of a patient or a fitness user. Kreger at 9:9-40 **Still referring to FIGS. 17 and 18, the interface device 502 may receive pulse oximeter and other sensors signals on conductors 536 and perform various transformations on the signals**. For example, high frequency noise may be reduced with high pass filter538, DC offsets and baseline wander can may be reduced with a low pass filter 440, These filters may be instrumental in creating a signal which is usable for examples as a diagnostic display, an SPO2 calculation, a BPM calculation, and so forth. **Internal mobile device filters, for example such as an anti-aliasing filter for recording inputs or a CODEC filter may be used. Alternatively, internal filters can be reconfigured or disabled to allow, for example, the reception of lower frequency signals by the mobile 12 CODEC 76 or AtoD converter 78.** Kreger at 14:4-17 **The photo plethysmograph output signal and temperature sensor signal may be communicated from sensors assembly 587 by separate (i.e. parallel) conductors 588, 590 to interface device 582. High frequency noise, DC offsets and baseline wander may be reduced with anti-alias filters592, 593. The filtered signals are received by the serial AtoD converter 594, which converts them to digital values that are serialized for transmission to serial electrical connector 588 on mobile 586.** Kreger at 14:65-15:5

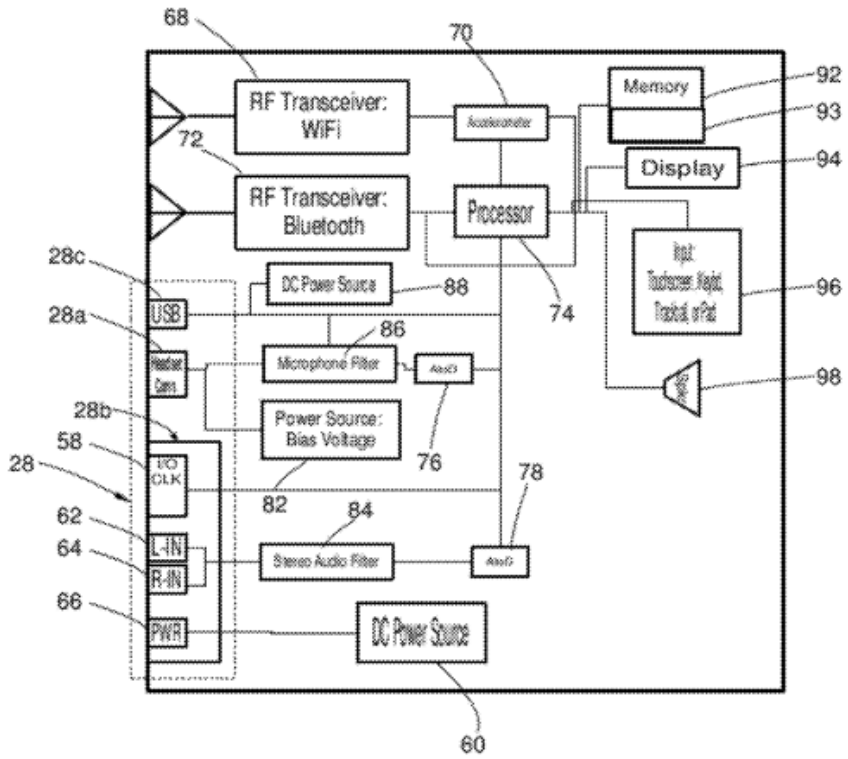
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	The biosensor signals 244 are received by mobile 212 through dock connector 246 which is in communication with an electrical connector on mobile 212 (not visible). The signals may be processed by the interface device dock 242 before being communicated to mobile 212. The biosensor signals may be further processed by the mobile 212 to produce measurements such as BPM 264 or for plotting signals for medical diagnosis such as ECG 266 and respiratory end-tidal CO2 (ETCO2) 267**. 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 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at	Kreger discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. **In alternative embodiments the mobile communication device may be a mobile phone, a personal digital assistant, a smartphone, a portable media playback device, a handheld tablet, and the like. Thus, it is one object of the device to provide for an flexible interface apparatus that will be compatible with a variety of mobile communications devices.** Kreger at 2:21-26

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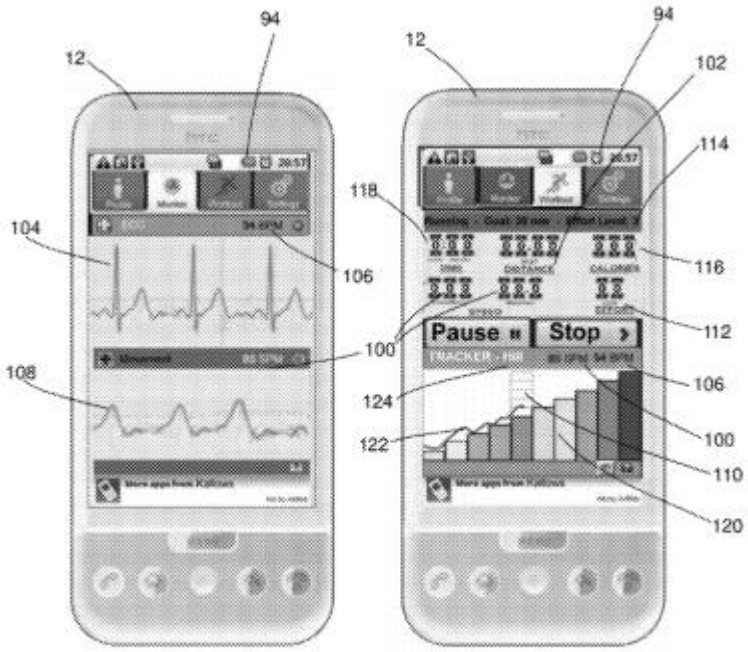
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least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	**With reference to FIG. 1, there is shown a first embodiment of the biosensor interface apparatus for use with a mobile communication device 10. The biosensor 14 produces one or more biosensor signals transmitted via cable 22 and received by interface device 20. The interface device transforms the biosensor signals so that they can be conducted via electrical connector 28 and compatibly received by the mobile communications device shown as smart phone 12.** Kreger at 5:40-47 **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 **The 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

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	 FIG. 3 Kreger at Fig.3 **Turning now to FIG. 3, a mobile communications device 12 of the present invention is shown as a block diagram. The biosensor signals may be received by one or more electrical connectors 28 on the mobile 12 and communicated to the processor 16 whereupon the microprocessor produces a biosensor measurement or a biosensor signal for analysis. The electrical connectors 28 are shown as a headset audio connector 28 a (providing a microphone input and at least one audio output); a hybrid power, data and audio connector 28 b (aka docking connector); and USB connector 28 c. Although the USB connector 28 c may provide data communications, it may also double as a headset connector**. The docking connector 28 b may be comprised of connections that allow recording high quality with audio inputs 62, 64; provide a source of DC power 60 via power connection 66; and provide other data input/output (“I/O”) via I/O and clock connections 58.

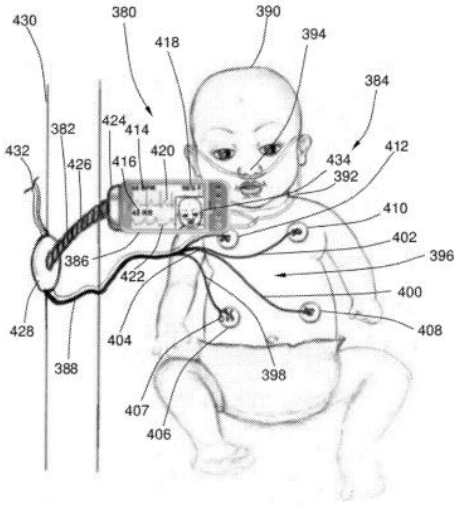
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	Referring now to FIGS. 4 a and 4 b and also to FIG. 3, the microprocessor 74 may drive a display 94 to display the biosensor signals and measurements derived there from. For example a movement sensor may be used to determine the speed 100 (strides per minute or SPM) or distance traveled 102 by an athlete during a workout. A cardiac sensor my provide an ECG signal 104 which can be used to calculate the heart rate 106. The speed 100 can be used separately, but preferably in tandem, to perform a cardiac stress exam and determine a patient's stress level. Speed 100 and/or heart rate 106 may also be used to monitor and control an effort level 110, 112 in a workout. As well, effort level 114 may be a target that is set for the workout. Goals may be set and measurements may be displayed on, for example, a workout timer 112, which may show elapsed or remaining time and may have controls to set workout time. Moreover, other measurements such as Calories 116 may be displayed as “Calories elapsed” or “Calories remaining until goal”. Similarly for elapsed or remaining distance 102, a distance goal can be set, for example, in strides, miles, or kilometers. As well, for effort where an actual effort level 122 and a target effort level 120 can be shown graphically and the user may choose a certain effort profile or course such as Hill 124. Kreger at 7:47-8:2

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	 FIG. 4a FIG. 4b Kreger at Fig.4A and 4B Turning now to FIGS. 6 and 7, **an embodiment of the biosensor interface apparatus 160 may be integrated into a mobile headset 162 having speakers 178 for the ear and a microphone 180, but also having a sensors assembly 164. The sensors assembly 164 may have a cardiac sensor and a movement sensor, for example, a PPG and an accelerometer. In this embodiment the sensors assembly 164 receives power from and communicates signals to the interface device 166 as follows: PPG signal on conductor 26 a, one or more accelerometer signals on conductors 26 b, and power on conductor 27.** Furthermore, power source 168 on interface device 166, which supplies power on conductor 27, may also supply power to the other circuits on the interface device 166, and may receive power via power charging circuit 170. Power charging circuit 170 may receive power from mobile communications device 12, for example, from a microphone bias voltage via headset connector 28 a, or

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	from a power source on docking connector 28 b. In alternative embodiments the power source 168 may be external or it may be within mobile 12, sensors assembly 164, and/or interface device 166. Kreger at 8:26-45 Referring now to FIG. 8, an embodiment of the biosensor interface apparatus 190 may be integrated into an emergency or pre-hospital critical care monitor having multiple biosensors. **The biosensors are arranged so that the patient 192 may be wearing an ECG electrode retaining device such as garment 193 that holds cloth or textile ECG electrodes 192, 194, 196, 198 in communication with the patient's skin**. There also may be an thermal sensor 202 for measuring the patient's body temperature (shown under the patient's arm), and a movement sensor accelerometer 204, which is in communication with the patient's thorax 206 measuring thoracic movement as a respiratory monitor. The interface device 208 receives the biosensor signals via electrical cable 210, processes the signals, and outputs them to the mobile communication device 212 via one or more electrical connectors. **Various sensor signals and measurements may be displayed on the mobile's screen 214 such as electrocardiogram (ECG) 216, heart rate (BPM) 218, respiratory movement 220, respiratory rate (RR) 224, and body temperature (degrees Fahrenheit or Centigrade) 222. In another embodiment the connection of cable 210 to interface device 208 may have releasable connectors either for a single electrical cable such as 210, or as individual sensor connectors. In another embodiment one or more sensors communicate with the interface device 208 wirelessly such as with bluetooth-capable sensors.** In another alternative embodiment, the patient is using adhesive ECG electrodes, and there is no retaining garment 193. In yet another embodiment the accelerometer 204 can be used to determine periods of activity, rest, and cessation of patient movement, as well as patient position. The movement sensor 204 can also track user 192 position, velocity and acceleration, either of a patient or a fitness user. Kreger at 9:9-40 **19. The bio sensor interface apparatus of claim 1 further comprising a cell phone display with the processor configured to communicate the measurement to the display.** Kreger at claim 19

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	The electrical PPG signal 174 a is communicated to headset interface circuit 176, which may further condition the signal, for example to match an electrical circuit impedance. As well, the headset interface circuit connects or switches the resulting signal to output conductor 29 a. The headset interface circuit may also connect the headset speakers 178 and microphone 180 to output conductor 29 a. The headset interface circuit may also combine or multiplex the microphone signal 182 and the PPG signal 174 a to output conductor 29 a. Kreger at 8:52-60  FIG. 12 Kreger at Fig.12 **Continuing with FIG. 12, the biosensor signals are received by a smart phone 386 through dock connector 382, which is in communication with an electrical connector on smart phone 386 (obscured). The interface device dock 382 converts the human breath and human biopotential signals from sampling tube 388 and ECG leads 396 respectively into electrical signals suitable for**

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	communication to the smart phone 386 via one or more of the smart phone's electrical connectors such as a USB connector, a docking connector, or a headset connector. The electrical biosensor signals may be further processed by the smart phone 386 to produce displayed measurements such as BPM 414, respiratory rate 372, body temperature 418, and the like. As well, the biosensor signals may be plotted or otherwise displayed. For example, biosensor signals may be displayed by smart phone 386 such as ECG 420, ETCO 2 422, and the like. **Biosensor signals may also be received by one or more RF receivers in the dock 346 (not shown) and communicated to the smart phone 386 via wired electrical connectors. Interface device dock 382 may also include a connecting and supporting component 424 for communicating with electrical connectors and retaining the smart phone 386**. The connecting and supporting component 424 may have an attached neck or supporting component 426, which may be connected to base 428. The neck 426 may be articulated or otherwise provide a position for smart phone 386 such that the patient 390 is viewable for video monitoring or audible for audio monitoring 434. Base 428 may provide a secure mechanism for attaching the interface apparatus 380 to, for example, an incubator side 430. In addition, interface apparatus 380 may have an external source of AC or DC electrical power 432, which may provide electrical power to smart phone 386 through the electrical connectors in communication with connecting and supporting component 424. Further, **all signals received by the smart phone 386, such as ECG, ETCO2, body temperature, respiratory movement, video, and audio may be transmitted wirelessly by smart phone 386 or via a cable connected to the mobile for remote monitoring and storage.** Kreger at 11:35-12:4 **Continuing to refer to FIG. 3, the microprocessor 74 receives one or more biosensor signals and may transform the data into a biosensor measurement such as BPM, or an otherwise useful signal such as a ECG signal suitable for medical diagnosis. The signals and measurements may be stored in memory 12 and may be used for plotting on display 94.** The signals and measurements may also be used to provide information such as a BPM via speaker 98 or via a headset or earpiece (not shown). In addition, biosensor data may be produced by the mobile's internal accelerometer 70 if it is in communication with a human body, thereby serving as a biosensor that may be used to determine the patient's position, respiratory movement, and so forth. Kreger at 7:26-38

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1[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Kreger discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. **Continuing to refer to FIG. 3, the microprocessor 74 receives one or more biosensor signals and may transform the data into a biosensor measurement such as BPM, or an otherwise useful signal such as a ECG signal suitable for medical diagnosis. The signals and measurements may be stored in memory 12 and may be used for plotting on display 94.** The signals and measurements may also be used to provide information such as a BPM via speaker 98 or via a headset or earpiece (not shown). In addition, biosensor data may be produced by the mobile's internal accelerometer 70 if it is in communication with a human body, thereby serving as a biosensor that may be used to determine the patient's position, respiratory movement, and so forth. Kreger at 7:26-38 **Referring now to FIGS. 4 a and 4 b and also to FIG. 3, the microprocessor 74 may drive a display 94 to display the biosensor signals and measurements derived there from. For example a movement sensor may be used to determine the speed 100 (strides per minute or SPM) or distance traveled 102 by an athlete during a workout. A cardiac sensor my provide an ECG signal 104 which can be used to calculate the heart rate 106.** The speed 100 can be used separately, but preferably in tandem, to perform a cardiac stress exam and determine a patient's stress level. Speed 100 and/or heart rate 106 may also be used to monitor and control an effort level 110, 112 in a workout. As well, effort level 114 may be a target that is set for the workout. Goals may be set and measurements may be displayed on, for example, a workout timer 112, which may show elapsed or remaining time and may have controls to set workout time. Moreover, other measurements such as Calories 116 may be displayed as “Calories elapsed” or “Calories remaining until goal”. Similarly for elapsed or remaining distance 102, a distance goal can be set, for example, in strides, miles, or kilometers. As well, for effort where an actual effort

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	level 122 and a target effort level 120 can be shown graphically and the user may choose a certain effort profile or course such as Hill 124. Kreger at 7:47-8:2 In one aspect of another embodiment**, the biosensor interface apparatus further includes one or more biosensors. The biosensors may be electrodes including ECG electrodes, a photo plethysmograph (PPG), a pulse oximeter, a sphygmomanometer (inflatable blood pressure cuff), a thermometer/temperature sensor, a pedometer, a capnograph, a respiratory movement sensor, a respiratory flow sensor, a transdermal blood alcohol sensor, and a blood sugar sensor (glucometer). Thus it is an object to provide for a wide range of common medical and sport/fitness biosensors in a single compact interface apparatus**. Kreger at 3:24-34 In one aspect of another embodiment, **the biosensor interface apparatus further includes at least one connector capable of receiving a biosensor signal, wherein the biosensor signal is an electrical signal, a chemical signal, a gas signal, or a force signal. Thus, it is one object to provide for transmission of gas, chemical compounds, or force such as through a tube in order to measure, for example, end-tidal CO2 (ETCO2), respiratory rate (RR), or respiratory flow with a capnograph. It is another object to provide for the transmission of an electrical signal such as from an ECG or pulse oximeter. In addition vibrations and other audible and inaudible force may be detected by a force sensor that could be in communication with a stethoscope or accelerometer.** Kreger at 3:42-54 **Continuing with FIG. 1, the biosensor is shown as a pulse oximeter 14 in communication with finger 16. The pulse oximeter may provide a pulse signal to calculate BPM, a SPO2 reading, or a diagnostic cardiac waveform. The pulse oximeter 14 may be retained against the base of finger 16 using a mounting device that may be worn on the finger or hand, shown as gauntlet 18. Alternatively, the pulse oximeter may be worn on the fingertip, ear, forehead, or nasal septum using various mounting devices such as rings, clips, elastic straps, and adhesive pads.** Kreger at 5:54-63

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1[i]. 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;	Kreger discloses or renders obvious 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. **The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150.** The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Turning now to FIG. 13 a, **a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** In one embodiment the light receiving device 458 is a photo diode, in another embodiment the

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	receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47 Turning now to FIG. 15, **a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. **Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth**. Kreger at 13:4-29 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 drif**t, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth. Kreger at 3:17-23 The interface device 20 may also provide a sensors interface circuit 42 which receives biosensor signals on input conductor 24 and transforms the signals to output electrical signals 43 that are output on electrical connector 28. **The interface circuit provides output electrical signals 43 signals that are**

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	electrically compatible, for example, with respect to impedance, voltage amplitude, noise levels, and so forth such that the signals can be received by the mobile's processor via connector 24. Kreger at 6:22-30 Still referring to FIGS. 17 and 18, **the interface device 502 may receive pulse oximeter and other sensors signals on conductors 536 and perform various transformations on the signals. For example, high frequency noise may be reduced with high pass filter538, DC offsets and baseline wander can may be reduced with a low pass filter 440, These filters may be instrumental in creating a signal which is usable for examples as a diagnostic display, an SPO2 calculation, a BPM calculation, and so forth**. Internal mobile device filters, for example such as an anti-aliasing filter for recording inputs or a CODEC filter may be used. Alternatively, internal filters can be reconfigured or disabled to allow, for example, the reception of lower frequency signals by the mobile 12 CODEC 76 or AtoD converter 78. Kreger at 14:4-17 Still referring to FIG. 19, the interface device 552 may receive pulse oximeter, other sensors signals, and synchronizing signals on conductors 567, 568 and perform various transformations on the signals**. For example, high frequency noise, DC offsets and baseline wander may be reduced with a band pass filter570. In addition, proper matching of the electrical characteristics of mobile's electrical connector may provided by matching stage 572, for example, as provided by matching stage 542 above.** Kreger at 14:49-57 **The photo plethysmograph output signal and temperature sensor signal may be communicated from sensors assembly 587 by separate (i.e. parallel) conductors 588, 590 to interface device 582. High frequency noise, DC offsets and baseline wander may be reduced with anti-alias filters592, 593.** The filtered signals are received by the serial AtoD converter 594, which converts them to digital values that are serialized for transmission to serial electrical connector 588 on mobile 586. Kreger at 14:65-15:5

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1[j]. the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off,	Kreger discloses or renders obvious the detection system further configured to: generate a first signal responsive to light received while the semiconductor sources are off. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, 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 semiconductor sources is on; and	Kreger discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on; and. Referring to FIGS. 17 and 18, to determine **SPO_2 the LEDs510, 512 may be turned on alternately and without overlapping with power control unit526 and LED control lines528, 530 as shown by voltage plots529, 531 respectively. The information containing light520, 522 has separate contributions shown in plots523, 525. The alternating lights520, 522 are received and combined (multiplexed) by a single receiver524 as shown in plot526. Further processing of the signal to yield SPO_2 must separate (demultiplex) the two signals into their individual components523, 525.** The signals**529**, **531**, and **533**, or information derived therefrom may be supplied to the mobile device**506** to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below). Kreger at 13:51-64

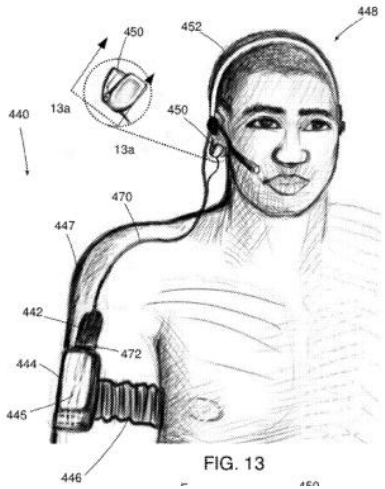
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	Continuing with FIG. 17, the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. **The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502**. Kreger at 13:36-50 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, 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	Kreger discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. Turning now to FIG. 15, **a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. **Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484.**

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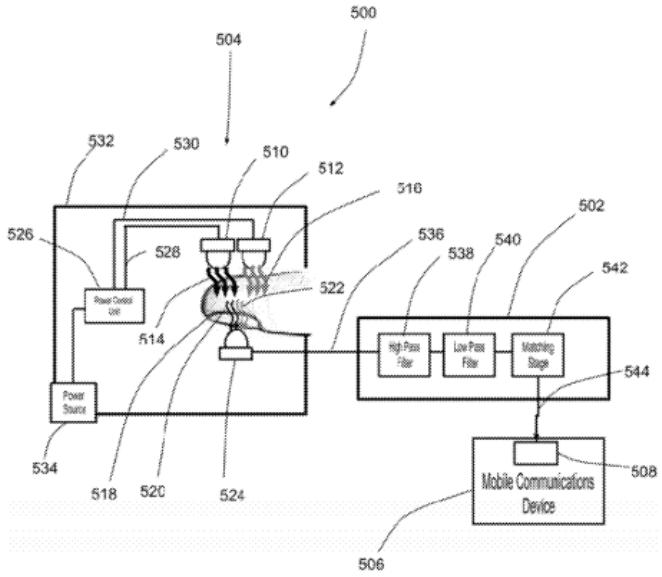
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	Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth. Kreger at 13:4-29 Thus, it is another object to provide compatible signals to the **mobile's electrical connectors which may involve transforming the biosensor signals to match requisite impedance and signal levels, eliminate noise, cancel DC noise and drif**t, demultiplex or multiplex multiple measurements, provide electrical isolation, serialization, synchronization, and so forth. Kreger at 3:17-23 The interface device 20 may also provide a sensors interface circuit 42 which receives biosensor signals on input conductor 24 and transforms the signals to output electrical signals 43 that are output on electrical connector 28. **The interface circuit provides output electrical signals 43 signals that are electrically compatible, for example, with respect to impedance, voltage amplitude, noise levels**, and so forth such that the signals can be received by the mobile's processor via connector 24. Kreger at 6:22-30 Still referring to FIGS. 17 and 18, **the interface device 502 may receive pulse oximeter and other sensors signals on conductors 536 and perform various transformations on the signals. For example, high frequency noise may be reduced with high pass filter538, DC offsets and baseline wander can may be reduced with a low pass filter 440, These filters may be instrumental in creating a signal which is usable for examples as a diagnostic display, an SPO2 calculation, a BPM calculation, and so forth**. Internal mobile device filters, for example such as an anti-aliasing filter for recording inputs or a CODEC filter may be used. Alternatively, internal filters can be reconfigured or disabled to allow, for example, the reception of lower frequency signals by the mobile 12 CODEC 76 or AtoD converter 78. Kreger at 14:4-17 Still referring to FIG. 19, the interface device 552 may receive pulse oximeter, other sensors signals, and synchronizing signals on conductors 567, 568 and perform various transformations on the signals**. For**

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	example, high frequency noise, DC offsets and baseline wander may be reduced with a band pass filter570. In addition, proper matching of the electrical characteristics of mobile's electrical connector may provided by matching stage 572, for example, as provided by matching stage 542 above. Kreger at 14:49-57 **The photo plethysmograph output signal and temperature sensor signal may be communicated from sensors assembly 587 by separate (i.e. parallel) conductors 588, 590 to interface device 582. High frequency noise, DC offsets and baseline wander may be reduced with anti-alias filters592, 593.** The filtered signals are received by the serial AtoD converter 594, which converts them to digital values that are serialized for transmission to serial electrical connector 588 on mobile 586. Kreger at 14:65-15:5 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Kreger discloses or renders obvious wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. **With reference to FIG. 1, there is shown a first embodiment of the biosensor interface apparatus for use with a mobile communication device 10. The biosensor 14 produces one or more biosensor signals transmitted via cable 22 and received by interface device 20. The interface device transforms the biosensor signals so that they can be conducted via electrical connector 28 and compatibly received by the mobile communications device shown as smart phone 12.** Kreger at 5:40-47

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	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 **Continuing with FIG. 1, the biosensor is shown as a pulse oximeter 14 in communication with finger 16. The pulse oximeter may provide a pulse signal to calculate BPM, a SPO2 reading, or a diagnostic cardiac waveform. The pulse oximeter 14 may be retained against the base of finger 16 using a mounting device that may be worn on the finger or hand, shown as gauntlet 18. Alternatively, the pulse oximeter may be worn on the fingertip, ear, forehead, or nasal septum using various mounting devices such as rings, clips, elastic straps, and adhesive pads.** Kreger at 5:54-63  FIG. 13 Kreger at Fig.13 Turning now to FIG. 13, an embodiment of the interface apparatus 440 comprises an interface device 442 that may connect multiple medical or other biosensors to a mobile device such as smart phone 444 via electrical connector, for example 472. **The biosensors may include a sphygmomanometer such as**

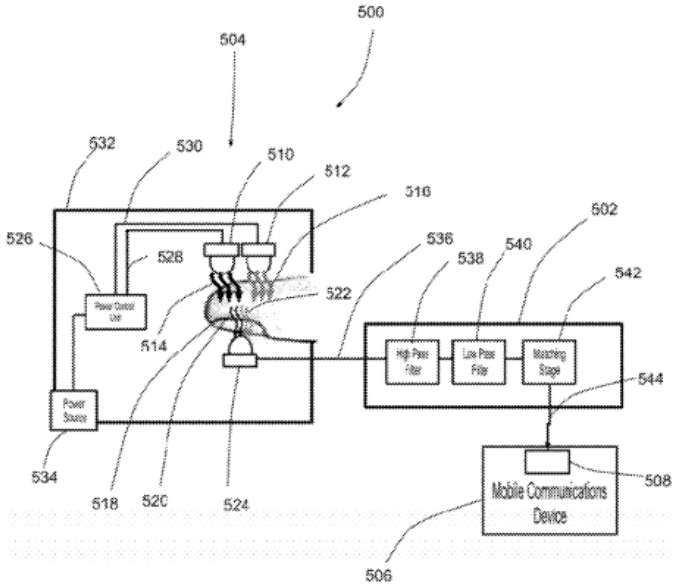
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	inflatable blood pressure cuff 446 to measure or monitor the user's blood pressure. The blood pressure cuff 446 may be in communication with the user's arm 447 and may also house or otherwise carry mobile 444. The embodiment of interface apparatus 440 may also have an integral headset 448 worn by user 452, and a PPG 450, for example, attached to the user's earlobe. Mobile device smart phone 444 may derive measurements and display plots of the biosensor data on its display 445. Smart phone 444 may also transmit the patient's biosensor data and measurements using one or more internal RF transmitters, for example, over the mobile's data network, or as as modulated data, using frequency shift key (FSK), phase shift key (PSK) encoding or like modulation schemes over the mobile's voice network. In addition, the mobile 444 may transmit the data over a serial cable or an RF bluetooth channel, to a PC or other computing device, or via various other such wireless and wired interfaces, such as 3G, 4G, wired and wireless Ethernet and the like. Kreger at 12:5-28 Referring to FIGS. 1 and 2, the biosensor 14 may be in communication with the interface device 20 via cable 22. The cable may contain one or more conductors 24, 26**. The cable 22 may transmit power to the pulse oximeter 14 via conductor 26, or may transmit biosensor signals, such as the two absorption light signals from the pulse oximeter 14, via conductor 24.** Kreger at 5:64-6:3 **The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown).** Kreger at 8:9-25

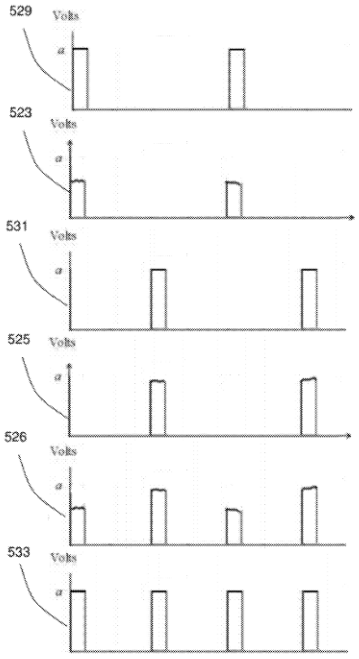
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	The pulse oximeter output signal 558 may be multiplexed with accelerometer signal 560 by multiplexer 562. Recall that the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526. Similarly, power control unit 564 may supply a signal to the multiplexor 562 to time multiplex the accelerometer and pulse oximeter signals 566 into a combined signal 567. Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals combined in pulse ox output 558 and the accelerometer output 569 into their three individual components (and perhaps more for additional accelerometer outputs). The power control unit 564 may provide a synchronizing signal such as 568 to the mobile device 556 to demultiplex the pulse oximeter data and accelerometer data. The synchronizing signal 568 may be further combined with the sensor data by another multiplexer 576. Kreger at 14:33-48  FIG. 17 Kreger at Fig.17

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	Turning now to FIG. 15, a cross section of photo plethys mograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IRLED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers Kreger at 13:4-10. Continuing with FIG. 17, **the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502.** Kreger at 13:36-50 Referring to FIGS. 17 and 18, **to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown in plots 523, 525. The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526.** Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525. The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506 to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below). Kreger at 13:51-64 One of ordinary skill would find this limitation disclosed either expressly 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 1 above. Kreger discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27**. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”) 142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150.** The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Continuing with FIG. 17, **the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the**

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	photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502. Kreger at 13:36-50  FIG. 17 Kreger at Fig. 17

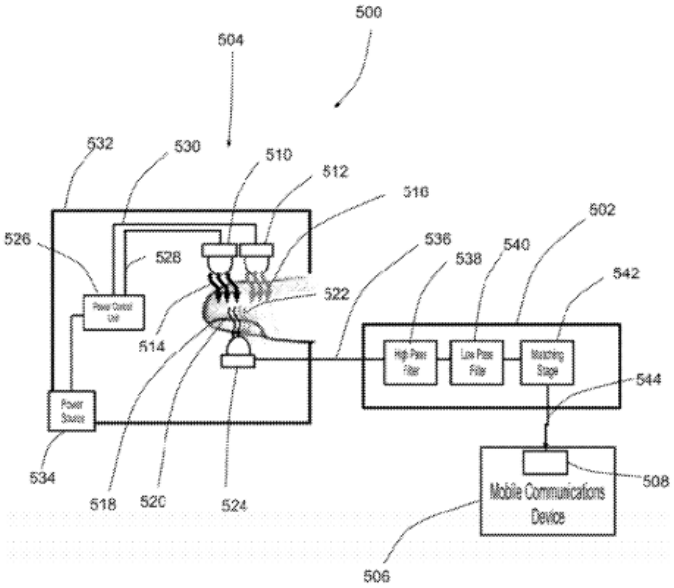
’455 Patent	Kreger
	 FIG. 18 Kreger at Fig. 18 Referring to FIGS. 17 and 18, **to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown in plots 523, 525. The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526.** Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525. The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506 to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below).

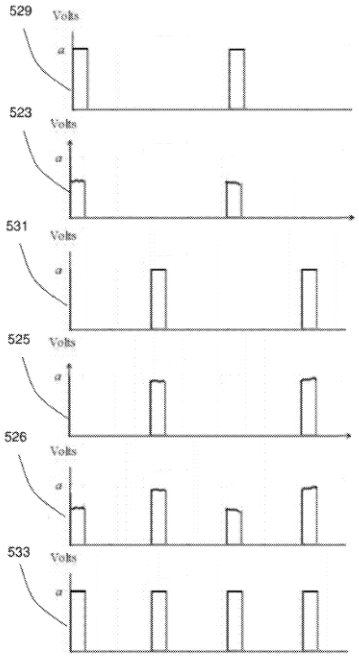
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	Kreger at 13:51-64 Turning now to FIG. 10, an embodiment of the interface apparatus 240 may provide an interface device such as dock 242 in order to interface multiple medical or other biosensors 244 to mobile device 212. For example, dock 246 may provide a connector 248 to mate with the circular push-pull connector 250, which connects to one or more electrical signals 251 such as an ECG, EEG, or the like. The dock 246 may also provide a connector 252 to mate with an air tube connector 254, which provides air or other gas from a biosensor such as human breath 255 for a capnograph to measure CO2. The dock 246 may also provide a connector 256 to mate with a fiber optic connector 258, **which may provide one or more light signals 259 such as from a photo plethysmograph to measure BPM and the like.** The dock 242 may have any number of other connectors for connecting biosensors and their associated leads and cabling including, for example, an electrical sub-d connector 260 to mate with connector 262, which may have one or more electrical biosensor signals 263 such as from an ECG or PPG. Other electrical connectors, optical connectors, and air/gas connectors configured to provide a biosensor signal are within the scope of the invention. Kreger at 9:60-10:13 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	See claim 2 above. Kreger discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. The sensor assembly 134 has a cardiac sensor shown as photo plethysmograph (“PPG”) 136, a movement sensor accelerometer 138, and an external power source 140 supplying power to both sensors via power connection 27**. The PPG 136 works as follows: first, an infrared (“IR”) light emitting diode (“LED”)**

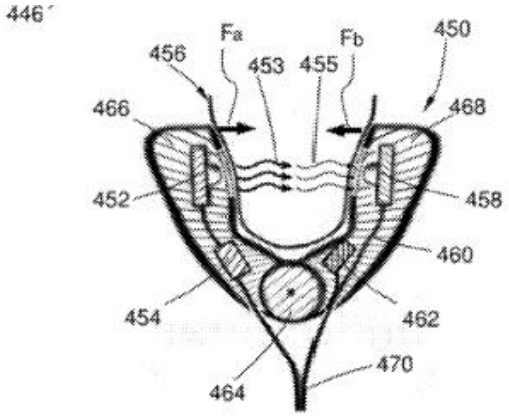
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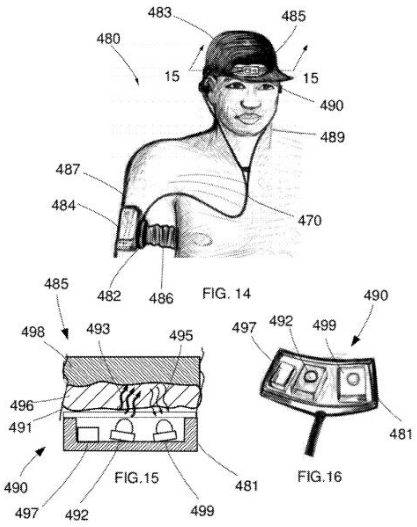
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	142 has power applied by power control unit 143 thereby stimulating it to emit IR light 144, some of which is scattered, reflected or absorbed by a human tissue such as finger 146. Next, some light 148 emerges from finger 146 striking an infrared sensor such as photodiode 150. The photodiode electrical output (i.e. the PPG signal having pulsatile blood flow) is communicated to interface device 132 via connection 26 a, while one or more accelerometer signals are communicated to the interface device 132 via connection 26 b. Note that 26 a, 26 b may be hardwired as shown or releaseably connected to interface device with mating connectors (not shown). Kreger at 8:9-25 Turning now to FIG. 15, a cross section of photo plethys mograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IRLED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers Kreger at 13:4-10. Continuing with FIG. 17, **the pulse oximeter 504 has, for example, two LED light-emitting elements 510, 512 emitting two different frequencies of light, for example red light 514 with a wavelengths of substantially 660 nanometers, and infrared light 516 with wavelengths of substantially 940 nanometers. The light 514, 516 is partially transmitted through fingertip 518 and emerges as modulated light 520, 522 respectively, now having a cardiac signal and information about the saturated percentage of oxygen in the blood, referred to as SPO2. The user's heart rate and other information may be derived from the pulse oximeter signal as well. The information containing light 520,522 strikes light receiving device such as photo transistor 524 which transforms the photonic energy to a corresponding electrical signal transmitted via one or more conductors 536 to interface device 502.** Kreger at 13:36-50

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	 FIG. 17 Kreger at Fig. 17

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	 FIG. 18 Kreger at Fig. 18 Referring to FIGS. 17 and 18, **to determine SPO2 the LEDs 510, 512 may be turned on alternately and without overlapping with power control unit 526 and LED control lines 528, 530 as shown by voltage plots 529, 531 respectively. The information containing light 520, 522 has separate contributions shown in plots 523, 525. The alternating lights 520, 522 are received and combined (multiplexed) by a single receiver 524 as shown in plot 526.** Further processing of the signal to yield SPO2 must separate (demultiplex) the two signals into their individual components 523, 525. The signals 529, 531, and 533, or information derived therefrom may be supplied to the mobile device 506 to demultiplex the pulse oximeter data as well as other sensor data (see detailed description of FIG. 19 below).

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	Kreger at 13:51-64 Turning now to FIG. 10, an embodiment of the interface apparatus 240 may provide an interface device such as dock 242 in order to interface multiple medical or other biosensors 244 to mobile device 212. For example, dock 246 may provide a connector 248 to mate with the circular push-pull connector 250, which connects to one or more electrical signals 251 such as an ECG, EEG, or the like. The dock 246 may also provide a connector 252 to mate with an air tube connector 254, which provides air or other gas from a biosensor such as human breath 255 for a capnograph to measure CO2. The dock 246 may also provide a connector 256 to mate with a fiber optic connector 258, **which may provide one or more light signals 259 such as from a photo plethysmograph to measure BPM and the like.** The dock 242 may have any number of other connectors for connecting biosensors and their associated leads and cabling including, for example, an electrical sub-d connector 260 to mate with connector 262, which may have one or more electrical biosensor signals 263 such as from an ECG or PPG. Other electrical connectors, optical connectors, and air/gas connectors configured to provide a biosensor signal are within the scope of the invention. Kreger at 9:60-10:13  FIG.13a Kreger at Fig. 13a

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	Turning now to FIG. 13 a, **a cross section of photo plethysmograph 450 taken along axes 13 a is shown. The PPG 450 contains a light emitting element such as IR LED 452. The LED 452 emits a light 453 when activated by power from a power control unit 454. The light 453 has a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 453 enters the human tissue having a blood flow such as in earlobe 456. The light is partially absorbed, or otherwise filtered by the blood flowing in the earlobe 456 and emerges as light signal 455, carrying a blood flow signal. The light signal 455 is received by the light signal receiving device 458, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** In one embodiment the light receiving device 458 is a photo diode, in another embodiment the receiving device 458 is a photo transistor, in yet another embodiment the light receiving device 458 has an internal amplifier for amplifying the output signal, for example, transmitted over conductor 460. Kreger at 12:29-47  Kreger at Fig. 14,15 and 16

’455 Patent	Kreger
	Turning now to FIG. 15, **a cross section of photo plethysmograph 490 taken along axes 15 is shown. Referring also to the PPG 490 shown in isometric view in FIGS. 14 and 16, the PPG 490 contains a light emitting element such IR LED 492. A light 493 is emitted from the LED 492 with a substantially distinct wavelength such as 880 nanometers or 920 nanometers. The light 493 enters the human tissue 496 having a blood flow such as forehead 485. The light is partially absorbed, or otherwise filtered by the blood flowing in the tissue 496, is reflected off bone 498, and emerges as light signal 495 carrying blood flow signal. The light signal 495 is received by the light signal receiving device 499, which transforms the energy from the photons of the light signal 455 into a corresponding electrical signal.** Biosensors may also include a temperature sensor 497 to measure the user's body temperature in thermal communication with the user's skin 491. The PPG 450 and temperature sensor 497 may be contained in sensors housing 481 which can be brought into communication with the user's forehead 456 by using a mounting or retaining device such as hat 483 worn by user 489. **Additionally, PPG 490 and thermal sensor 498 are connected via conductors 470 to interface device 482 which is mated to one or more electrical connectors on smart phone 484. Other embodiments may retain the sensors using a headband, a visor, a cap, other types of hats, adhesive bands, and so forth**. Kreger at 13:4-29 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 8	
8[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kreger discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. See above at claim 1[pre]

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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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. The wearable device adapted to be placed on a wrist or an ear of a user,	Kreger discloses or renders obvious the wearable device adapted to be placed on a wrist or an ear of a user. See above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Kreger discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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8[c]. the 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;	Kreger discloses or renders obvious the 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. See above at claim 1[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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source;	Kreger discloses or renders obvious the wearable device further comprising 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. 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[e]. wherein the detection system is configured to be synchronized to the light source;	Kreger discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source.

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	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 incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. 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 spatially separated detectors;	Kreger 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 spatially separated detectors. See above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion	Kreger discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link; See above at claim 1[g].

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of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Kreger discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[i]. 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; and	Kreger discloses or renders obvious 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. See above at claim 1[i].

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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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Kreger 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 above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Kreger discloses or renders obvious generate a second signal responsive to light received while at least one of the light emitting diodes is on. See above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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8[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Kreger discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Kreger discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. See above 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	See claim 8 above. Kreger discloses or renders obvious the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	See claim 9 above. Kreger discloses or renders obvious the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths. See above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading
Claim 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Kreger discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. See above at claim 1[pre]

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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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[a]. The wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Kreger discloses or renders obvious the wearable device adapted to be placed on teeth, a wrist, or an ear of a user, See above at claim 1[a] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[b].including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Kreger discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. See above at claim 1[b] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[c]. the 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;	Kreger discloses or renders obvious the 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. See above at claim 1[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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[d]. the wearable device further comprising 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,	Kreger discloses or renders obvious the wearable device further comprising 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,. 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[e].wherein the detection system is configured to be synchronized to the light source;	Kreger discloses or renders obvious wherein the detection system is configured to be synchronized to the light source. 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[f]. 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 spatially separated detectors;	Kreger discloses 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 spatially separated detectors. See above at claim 1[f] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal; wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link	Kreger discloses or renders obvious the wearable device further comprising 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, wherein the detection system is configured to be synchronized to the light source. wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link See above at claim 1[g] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Kreger discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. See above at claim 1[h] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[i]. 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; and	**Kreger** discloses or renders obvious 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. See above at claim 1[i] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants’ Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Kreger 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 above at claim 1[j]

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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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Kreger discloses or renders obvious generate a second signal responsive to light received while at least one of the semiconductor sources is on;and See above at claim 1[k] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal;	Kreger discloses or renders obvious increase the signal-to-noise ratio by comparing the first signal and the second signal. See above at claim 1[l] One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would

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	have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes,	Kreger discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, See above 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[n]. wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	Kreger discloses or renders obvious wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. See above 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 Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[o]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure	**Kreger** discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. See above at claim 3

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a level of oxy-hemoglobin and deoxy-hemoglobin.	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendants' Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclosed by Kreger, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Kreger, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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EXHIBIT E18

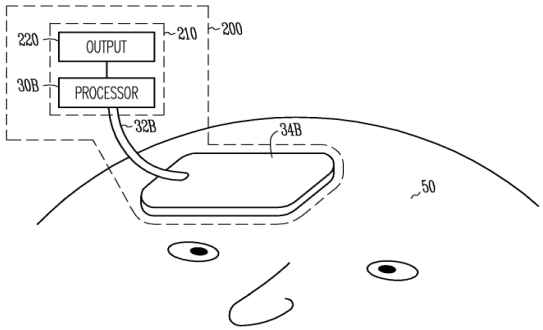
U.S. Pat. No. 11,160,455 in view of U.S. Patent No. 8,725,226 to Philip O. Isaacson ("Isaacson")

As described in detail below, Isaacson (individually or collectively) anticipates and/or renders obvious claim 1-3, 8-10, 15 ("Asserted Claims") of U.S. Patent No. 11,160,455 B2 (the "'455 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 E1-E17, 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 '455 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 Isaacson. The cited portions of Isaacson are merely illustrative, and Defendants reserve the right to rely on alternative or additional evidence, including uncited portions of Isaacson. 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 Isaacson "describes" or "provides for" a limitation, such disclosure may be express, inherent, or implicit. To the extent it is found Isaacson 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 Isaacson (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 Isaacson anticipates and/or renders obvious the Asserted Claims of the '455 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.

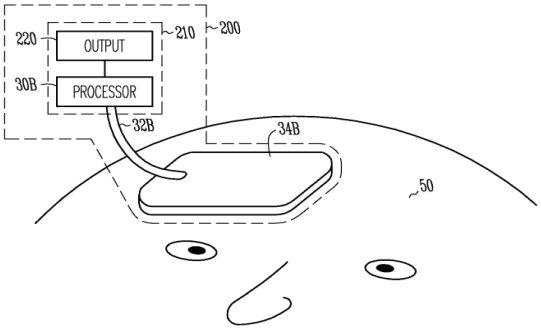
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	Claim 1
1[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Isaacson discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet.  *Fig.2* Isaacson at Fig. 2 One example includes an apparatus for in vivo monitoring of blood metabolites such as hemoglobin oxygen concentration in any of a plurality of different regions of a patient through application of an optical sensor assembly. The optical sensor assembly is in communication with, or is coupled to, a processor. The processor can be configured to control the sensor and analyze data from the sensor. One example of a processor includes a monitor which provides a visible display based on the analysis. Isaacson at 2:63-3:4 Processor 30A is in communication with, or is coupled to, sensor 34A by link 32A. Processor 30A can include a digital processor, a central processor unit (CPU), a microprocessor, a computer, a digital signal processor, an application specific integrated circuit (ASIC), an analog processor, or a mixed signal processor. In addition, processor 30A can include a memory or other device for storing instructions or data. Processor 30A can include other elements as well, including, for example, an

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	analog-to-digital converter (ADC), a digital-to-analog converter (DAC), a driver, an amplifier, a filter, or other circuitry to perform a method as described herein. Isaacson at 3:14-25. FIG. 2 illustrates system 200 according to one example. System 200 includes sensor 34B coupled by link 32B to a module, here shown to include processor 30B. Sensor 34B is affixed to a forehead of biological tissue 50 (depicted herein as that of an infant or neonate), however, sensor 34B can be affixed to another particular site of a human. Sensor 34B includes a pair of emitters and a pair of detectors as described elsewhere in this document, and in the example shown, is depicted as adhesively coupled to tissue 50. Link 32B is illustrated as a wired connection however, a wireless coupling is also contemplated. For example, link 32B can include an optical fiber or a short-range radio frequency (RF) transceiver. Isaacson at 5:16-28 Processor 30B is shown coupled to output 220. Output 220 can include, in various examples, a visual display, a memory, a printer, a network (data or communication), a speaker, or other such device. In one example, processor 30B generates a processor output that is communicated to output 220. In one example, processor 30B and output 220 are part of a stand-alone unit typically referred to as monitor 210. Monitor 210 can be configured for patient use or for use by medical personnel. Isaacson at 5:29-37 Processor 30A uses the first output (from first detector 12) and the second output (from detector 22) to determine a parameter for the biological tissue. The parameter, for example can include a measure of blood oximetry or tissue oximetry. Isaacson at 6:30-34. At 440, method 400 includes using a calculated dimension 24A to position first emitter 10 relative to first detector 12 in housing 38 and using approximately the same dimension 24B to position second emitter 20 relative to second detector 22 in housing 38. In one example, this includes affixing second

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	emitter 20 and second detector 22 at a spacing of 20 mm. Sensor 34A is configured to determine a physiological parameter of biological tissue 50. Isaacson at 6:55-62 In one example, processor 30A executes instructions to determine oxygenation or other physiological parameter using the first output (from first detector 10) and the second output (from second detector 20). This can include executing an instruction to perform an algorithm wherein the instructions are stored in a memory accessible to processor 30A. In one example, the instructions can include using a look-up table stored in a memory. Isaacson at 6:63-7:3 Method examples described herein can be machine or computer-implemented at least in part. Some examples can include a computer-readable medium or machine-readable medium encoded with instructions operable to configure an electronic device to perform methods as described in the above examples. An implementation of such methods can include code, such as microcode, assembly language code, a higher-level language code, or the like. Such code can include computer readable instructions for performing various methods. The code may form portions of computer program products. Further, the code may be tangibly stored on one or more volatile or non-volatile computer-readable media during execution or at other times. These computer-readable media may include, but are not limited to, hard disks, removable magnetic disks, removable optical disks (e.g., compact disks and digital video disks), magnetic cassettes, memory cards or sticks, random access memories (RAMs), read only memories (ROMs), and the like. Isaacson at 8:33-50. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it

’455 Patent	Isaacson
	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user, and	Isaacson discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. Isaacson at 3:65-4:3  *Fig.2* Isaacson at Fig. 2 One example includes an apparatus for in vivo monitoring of blood metabolites such as hemoglobin oxygen concentration in any of a plurality of different regions of a patient through application of an optical sensor assembly. The optical sensor assembly is in communication with, or is coupled to, a processor. The processor can be configured to control the sensor and analyze data from the sensor. One example of a processor includes a monitor which provides a visible display based on the analysis. Isaacson at 2:63-3:4 In addition to sensor 34A, FIG. 1 illustrates biological tissue 50. Biological tissue 50, in the example shown, depicts a portion of a human forehead; however other biological tissue can be monitored as well.

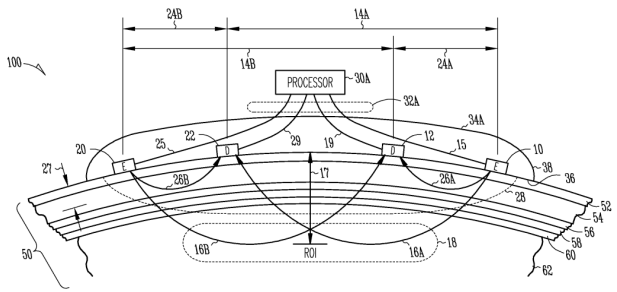
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	For example, the present subject matter can be used with an arm, a finger (or thumb), a toe, an ear lobe, and a torso. FIG. 2 illustrates system 200 according to one example. System 200 includes sensor 34B coupled by link 32B to a module, here shown to include processor 30B. Sensor 34B is affixed to a forehead of biological tissue 50 (depicted herein as that of an infant or neonate), however, sensor 34B can be affixed to another particular site of a human. Sensor 34B includes a pair of emitters and a pair of detectors as described elsewhere in this document, and in the example shown, is depicted as adhesively coupled to tissue 50. Link 32B is illustrated as a wired connection however, a wireless coupling is also contemplated. For example, link 32B can include an optical fiber or a short-range radio frequency (RF) transceiver. Isaacson at 5:16-28 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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[b]. including a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths;	Isaacson discloses or renders obvious the wearable device includes a light source comprising a driver and a plurality of semiconductor sources, the plurality of semiconductor sources configured to generate an output optical light having a plurality of optical wavelengths. The present subject matter includes systems and methods as described herein. For example, a patient sensor includes a first emitter and a first detector separated by a first dimension and a second emitter and a second detector separated by a second dimension. The first dimension and the second dimension can be determined by a particular technique. In one example, the sensor is fully compensated and include two emitters and two detectors. In this example, a first emitter and a first detector are coupled by a short path that traverses a surface layer of the tissue as well as an exclusion region within the tissue. The first emitter is also coupled to a second detector by a long path that traverses the surface layers of the tissue as well as a region of interest at a particular depth within the tissue. A second emitter is coupled to the first detector by a long path that

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	traverses the surface layers of the tissue as well as the region of interest within the tissue. The second emitter is also coupled to the second detector by a short path that traverses the surface layers of the tissue and passes through exclusion region of the tissue without encroaching on the region of interest. Isaacson at 1:21-41 One example can be used for non-invasive determination of tissue oxygenation or non-invasive cerebral oximetry. Cerebral oximetry provides a measure of blood oxygen saturation in the brain. One example includes an optical sensor having light emitters and detectors that can be applied to the forehead of the patient. Isaacson at 2:56-62. Processor 30A is in communication with, or is coupled to, sensor 34A by link 32A. Processor 30A can include a digital processor, a central processor unit (CPU), a microprocessor, a computer, a digital signal processor, an application specific integrated circuit (ASIC), an analog processor, or a mixed signal processor. In addition, processor 30A can include a memory or other device for storing instructions or data. Processor 30A can include other elements as well, including, for example, an analog-to-digital converter (ADC), a digital-to-analog converter (DAC), a driver, an amplifier, a filter, or other circuitry to perform a method as described herein. Isaacson at 3:14-25 Sensor 34A includes first emitter 10, second emitter 20, first detector 12, and second detector 22. Emitters 10 and 20 and detectors 12 and 22 are positioned about surface 36 in a manner that allows optical signals to freely pass between sensor 34A and biological tissue 50. In one example, emitters 10 and 20 and detectors 12 and 22 are mounted to an electrical circuit (such as a printed wire board, a substrate, rigid circuit board, or flexible circuit material) within sensor 34A and optical energy passes through an aperture or window in surface 36. Isaacson at 3:34-43

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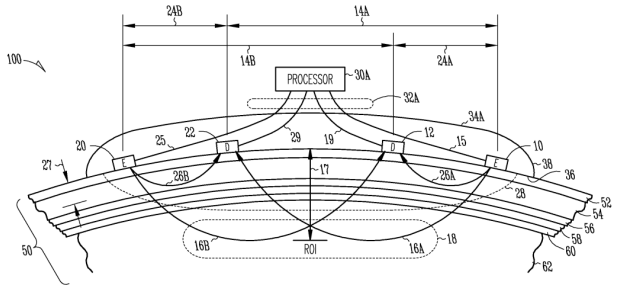
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	In one example, at least one of first emitter 10 and second emitter 20 includes a light emitting diode (LED). In the figure, first emitter 10 and second emitter 20 are shown as unitary devices but in various examples, either can include multiple individual LEDs configured to produce light of a particular wavelength. In one example, first emitter 10 and second emitter 20 include a fiber-optic element. The energy emitted by emitter 10 or emitter 20 can include visible light, infrared energy, and near infrared energy. In one example, first emitter 10 produces light of a particular wavelength and second emitter 20 produces light of a different wavelength. First emitter 10 and second emitter 20 are coupled to processor 30A by link 15 and link 25, respectively. Isaacson at 3:44-56 In one example, at least one of first detector 12 and second detector 22 includes a photodetector. First detector 12 and second detector 22 are configured to generate an output based on received energy having a particular wavelength. The sensitivities of first detector 12 and second detector 22 can be selected (or adjusted) to generate an output for particular wavelengths. First detector 12 and second detector 22 are coupled to processor 30A by link 19 and link 29, respectively. Isaacson at 3:57-64 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[c]. the 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;	Isaacson discloses or renders obvious the 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.

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	 *Fig.1* Isaacson at Fig. 1 The processor can be configured to operate the sensor. The sensor is configured to couple with tissue of the patient and emit and detect light energy. The sensor provides an output signal to the processor corresponding to the detected energy. Isaacson at 3:5-8 In one example, at least one of first emitter 10 and second emitter 20 includes a light emitting diode (LED). In the figure, first emitter 10 and second emitter 20 are shown as unitary devices but in various examples, either can include multiple individual LEDs configured to produce light of a particular wavelength. In one example, first emitter 10 and second emitter 20 include a fiber-optic element. The energy emitted by emitter 10 or emitter 20 can include visible light, infrared energy, and near infrared energy. In one example, first emitter 10 produces light of a particular wavelength and second emitter 20 produces light of a different wavelength. First emitter 10 and second emitter 20 are coupled to processor 30A by link 15 and link 25, respectively. Isaacson at 3:44-56 As shown in the figure, energy emitted from first emitter 10 can be modeled by path 16A and by path 26A. Path 16A enters biological tissue 50, traverses region of interest 18, and emerges from biological tissue 50 and the resulting energy is detected by second detector 22. Path 26A enters biological tissue 50, traverses exclusion region 28, and emerges from biological tissue 50 and the resulting energy is

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	detected by first detector 12. In a similar manner, energy emitted from second emitter 20 can be modeled by path 16B and by path 26B. Path 16B enters biological tissue 50, traverses region of interest 18, and emerges from biological tissue 50 and the resulting energy is detected by first detector 12. Path 26B enters biological tissue 50, traverses exclusion region 28, and emerges from biological tissue 50 and the resulting energy is detected by second detector 22. Isaacson at 4:35-49 To the extent that paths 16A and 16B and paths 26A and 26B are models, the actual path followed by energy delivered by sensor 34A may be different than that shown. For example, light scattering and other optical effects can change the actual path through biological tissue 50. Paths 16A, 16B, 26A, and 26B represent a mean path by which light traverses biological tissue 50. In general, the light traverses the tissue in a curved shape that resembles a banana. Isaacson at 4:50-57 Path 16B and path 26A illustrate that energy detected by first detector 12 originates from second emitter 20 and first emitter 10, respectively. In a similar manner, path 26B and path 16A illustrate that energy detected by second detector 22 originates from second emitter 20 and first emitter 10, respectively. Isaacson at 4:58-63 FIG. 3 includes method 300 according to one example. At 305, method 300 includes identifying a region of interest. The region of interest can include the cerebral cortex, a muscle, or other substance at a particular depth within biological tissue. At 310, method 300 includes selecting a path depth based on the region of interest. The path traverses the biological tissue and the region of interest at a particular depth. In the example shown in FIG. 1, a representative path depth is depicted as first depth 17. Isaacson at 5:38-46 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references

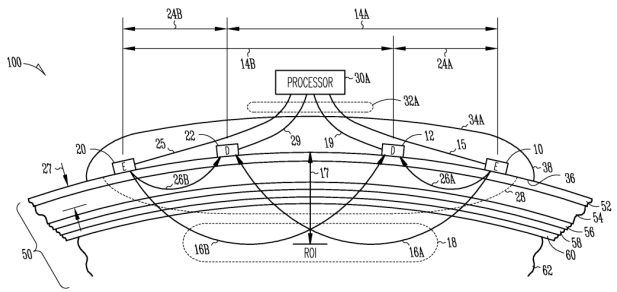
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	identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[d]. the wearable device further comprising 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,	Isaacson discloses or renders obvious the wearable device further comprising 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.  *Fig.1* Isaacson at Fig. 1 The present subject matter includes systems and methods as described herein. For example, a patient sensor includes a first emitter and a first detector separated by a first dimension and a second emitter and a second detector separated by a second dimension. The first dimension and the second dimension can be determined by a particular technique. In one example, the sensor is fully compensated and include two emitters and two detectors. In this example, a first emitter and a first detector are coupled by a short path that traverses a surface layer of the tissue as well as an exclusion region within the tissue. The first emitter is also coupled to a second detector by a long path that traverses the surface layers of the tissue as well as a region of interest at a particular depth within the tissue. A second emitter is coupled to the first detector by a long path that traverses the surface layers of the tissue as well as the region of interest within the tissue. The second

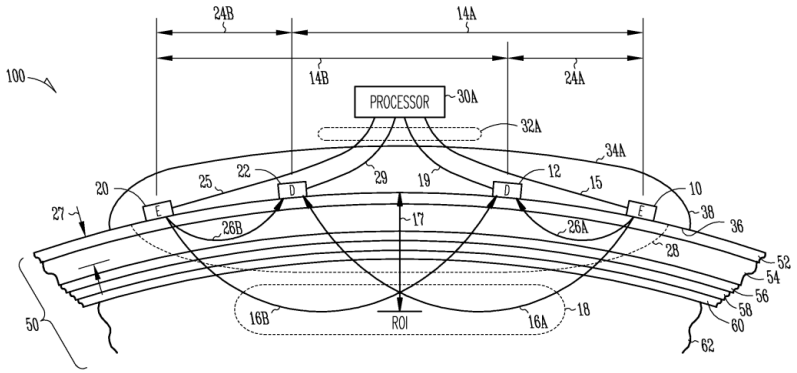
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	emitter is also coupled to the second detector by a short path that traverses the surface layers of the tissue and passes through exclusion region of the tissue without encroaching on the region of interest. Isaacson at 1:21-41 One example includes an apparatus for in vivo monitoring of blood metabolites such as hemoglobin oxygen concentration in any of a plurality of different regions of a patient through application of an optical sensor assembly. The optical sensor assembly is in communication with, or is coupled to, a processor. The processor can be configured to control the sensor and analyze data from the sensor. One example of a processor includes a monitor which provides a visible display based on the analysis. Isaacson at 2:63-3:4 Processor 30A is in communication with, or is coupled to, sensor 34A by link 32A. Processor 30A can include a digital processor, a central processor unit (CPU), a microprocessor, a computer, a digital signal processor, an application specific integrated circuit (ASIC), an analog processor, or a mixed signal processor. In addition, processor 30A can include a memory or other device for storing instructions or data. Processor 30A can include other elements as well, including, for example, an analog-to-digital converter (ADC), a digital-to-analog converter (DAC), a driver, an amplifier, a filter, or other circuitry to perform a method as described herein. Isaacson at 3:14-25 Sensor 34A includes first emitter 10, second emitter 20, first detector 12, and second detector 22. Emitters 10 and 20 and detectors 12 and 22 are positioned about surface 36 in a manner that allows optical signals to freely pass between sensor 34A and biological tissue 50. In one example, emitters 10 and 20 and detectors 12 and 22 are mounted to an electrical circuit (such as a printed wire board, a substrate, rigid circuit board, or flexible circuit material) within sensor 34A and optical energy passes through an aperture or window in surface 36. In one example, at least one of first detector 12 and second detector 22 includes a photodetector. First detector 12 and second detector 22 are configured to generate an output based on received energy having a particular wavelength. The sensitivities of first detector 12 and second detector 22 can be selected (or

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	adjusted) to generate an output for particular wavelengths. First detector 12 and second detector 22 are coupled to processor 30A by link 19 and link 29, respectively. Isaacson at 3:34-64. As shown in the figure, energy emitted from first emitter 10 can be modeled by path 16A and by path 26A. Path 16A enters biological tissue 50, traverses region of interest 18, and emerges from biological tissue 50 and the resulting energy is detected by second detector 22. Path 26A enters biological tissue 50, traverses exclusion region 28, and emerges from biological tissue 50 and the resulting energy is detected by first detector 12. In a similar manner, energy emitted from second emitter 20 can be modeled by path 16B and by path 26B. Path 16B enters biological tissue 50, traverses region of interest 18, and emerges from biological tissue 50 and the resulting energy is detected by first detector 12. Path 26B enters biological tissue 50, traverses exclusion region 28, and emerges from biological tissue 50 and the resulting energy is detected by second detector 22. Isaacson at 4:35-49 To the extent that paths 16A and 16B and paths 26A and 26B are models, the actual path followed by energy delivered by sensor 34A may be different than that shown. For example, light scattering and other optical effects can change the actual path through biological tissue 50. Paths 16A, 16B, 26A, and 26B represent a mean path by which light traverses biological tissue 50. In general, the light traverses the tissue in a curved shape that resembles a banana. Isaacson at 4:50-57 Path 16B and path 26A illustrate that energy detected by first detector 12 originates from second emitter 20 and first emitter 10, respectively. In a similar manner, path 26B and path 16A illustrate that energy detected by second detector 22 originates from second emitter 20 and first emitter 10, respectively. Isaacson at 4:58-63. With reference to FIG. 1, first detector 12 generates a first output based on the optical coupling with first emitter 10 (via exclusion region 28) and second emitter 20 (via region of interest 18). The first

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	output from first detector 12 can include an analog or digital signal provided by a photodetector. In similar manner, second detector 22 generates a second output based on the optical coupling with second emitter 20 (via exclusion region 28) and first emitter 10 (via region of interest 18). Processor 30A uses the first output (from first detector 12) and the second output (from detector 22) to determine a parameter for the biological tissue. The parameter, for example can include a measure of blood oximetry or tissue oximetry. The first output and the second output can be configured to selectively correspond to the region of interest 18 or the exclusion region 28. For example, an emitter (such as emitter 10 or emitter 20) can be configured to produce a particular wavelength of light. In addition, a detector (such as detector 12 or detector 22) can be configured for sensitivity to light having a particular wavelength. Isaacson at 6:21-41. 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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[e]. wherein the detection system is configured to be synchronized to the light source;	Isaacson discloses or renders obvious the detection system is configured to be synchronized to the light source.

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	 *Fig.1* Isaacson at Fig. 1 One example includes an apparatus for in vivo monitoring of blood metabolites such as hemoglobin oxygen concentration in any of a plurality of different regions of a patient through application of an optical sensor assembly. The optical sensor assembly is in communication with, or is coupled to, a processor. The processor can be configured to control the sensor and analyze data from the sensor. One example of a processor includes a monitor which provides a visible display based on the analysis. The processor can be configured to operate the sensor. The sensor is configured to couple with tissue of the patient and emit and detect light energy. The sensor provides an output signal to the processor corresponding to the detected energy. Isaacson at 2:63-3:8 In one example, at least one of first emitter 10 and second emitter 20 includes a light emitting diode (LED). In the figure, first emitter 10 and second emitter 20 are shown as unitary devices but in various examples, either can include multiple individual LEDs configured to produce light of a particular wavelength. In one example, first emitter 10 and second emitter 20 include a fiber-optic element. The energy emitted by emitter 10 or emitter 20 can include visible light, infrared energy, and near infrared energy. In one example, first emitter 10 produces light of a particular wavelength and second emitter 20 produces light of a different wavelength. First emitter 10 and second emitter 20 are coupled to processor 30A by link 15 and link 25, respectively. Isaacson at 3:44-56

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	In one example, at least one of first detector 12 and second detector 22 includes a photodetector. First detector 12 and second detector 22 are configured to generate an output based on received energy having a particular wavelength. The sensitivities of first detector 12 and second detector 22 can be selected (or adjusted) to generate an output for particular wavelengths. First detector 12 and second detector 22 are coupled to processor 30A by link 19 and link 29, respectively. Isaacson at 3:57-64 With reference to FIG. 1, first detector 12 generates a first output based on the optical coupling with first emitter 10 (via exclusion region 28) and second emitter 20 (via region of interest 18). The first output from first detector 12 can include an analog or digital signal provided by a photodetector. In similar manner, second detector 22 generates a second output based on the optical coupling with second emitter 20 (via exclusion region 28) and first emitter 10 (via region of interest 18). Isaacson at 6:21-29 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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[f]. 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 spatially separated detectors;	Isaacson 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 spatially separated detectors.

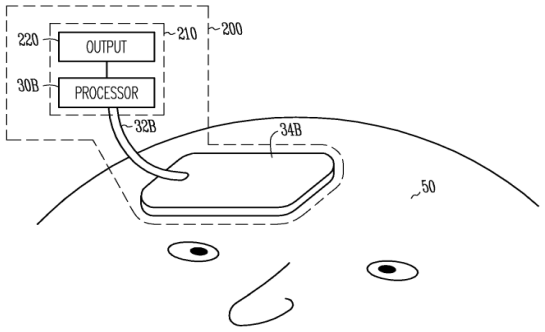
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	 *Fig. 1* Isaacson at Fig. 1 The present subject matter includes systems and methods as described herein. For example, a patient sensor includes a first emitter and a first detector separated by a first dimension and a second emitter and a second detector separated by a second dimension. The first dimension and the second dimension can be determined by a particular technique. In one example, the sensor is fully compensated and include two emitters and two detectors. In this example, a first emitter and a first detector are coupled by a short path that traverses a surface layer of the tissue as well as an exclusion region within the tissue. The first emitter is also coupled to a second detector by a long path that traverses the surface layers of the tissue as well as a region of interest at a particular depth within the tissue. A second emitter is coupled to the first detector by a long path that traverses the surface layers of the tissue as well as the region of interest within the tissue. The second emitter is also coupled to the second detector by a short path that traverses the surface layers of the tissue and passes through exclusion region of the tissue without encroaching on the region of interest. Isaacson at 1:21-41 Processor 30A is in communication with, or is coupled to, sensor 34A by link 32A. Processor 30A can include a digital processor, a central processor unit (CPU), a microprocessor, a computer, a digital signal processor, an application specific integrated circuit (ASIC), an analog processor, or a mixed signal processor. In addition, processor 30A can include a memory or other device for storing instructions or

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	data. Processor 30A can include other elements as well, including, for example, an analog-to-digital converter (ADC), a digital-to-analog converter (DAC), a driver, an amplifier, a filter, or other circuitry to perform a method as described herein. Isaacson at 3:14-25 Sensor 34A includes first emitter 10, second emitter 20, first detector 12, and second detector 22. Emitters 10 and 20 and detectors 12 and 22 are positioned about surface 36 in a manner that allows optical signals to freely pass between sensor 34A and biological tissue 50. In one example, emitters 10 and 20 and detectors 12 and 22 are mounted to an electrical circuit (such as a printed wire board, a substrate, rigid circuit board, or flexible circuit material) within sensor 34A and optical energy passes through an aperture or window in surface 36. Isaacson at 3:34-43 First emitter 10 is separated from first detector 12 by a lateral distance denoted in the figure as dimension 24A and is separated from second detector 22 by a lateral distance denoted in the figure as dimension 14A. In a similar manner, second emitter 20 is separated from second detector 22 by a lateral distance denoted in the figure as dimension 24B and is separated from first detector 12 by a lateral distance denoted in the figure as dimension 14B. Dimension 14A and dimension 14B are approximately equal and dimension 24A and dimension 24B are approximately equal. Dimension 14A (and thus dimension 14B) is approximately twice the length of dimension 24A (and thus dimension 24B), thus having a ratio of approximately 2:1. Isaacson at 4:64-5-9. FIG. 2 illustrates system 200 according to one example. System 200 includes sensor 34B coupled by link 32B to a module, here shown to include processor 30B. Sensor 34B is affixed to a forehead of biological tissue 50 (depicted herein as that of an infant or neonate), however, sensor 34B can be affixed to another particular site of a human. Sensor 34B includes a pair of emitters and a pair of detectors as described elsewhere in this document, and in the example shown, is depicted as adhesively coupled to tissue 50. Link 32B is illustrated as a wired connection however, a wireless coupling is also

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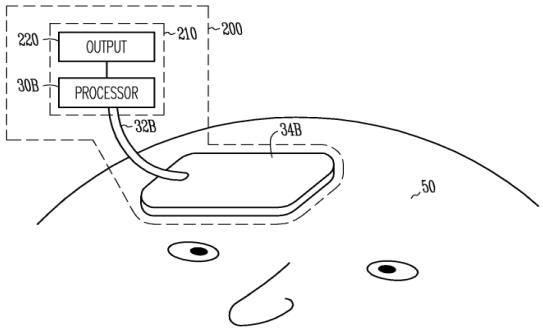
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	contemplated. For example, link 32B can include an optical fiber or a short-range radio frequency (RF) transceiver. Isaacson at 5:16-28 With reference to FIG. 1, first detector 12 generates a first output based on the optical coupling with first emitter 10 (via exclusion region 28) and second emitter 20 (via region of interest 18). The first output from first detector 12 can include an analog or digital signal provided by a photodetector. In similar manner, second detector 22 generates a second output based on the optical coupling with second emitter 20 (via exclusion region 28) and first emitter 10 (via region of interest 18). Isaacson at 6:21-29 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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed	Isaacson discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link.

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output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	 *Fig.2* Isaacson at Fig. 2 One example includes an apparatus for in vivo monitoring of blood metabolites such as hemoglobin oxygen concentration in any of a plurality of different regions of a patient through application of an optical sensor assembly. The optical sensor assembly is in communication with, or is coupled to, a processor. The processor can be configured to control the sensor and analyze data from the sensor. One example of a processor includes a monitor which provides a visible display based on the analysis. Isaacson at 2:63-3:4 Processor 30A is in communication with, or is coupled to, sensor 34A by link 32A. Processor 30A can include a digital processor, a central processor unit (CPU), a microprocessor, a computer, a digital signal processor, an application specific integrated circuit (ASIC), an analog processor, or a mixed signal processor. In addition, processor 30A can include a memory or other device for storing instructions or data. Processor 30A can include other elements as well, including, for example, an analog-to-digital converter (ADC), a digital-to-analog converter (DAC), a driver, an amplifier, a filter, or other circuitry to perform a method as described herein. Isaacson at 3:14-25.

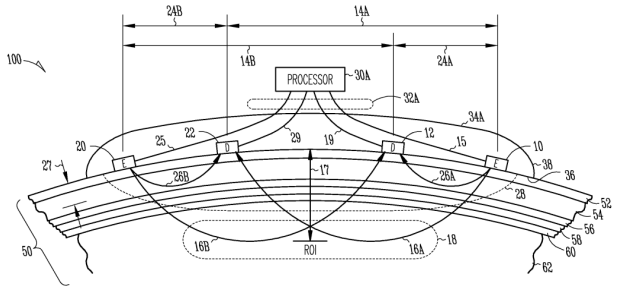
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	FIG. 2 illustrates system 200 according to one example. System 200 includes sensor 34B coupled by link 32B to a module, here shown to include processor 30B. Sensor 34B is affixed to a forehead of biological tissue 50 (depicted herein as that of an infant or neonate), however, sensor 34B can be affixed to another particular site of a human. Sensor 34B includes a pair of emitters and a pair of detectors as described elsewhere in this document, and in the example shown, is depicted as adhesively coupled to tissue 50. Link 32B is illustrated as a wired connection however, a wireless coupling is also contemplated. For example, link 32B can include an optical fiber or a short-range radio frequency (RF) transceiver. Isaacson at 5:16-28 Processor 30B is shown coupled to output 220. Output 220 can include, in various examples, a visual display, a memory, a printer, a network (data or communication), a speaker, or other such device. In one example, processor 30B generates a processor output that is communicated to output 220. In one example, processor 30B and output 220 are part of a stand-alone unit typically referred to as monitor 210. Monitor 210 can be configured for patient use or for use by medical personnel. Isaacson at 5:29-37 Method examples described herein can be machine or computer-implemented at least in part. Some examples can include a computer-readable medium or machine-readable medium encoded with instructions operable to configure an electronic device to perform methods as described in the above examples. An implementation of such methods can include code, such as microcode, assembly language code, a higher-level language code, or the like. Such code can include computer readable instructions for performing various methods. The code may form portions of computer program products. Further, the code may be tangibly stored on one or more volatile or non-volatile computer-readable media during execution or at other times. These computer-readable media may include, but are not limited to, hard disks, removable magnetic disks, removable optical disks (e.g., compact disks and digital video disks), magnetic cassettes, memory cards or sticks, random access memories (RAMs), read only memories (ROMs), and the like. Isaacson at 8:33-50.

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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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, 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 one or more of the physiological parameters;	Isaacson discloses or renders obvious the output signal is indicative of one or more of the physiological parameters.  *Fig.2* Isaacson at Fig. 2 The present subject matter is directed to in vivo optical examination and monitoring of selected blood metabolites or constituents in human or other living subjects. Examination and monitoring can include transmitting selected wavelengths of light into a particular area of biological tissue and receiving the resulting light as it emerges from the area, and analyzing the received light to determine the desired data based on light absorption. Isaacson at 2:45-52

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	FIG. 2 illustrates system 200 according to one example. System 200 includes sensor 34B coupled by link 32B to a module, here shown to include processor 30B. Sensor 34B is affixed to a forehead of biological tissue 50 (depicted herein as that of an infant or neonate), however, sensor 34B can be affixed to another particular site of a human. Sensor 34B includes a pair of emitters and a pair of detectors as described elsewhere in this document, and in the example shown, is depicted as adhesively coupled to tissue 50. Link 32B is illustrated as a wired connection however, a wireless coupling is also contemplated. For example, link 32B can include an optical fiber or a short-range radio frequency (RF) transceiver. Isaacson at 5:16-28 Processor 30B is shown coupled to output 220. Output 220 can include, in various examples, a visual display, a memory, a printer, a network (data or communication), a speaker, or other such device. In one example, processor 30B generates a processor output that is communicated to output 220. In one example, processor 30B and output 220 are part of a stand-alone unit typically referred to as monitor 210. Monitor 210 can be configured for patient use or for use by medical personnel. Isaacson at 5:29-37 Processor 30A uses the first output (from first detector 12) and the second output (from detector 22) to determine a parameter for the biological tissue. The parameter, for example can include a measure of blood oximetry or tissue oximetry. Isaacson at 6:30-34. At 440, method 400 includes using a calculated dimension 24A to position first emitter 10 relative to first detector 12 in housing 38 and using approximately the same dimension 24B to position second emitter 20 relative to second detector 22 in housing 38. In one example, this includes affixing second emitter 20 and second detector 22 at a spacing of 20 mm. Sensor 34A is configured to determine a physiological parameter of biological tissue 50. Isaacson at 6:55-62

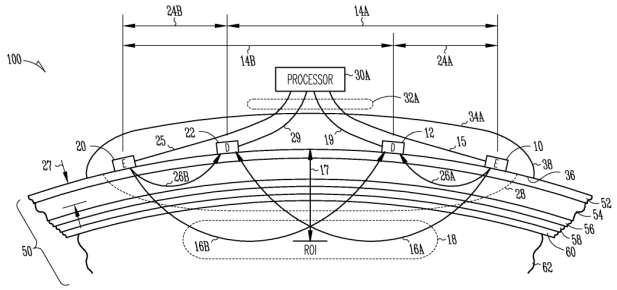
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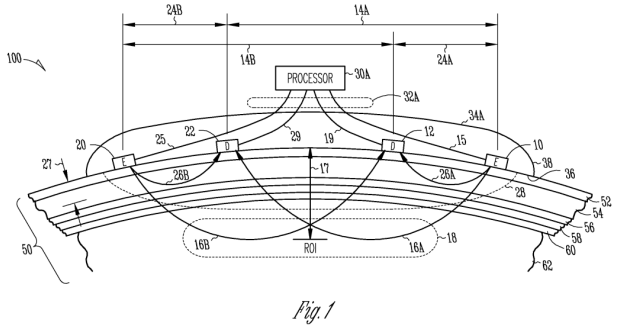
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	In one example, processor 30A executes instructions to determine oxygenation or other physiological parameter using the first output (from first detector 10) and the second output (from second detector 20). This can include executing an instruction to perform an algorithm wherein the instructions are stored in a memory accessible to processor 30A. In one example, the instructions can include using a look-up table stored in a memory. Isaacson at 6:63-7:3 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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[i]. 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;	Isaacson discloses or renders obvious 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.  *Fig. 1* Isaacson at Fig. 1 One example includes an apparatus for in vivo monitoring of blood metabolites such as hemoglobin oxygen concentration in any of a plurality of different regions of a patient through application of an optical sensor assembly. The optical sensor assembly is in communication with, or is coupled to, a

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	processor. The processor can be configured to control the sensor and analyze data from the sensor. One example of a processor includes a monitor which provides a visible display based on the analysis. The processor can be configured to operate the sensor. The sensor is configured to couple with tissue of the patient and emit and detect light energy. The sensor provides an output signal to the processor corresponding to the detected energy. Isaacson at 2:63-3:8. Sensor 34A includes first emitter 10, second emitter 20, first detector 12, and second detector 22. Emitters 10 and 20 and detectors 12 and 22 are positioned about surface 36 in a manner that allows optical signals to freely pass between sensor 34A and biological tissue 50. In one example, emitters 10 and 20 and detectors 12 and 22 are mounted to an electrical circuit (such as a printed wire board, a substrate, rigid circuit board, or flexible circuit material) within sensor 34A and optical energy passes through an aperture or window in surface 36. Isaacson at 3:34-43 In one example, at least one of first emitter 10 and second emitter 20 includes a light emitting diode (LED). In the figure, first emitter 10 and second emitter 20 are shown as unitary devices but in various examples, either can include multiple individual LEDs configured to produce light of a particular wavelength. In one example, first emitter 10 and second emitter 20 include a fiber-optic element. The energy emitted by emitter 10 or emitter 20 can include visible light, infrared energy, and near infrared energy. In one example, first emitter 10 produces light of a particular wavelength and second emitter 20 produces light of a different wavelength. First emitter 10 and second emitter 20 are coupled to processor 30A by link 15 and link 25, respectively. Isaacson at 3:44-56 With reference to FIG. 1, first detector 12 generates a first output based on the optical coupling with first emitter 10 (via exclusion region 28) and second emitter 20 (via region of interest 18). The first output from first detector 12 can include an analog or digital signal provided by a photodetector. In similar manner, second detector 22 generates a second output based on the optical coupling with second emitter 20 (via exclusion region 28) and first emitter 10 (via region of interest 18).

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	Isaacson at 6:21-29 At 440, method 400 includes using a calculated dimension 24A to position first emitter 10 relative to first detector 12 in housing 38 and using approximately the same dimension 24B to position second emitter 20 relative to second detector 22 in housing 38. In one example, this includes affixing second emitter 20 and second detector 22 at a spacing of 20 mm. Sensor 34A is configured to determine a physiological parameter of biological tissue 50. Isaacson at 6:55-62 In one example, processor 30A executes instructions to determine oxygenation or other physiological parameter using the first output (from first detector 10) and the second output (from second detector 20). This can include executing an instruction to perform an algorithm wherein the instructions are stored in a memory accessible to processor 30A. In one example, the instructions can include using a look-up table stored in a memory. Isaacson at 6:63-7:3 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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, 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 semiconductor sources are off,	Isaacson discloses or renders obvious the detection system further configured to generate a first signal responsive to light received while the semiconductor sources are off. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are

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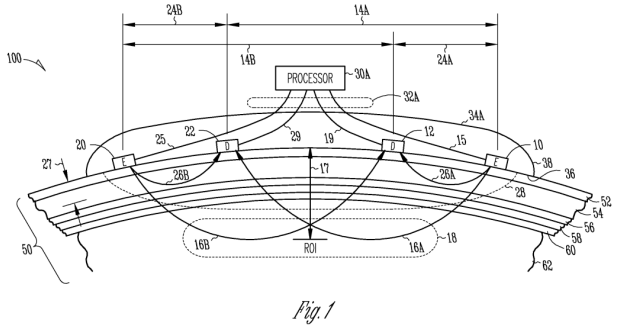
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	incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as 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 semiconductor sources is on; and	Isaacson discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the semiconductor sources is on.  *Fig. 1* Isaacson at Fig. 1 The processor can be configured to operate the sensor. The sensor is configured to couple with tissue of the patient and emit and detect light energy. The sensor provides an output signal to the processor corresponding to the detected energy. Isaacson at 3:5-8 Sensor 34A includes first emitter 10, second emitter 20, first detector 12, and second detector 22. Emitters 10 and 20 and detectors 12 and 22 are positioned about surface 36 in a manner that allows optical signals to freely pass between sensor 34A and biological tissue 50. In one example, emitters 10 and 20 and detectors 12 and 22 are mounted to an electrical circuit (such as a printed wire board, a substrate, rigid circuit board, or flexible circuit material) within sensor 34A and optical energy passes through an aperture or window in surface 36. Isaacson at 3:34-43

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	With reference to FIG. 1, first detector 12 generates a first output based on the optical coupling with first emitter 10 (via exclusion region 28) and second emitter 20 (via region of interest 18). The first output from first detector 12 can include an analog or digital signal provided by a photodetector. In similar manner, second detector 22 generates a second output based on the optical coupling with second emitter 20 (via exclusion region 28) and first emitter 10 (via region of interest 18). Isaacson at 6:21-29 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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, 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	Isaacson discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal.  *Fig 1* Isaacson at Fig. 1

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	The processor can be configured to operate the sensor. The sensor is configured to couple with tissue of the patient and emit and detect light energy. The sensor provides an output signal to the processor corresponding to the detected energy. Isaacson at 3:5-8 Sensor 34A includes first emitter 10, second emitter 20, first detector 12, and second detector 22. Emitters 10 and 20 and detectors 12 and 22 are positioned about surface 36 in a manner that allows optical signals to freely pass between sensor 34A and biological tissue 50. In one example, emitters 10 and 20 and detectors 12 and 22 are mounted to an electrical circuit (such as a printed wire board, a substrate, rigid circuit board, or flexible circuit material) within sensor 34A and optical energy passes through an aperture or window in surface 36. Isaacson at 3:34-43 With reference to FIG. 1, first detector 12 generates a first output based on the optical coupling with first emitter 10 (via exclusion region 28) and second emitter 20 (via region of interest 18). The first output from first detector 12 can include an analog or digital signal provided by a photodetector. In similar manner, second detector 22 generates a second output based on the optical coupling with second emitter 20 (via exclusion region 28) and first emitter 10 (via region of interest 18). Isaacson at 6:21-29 In one example processor 30A calculates a physiological parameter using an algorithm in which the optical absorbance corresponding to the short paths is subtracted from the optical absorbance corresponding to the long paths. Isaacson at 7:59-62 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s 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 disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
1[m]. wherein the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths.	Isaacson discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. The present subject matter is directed to in vivo optical examination and monitoring of selected blood metabolites or constituents in human or other living subjects. Examination and monitoring can include transmitting selected wavelengths of light into a particular area of biological tissue and receiving the resulting light as it emerges from the area, and analyzing the received light to determine the desired data based on light absorption. Isaacson at 2:45-52 In one example, at least one of first emitter 10 and second emitter 20 includes a light emitting diode (LED). In the figure, first emitter 10 and second emitter 20 are shown as unitary devices but in various examples, either can include multiple individual LEDs configured to produce light of a particular wavelength. In one example, first emitter 10 and second emitter 20 include a fiber-optic element. The energy emitted by emitter 10 or emitter 20 can include visible light, infrared energy, and near infrared energy. In one example, first emitter 10 produces light of a particular wavelength and second emitter 20 produces light of a different wavelength. First emitter 10 and second emitter 20 are coupled to processor 30A by link 15 and link 25, respectively. Isaacson at 3:44-56 In one example, at least one of first detector 12 and second detector 22 includes a photodetector. First detector 12 and second detector 22 are configured to generate an output based on received energy having a particular wavelength. The sensitivities of first detector 12 and second detector 22 can be selected (or adjusted) to generate an output for particular wavelengths. First detector 12 and second detector 22 are coupled to processor 30A by link 19 and link 29, respectively. Isaacson at 3:57-64

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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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 2	
2. The system of claim 1, wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 1 above. Isaacson discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.  *Fig. 1* Isaacson at Fig. 1 Sensor 34A includes first emitter 10, second emitter 20, first detector 12, and second detector 22. Emitters 10 and 20 and detectors 12 and 22 are positioned about surface 36 in a manner that allows optical signals to freely pass between sensor 34A and biological tissue 50. In one example, emitters 10 and 20 and detectors 12 and 22 are mounted to an electrical circuit (such as a printed wire board, a

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	substrate, rigid circuit board, or flexible circuit material) within sensor 34A and optical energy passes through an aperture or window in surface 36. Isaacson at 3:34-43 In one example, at least one of first emitter 10 and second emitter 20 includes a light emitting diode (LED). In the figure, first emitter 10 and second emitter 20 are shown as unitary devices but in various examples, either can include multiple individual LEDs configured to produce light of a particular wavelength. In one example, first emitter 10 and second emitter 20 include a fiber-optic element. The energy emitted by emitter 10 or emitter 20 can include visible light, infrared energy, and near infrared energy. In one example, first emitter 10 produces light of a particular wavelength and second emitter 20 produces light of a different wavelength. First emitter 10 and second emitter 20 are coupled to processor 30A by link 15 and link 25, respectively. Isaacson at 3:44-56 FIG. 2 illustrates system 200 according to one example. System 200 includes sensor 34B coupled by link 32B to a module, here shown to include processor 30B. Sensor 34B is affixed to a forehead of biological tissue 50 (depicted herein as that of an infant or neonate), however, sensor 34B can be affixed to another particular site of a human. Sensor 34B includes a pair of emitters and a pair of detectors as described elsewhere in this document, and in the example shown, is depicted as adhesively coupled to tissue 50. Link 32B is illustrated as a wired connection however, a wireless coupling is also contemplated. For example, link 32B can include an optical fiber or a short-range radio frequency (RF) transceiver. Isaacson at 5:16-28 With reference to FIG. 1, first detector 12 generates a first output based on the optical coupling with first emitter 10 (via exclusion region 28) and second emitter 20 (via region of interest 18). The first output from first detector 12 can include an analog or digital signal provided by a photodetector. In similar manner, second detector 22 generates a second output based on the optical coupling with second emitter 20 (via exclusion region 28) and first emitter 10 (via region of interest 18).

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	Isaacson at 6:21-29 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 Defendant's Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 3	
3. The system of claim 2, wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	*See* claim 2 above. Isaacson discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. One example can be used for non-invasive determination of tissue oxygenation or non-invasive cerebral oximetry. Cerebral oximetry provides a measure of blood oxygen saturation in the brain. One example includes an optical sensor having light emitters and detectors that can be applied to the forehead of the patient. Isaacson at 2:57-62. One example includes an apparatus for in vivo monitoring of blood metabolites such as hemoglobin oxygen concentration in any of a plurality of different regions of a patient through application of an optical sensor assembly. The optical sensor assembly is in communication with, or is coupled to, a processor. The processor can be configured to control the sensor and analyze data from the sensor. One example of a processor includes a monitor which provides a visible display based on the analysis. Isaacson at 2:63-3:4 The present subject matter is directed to in vivo optical examination and monitoring of selected blood metabolites or constituents in human or other living subjects. Examination and monitoring can include transmitting selected wavelengths of light into a particular area of biological tissue and receiving the

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	resulting light as it emerges from the area, and analyzing the received light to determine the desired data based on light absorption. Isaacson at 2:45-52 In one example, at least one of first emitter 10 and second emitter 20 includes a light emitting diode (LED). In the figure, first emitter 10 and second emitter 20 are shown as unitary devices but in various examples, either can include multiple individual LEDs configured to produce light of a particular wavelength. In one example, first emitter 10 and second emitter 20 include a fiber-optic element. The energy emitted by emitter 10 or emitter 20 can include visible light, infrared energy, and near infrared energy. In one example, first emitter 10 produces light of a particular wavelength and second emitter 20 produces light of a different wavelength. First emitter 10 and second emitter 20 are coupled to processor 30A by link 15 and link 25, respectively. Isaacson at 3:44-56 In one example, at least one of first detector 12 and second detector 22 includes a photodetector. First detector 12 and second detector 22 are configured to generate an output based on received energy having a particular wavelength. The sensitivities of first detector 12 and second detector 22 can be selected (or adjusted) to generate an output for particular wavelengths. First detector 12 and second detector 22 are coupled to processor 30A by link 19 and link 29, respectively. Isaacson at 3:57-64 One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, 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 system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Isaacson discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[a]. a wearable device adapted to be placed on a wrist or an ear of a user,	Isaacson discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user. *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical	Isaacson discloses or renders obvious a wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths. *See* above at claim 1[b].

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light having one or more optical wavelengths;	One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[c]. the 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;	Isaacson discloses or renders obvious the 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. *See* above at claim 1[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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[d]. the wearable device further comprising 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,	Isaacson discloses or renders obvious the wearable device further comprising 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. *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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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8[e]. wherein the detection system is configured to be synchronized to the light source;	Isaacson discloses or renders obvious the detection system is configured to be synchronized to the light source. *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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[f]. 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 spatially separated detectors;	Isaacson 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or	Isaacson discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal. The smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link.

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tablet configured to receive and process at least a portion of the output signal; wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link	*See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Isaacson discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[i]. 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; and	Isaacson discloses or renders obvious 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. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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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8[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off,	Isaacson 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* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[k] generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Isaacson discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[l] increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Isaacson discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l].

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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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
8[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes.	Isaacson discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes. *See* above 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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 9	
9. The system of claim 8, wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.	*See* claim 8 above. Isaacson discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs. *See* above 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 Defendant’s 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 disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 10	
10. The system of claim 9, wherein the output optical light comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, and wherein the optical wavelengths comprise near infrared and visible wavelengths.	*See* claim 9 above. Isaacson discloses or renders obvious the plurality of optical wavelengths comprises three optical wavelengths for measuring at least a portion of the one or more of the physiological parameters, wherein the optical wavelengths comprise near infrared or visible wavelengths. *See* above at claim 1[m]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
Claim 15	
15[pre]. A system for measuring one or more physiological parameters and for use with a smart phone or tablet, the system comprising:	By providing this disclosure, Defendants do not take a position on whether the preamble is limiting. Isaacson discloses or renders obvious a system for measuring one or more physiological parameters and for use with a smart phone or tablet. *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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it

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	would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[a]. a wearable device adapted to be placed on teeth, a wrist, or an ear of a user,	Isaacson discloses or renders obvious a wearable device adapted to be placed on teeth, a wrist, or an ear of a user *See* above at claim 1[a]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[b]. including a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths;	Isaacson discloses or renders obvious a wearable device includes a light source comprising a driver and a plurality of semiconductor sources that are light emitting diodes, the light emitting diodes configured to generate an output optical light having one or more optical wavelengths *See* above at claim 1[b]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[c]. the 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;	Isaacson discloses or renders obvious the 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. *See* above at claim 1[c].

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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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[d]. the wearable device further comprising 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,	Isaacson discloses or renders obvious the wearable device further comprising 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. *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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[e]. wherein the detection system is configured to be synchronized to the light source;	Isaacson discloses or renders obvious the detection system is configured to be synchronized to the light source. *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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[f]. 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 spatially separated detectors;	Isaacson 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 spatially separated detectors. *See* above at claim 1[f]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant's Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[g]. the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a microphone, a speaker, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, wherein the smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link;	Isaacson discloses or renders obvious the smart phone or tablet comprising a wireless receiver, a wireless transmitter, a display, a speaker, a voice input module, a microprocessor and a touch screen, the smart phone or tablet configured to receive and process at least a portion of the output signal, whereinthe smart phone or tablet is configured to store and display the processed output signal, and wherein at least a portion of the processed output signal is configured to be transmitted over a wireless transmission link. *See* above at claim 1[g]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant's Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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15[h]. wherein the output signal is indicative of one or more of the physiological parameters;	Isaacson discloses or renders obvious the output signal is indicative of one or more of the physiological parameters. *See* above at claim 1[h]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[i]. 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; and	Isaacson discloses or renders obvious 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. *See* above at claim 1[i]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[j]. the detection system further configured to: generate a first signal responsive to light received while the light emitting diodes are off	Isaacson 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* above at claim 1[j]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, 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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15[k]. generate a second signal responsive to light received while at least one of the light emitting diodes is on, and	Isaacson discloses or renders obvious the detection system further configured to generate a second signal responsive to light received while at least one of the light emitting diodes is on. *See* above at claim 1[k]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[l]. increase the signal-to-noise ratio by comparing the first signal and the second signal; and	Isaacson discloses or renders obvious the detection system further configured to increase the signal-to-noise ratio by comparing the first signal and the second signal. *See* above at claim 1[l]. One of ordinary skill would find this limitation disclosed either expressly or inherently in the teachings of the reference and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention, as evidenced, for example, by substantial other references identified in Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[m]. wherein the plurality of semiconductor sources comprises six light emitting diodes, and wherein the	Isaacson discloses or renders obvious the plurality of semiconductor sources comprises six light emitting diodes, and wherein the plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs.

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plurality of semiconductor sources and the plurality of spatially separated detectors are located on one or more arcs; and.	*See* above 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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.
15[n]. wherein the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin.	Isaacson discloses or renders obvious the output optical light comprises wavelengths between 600 nm and 1000 nm to measure a level of oxy-hemoglobin and deoxy-hemoglobin. *See* above at claim 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 Defendant’s Invalidity Contentions. Rather than repeat those disclosures here, they are incorporated by reference into this chart. To the extent this limitation is not disclsoed by Isaacson, it would have been obvious to one of ordinary skill in the art to combine, with the teachings of Isaacson, those elements, as known to them or as disclosed by other prior art identified in the cover pleading.

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