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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
62/061,497	10/08/2014	Eric Hensen	1095.00006

39682
Widerman Malek, PL
1990 W. New Haven Avenue, Suite 201
Melbourne, FL 32904

CONFIRMATION NO. 7662
POA ACCEPTANCE LETTER



Date Mailed: 03/19/2015

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/10/2015.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/agizaw/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:



Practitioners associated with Customer Number:

39682

OR

Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number

Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:



The address associated with Customer Number:

39682

OR

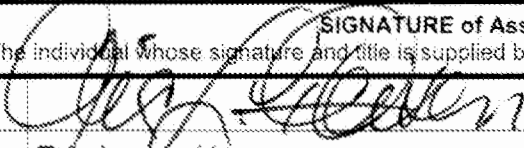
☐	Firm or Individual Name			
Address				
City		State		Zip
Country				
Telephone		Email		

Assignee Name and Address: K & E Holdings, LLC
6569 Crews Lake Crest Loop
Lakeland, FL 33813

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	03/05/15
Name	Eric Logan Hensen	Telephone	(850)-459-9149
Title	Inventor		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)Applicant/Patent Owner: Eric Hensen, Jason Andrew Petro, Thomas James Bryan, Robert Neal Tingler, and Chris CarlsonApplication No./Patent No.: 62/061,497 Filed/Issue Date: October 08, 2014Titled: Ear-Mounted Device with Integrated Pulse Oximetry and Associated MethodsK & E Holdings, LLC, a Limited Liability Company

(Name of Assignee)

(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose one of options 1, 2, 3 or 4 below):1. ☒ The assignee of the entire right, title, and interest.2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.4. ☐ The recipient, via a court proceeding or the like (e.g., bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose one of options A or B below):A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 035001, Frame 0998, or for which a copy thereof is attached.B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

[Page 1 of 2]

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.☐ Additional documents in the chain of title are listed on a supplemental sheet(s).☒ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature

Eric Logan Hensen

Printed or Typed Name

Date

Inventor

Title or Registration Number

[Page 2 of 2]

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	21722171
Application Number:	62061497
International Application Number:	
Confirmation Number:	7662
Title of Invention:	Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods
First Named Inventor/Applicant Name:	Eric Hensen
Customer Number:	39682
Filer:	Mark R. Malek/Heather Tellone
Filer Authorized By:	Mark R. Malek
Attorney Docket Number:	1095.00006
Receipt Date:	10-MAR-2015
Filing Date:	08-OCT-2014
Time Stamp:	11:38:29
Application Type:	Provisional

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		POA_and_Statement_AsFiled.pdf	4415289 73d737e625b67b331cd3c59a4e16a1670ba2fd0d	yes	4

	Multipart Description/PDF files in .zip description		
	Document Description	Start	End
	Power of Attorney	1	1
	Assignee showing of ownership per 37 CFR 3.73.	2	4
Warnings:			
Information:			
Total Files Size (in bytes):		4415289	
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.			



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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
62/061,497	10/08/2014		130	1095.00006		

CONFIRMATION NO. 7662

39682

Zies Widerman & Malek
1990 W. New Haven Avenue, Suite 201
Melbourne, FL 32904

FILING RECEIPT



Date Mailed: 10/21/2014

Receipt is acknowledged of this provisional patent application. It will not be examined for patentability and will become abandoned not later than twelve months after its filing date. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Eric Hensen, Lakeland, FL;
Jason Andrew Petro, Rockledge, FL;
Thomas James Bryan, Melbourne Beach, FL;
Robert Neal Tingler, Satellite Beach, FL;
Chris Carlson, Melbourne, FL;

Applicant(s)

K&E Holdings, LLC, Lakeland, FL

Power of Attorney:

Daniel Pierron--65173

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

If Required, Foreign Filing License Granted: 10/20/2014

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 62/061,497**

Projected Publication Date: None, application is not eligible for pre-grant publication

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier

license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit <http://www.SelectUSA.gov> or call +1-202-482-6800.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1095.00006
		Application Number	
Title of Invention	Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor 1					Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	Eric		Hensen			
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service						
City	Lakeland	State/Province	FL	Country of Residence i	US	
Mailing Address of Inventor:						
Address 1		6569 Crew Lake Crest Loop				
Address 2						
City	Lakeland	State/Province	FL			
Postal Code	33813	Country i	US			
Inventor 2					Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	Jason	Andrew	Petro			
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service						
City	Rockledge	State/Province	FL	Country of Residence i	US	
Mailing Address of Inventor:						
Address 1		1117 Auburn Lakes Drive				
Address 2						
City	Rockledge	State/Province	FL			
Postal Code	32955	Country i	US			
Inventor 3					Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	Thomas	James	Bryan			
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service						

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1095.00006
		Application Number	
Title of Invention	Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods		

City	Melbourne Beach	State/Province	FL	Country of Residence i	US
-------------	-----------------	-----------------------	----	-------------------------------	----

Mailing Address of Inventor:

Address 1	513 Poinsettia Rd				
Address 2					
City	Melbourne Beach	State/Province	FL		
Postal Code	32951	Country i	US		

Inventor 4

Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Robert	Neal	Tingler	

Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service

City	Satellite Beach	State/Province	FL	Country of Residence i	US
-------------	-----------------	-----------------------	----	-------------------------------	----

Mailing Address of Inventor:

Address 1	469 N Waterway Dr				
Address 2					
City	Satellite Beach	State/Province	FL		
Postal Code	32937	Country i	US		

Inventor 5

Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Chris		Carlson	

Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service

City	Melbourne	State/Province	FL	Country of Residence i	US
-------------	-----------	-----------------------	----	-------------------------------	----

Mailing Address of Inventor:

Address 1	4243 Palladian Way				
Address 2					
City	Melbourne	State/Province	FL		
Postal Code	32904	Country i	US		

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.

Add

Correspondence Information:Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).☐ An Address is being provided for the correspondence Information of this application.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1095.00006	
		Application Number		
Title of Invention	Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods			
Customer Number	39682			
Email Address	mark@zwmlegal.com	Add Email	Remove Email	
Email Address	docket@zwmlegal.com	Add Email	Remove Email	

Application Information:

Title of the Invention	Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods			
Attorney Docket Number	1095.00006	Small Entity Status Claimed ☒		
Application Type	Provisional			
Subject Matter	Utility			
Total Number of Drawing Sheets (if any)	6	Suggested Figure for Publication (if any)		1

Filing By Reference :

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐ Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.			
Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	39682		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1095.00006
		Application Number	
Title of Invention	Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the application number blank.

Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			Add

Foreign Priority Information:

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

- ☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
- NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1095.00006
		Application Number	
Title of Invention	Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods		

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Organization Name	K&E Holdings, LLC	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1095.00006
		Application Number	
Title of Invention	Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods		

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1095.00006		
		Application Number			
Title of Invention	Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods				
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EAR-MOUNTED DEVICE WITH INTEGRATED PULSE OXIMETRY AND ASSOCIATED METHODS

Field of the Invention

[0001] The present invention relates to systems and methods for ear-mounted devices with integrated pulse oximetry capability.

Brief Description of the Drawings

[0002] FIG. 1 is a perspective view of an ear-mounted device according to an embodiment of the present invention.

[0003] FIG. 2 is another perspective view of the ear-mounted device of FIG. 1.

[0004] FIG. 3 is a first side sectional elevation view of the ear-mounted device of FIG. 1.

[0005] FIG. 4 is a second side sectional elevation view of the ear-mounted device of FIG. 1.

[0006] FIG. 5 is an environmental view of an ear-mounted device according to an embodiment of the present invention being worn on the ear of a user.

[0007] FIG. 6 is a plurality of plots of data generated by a radiation sensing device according to an embodiment of the invention.

[0008] FIG. 7 is a flowchart illustrating a method of performing pulse oximetry according to an embodiment of the invention.

[0009] FIG. 8 is a flowchart illustrating another method of performing pulse oximetry according to an embodiment of the invention.

Detailed Description of the Invention

[0010] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Those of ordinary skill in the art realize that the following descriptions of the embodiments of the present invention are illustrative and are not intended to be limiting in any way. Other embodiments of the present invention will readily suggest themselves to such skilled persons having the benefit of this disclosure. Like numbers refer to like elements throughout.

[0011] Although the following detailed description contains many specifics for the purposes of illustration, anyone of ordinary skill in the art will appreciate that many variations and alterations to the following details are within the scope of the invention. Accordingly, the following embodiments of the invention are set forth without any loss of generality to, and without imposing limitations upon, the invention.

[0012] In this detailed description of the present invention, a person skilled in the art should note that directional terms, such as "above," "below," "upper," "lower," and other like terms are used for the convenience of the reader in reference to the drawings. Also, a person skilled in the art should notice this description may contain other terminology to convey position, orientation, and direction without departing from the principles of the present invention.

[0013] Furthermore, in this detailed description, a person skilled in the art should note that quantitative qualifying terms such as "generally," "substantially," "mostly," and other terms are used, in general, to mean that the referred to object, characteristic, or quality constitutes a majority of the subject of the reference. The meaning of any of these terms is dependent upon the context within which it is used, and the meaning may be expressly modified.

[0014] An embodiment of the invention, as shown and described by the various figures and accompanying text, provides an ear-mounted device comprising integrated pulse oximetry capabilities. The ear-mounted device may be configured to measure at least one of the pulse and the oxygen saturation of a user while simultaneously providing acoustic functionality to the user. Furthermore, the ear-mounted device may be configured to be wirelessly connected to an electronic device so as to provide the pulse oximetry information generated thereby to the electronic device. The ear-mounted device may be removably attached to an ear of the user so as to resist unintended detachment during periods of activity by the user, such as any type of exercise or athletic endeavor, including, but not limited to, running, jogging, stretching, acrobatics, aerobics, cycling, swimming, and any other type of high-impact, low-impact, or no impact exercise as is known. Current pulse oximetry devices that are attachable to an ear of the user are limited to clipping to the lobe, which is insecure and easily unintentionally detachable by design, and is likely to become detached during physical activity.

[0015] Embodiments of the ear-mounted pulse oximeter device of the present invention will be presented in the context of an ear-mounted device capable of audio playback for the user. However, the pulse oximetry features of the present invention do not require the acoustic capabilities of an ear-mounted device to provide pulse oximetry functionality. Accordingly, ear-mounted devices that provide pulse oximetry capability but are not operable to provide audio playback are contemplated and included within the scope of the invention.

[0016] Furthermore, while the ear-mounted device shown in the embodiments below may be directed to a particular orientation, i.e. is configured to be attached to the right ear of a user, an ear-mounted device oriented for attachment to the left ear of a user is contemplated and included within the scope of the invention.

[0017] Referring now to FIGS. 1-5 an ear-mounted device 100 according to an embodiment of the present invention is presented. The ear-mounted device 100 may be configured to be carried by an ear of the user in such an orientation so as to provide acoustic playback functionality to the user while also generating biometric information about the user, including pulse and oxygen saturation. The ear-mounted device 100

may comprise a proximal housing 200, an intermediate section 300, and a distal housing 400. The intermediate section 300 may be attached at a first end 302 to the proximal housing 200 and at a second end 304 to the distal housing 400. In some embodiments, one or more of the proximal housing 200, the intermediate section 300, and the distal housing 300 may be at least partially integrally formed.

[0018] Each of the proximal and distal housings 200, 400 and the intermediate section 300 may be configured such that, when attached, the ear-mounted device 100 may be positionable so as to be carried by an ear of the user. Furthermore, each of the proximal and distal housings 200, 400 and the intermediate section 300 may be configured such that when the ear-mounted device 100 is carried by the ear of the user, the proximal housing 200 is positioned generally behind the ear, and the distal housing 400 is positioned generally in front of the ear, such that at least one structure of the ear of the user is intermediate the proximal and distal housings 200, 400. Furthermore, when the ear-mounted device 100 is carried by the ear of the user, the intermediate section 300 may be positioned at least partially above a structure of the ear, such as the auricle.

[0019] Additional details regarding the proximal housing 200 will now be discussed. The proximal housing 200 may be configured to permit circuitry to be positioned therewithin. Referring now to FIGS. 3-4, the proximal housing 200 may comprise an outer wall 202 defining an interior section 204. The interior section 204 may be configured to permit circuitry to be positioned therewithin. Additionally, the outer wall 202 may comprise a proximal aperture 206 configured to permit electromagnetic radiation to pass therethrough, including radiation within at least one of the visible spectrum having a wavelength within the range from 390 nm to 700 nm, the infrared spectrum from 700 nm to 1 mm, and the ultraviolet spectrum from 10 nm to 390 nm. The proximal aperture 206 may be positioned within the outer wall 202 generally proximate to the distal housing 400 such that no other element or structure of the ear-mounted device 100 is intermediate the proximal aperture 206 and the distal housing 400. In some embodiments, the outer wall 202 may further comprise a proximal optic 208 configured to permit the above-recited electromagnetic radiation to pass therethrough while providing a seal between the proximal optic 208 and the outer wall

202, shielding the interior section 204 from the environment surrounding the proximal aperture 206. Furthermore, the proximal optic 208 may further be configured to reflect, refract, redirect, collimate, or otherwise change the direction of radiation traversing therethrough or is incident thereupon.

[0020] The distal housing 400 may comprise an outer wall 402, a canal member 404 attached to and extending from the outer wall 402, and an interior section 406 defined by the outer wall 402. The outer wall 402 may comprise a distal aperture 408 through which electromagnetic radiation, as discussed for the proximal aperture 206 of the proximal housing 200, may pass. Furthermore, the distal housing 400 may comprise a distal optic 410 configured to permit electromagnetic radiation to propagate therethrough while forming a seal with the outer wall 402 so as to shield the interior section 406 from the environment surrounding the distal housing 400. Furthermore, the distal optic 410 may further be configured to reflect, refract, redirect, collimate, or otherwise change the direction of radiation traversing therethrough or is incident thereupon. The canal member 404 may be configured to extend at least partially into an ear canal of the user. Furthermore, the canal member 404 may be configured to interface with a structure of the ear of the user.

[0021] The ear-mounted device 100 may further comprise a radiation emitting device 500, a radiation sensing device 600, processing circuitry 700, and a power source 800. One or both of the radiation emitting device 500 and the radiation sensing device 600 may be positioned in communication with the processing circuitry 700. Such communication may be established by wired communication or by wireless communication. Furthermore, the processing circuitry 700 may be configured to control the operation of either or both of the radiation emitting device 500 and the radiation sensing device 600.

[0022] The power source 800 may be any device capable of delivering electrical power to the electrical components of the ear-mounted device. Such devices include batteries, including all types of batteries known in the art, including rechargeable and non-rechargeable batteries. Additionally, each of the radiation emitting device 500, the radiation sensing device 600, and the processing circuitry 700 may be electrically

connected, either directly or indirectly, with the power source 800 to be powered thereby.

[0023] The radiation emitting device 500 will now be discussed in greater detail. The radiation emitting device 500 may be any device capable of emitting electromagnetic radiation within the wavelength ranges recited hereinabove. Such devices may include, but are not limited to, semiconductor devices, such as light-emitting diodes (LEDs), incandescent lighting devices, halogen lighting devices, and all other light-emitting devices as are known in the art. In the present embodiment, the radiation emitting device 500 may comprise one or more LEDs. Furthermore, the radiation emitting device 500 may be configured to emit light having a single peak wavelength intensity or multiple peak wavelength intensities. In some embodiments, the radiation emitting device 500 may be configured to emit radiation comprising at least two peak wavelength intensities. One peak wavelength intensity may be at a wavelength that is absorptive by a structure of the ear of the user and the anatomy contained therein, specifically hemoglobin within the structure. Such a wavelength may be within the red visible light spectrum. Another peak wavelength intensity may be at a wavelength that is non-absorptive. Such a wavelength may be within the infrared spectrum.

[0024] The radiation emitting device 500 may be positioned proximate to and in optical communication with at least one of the proximal aperture 206 of the proximal housing 200 and the distal aperture 408 of the distal housing 400. More specifically, the radiation emitting device 500 may be positioned such that radiation emitted therefrom may propagate through at least one of the proximal aperture 206 and the distal aperture 408. Additionally, the radiation emitting device 500 may be configured to emit light to cooperate with at least one of the proximal optic 208 and the distal optic 410 to affect radiation emitted thereby.

[0025] Furthermore, the radiation emitting device 500 may be connected to the processing circuitry 700 so as to have its operation controlled thereby. Accordingly, the radiation emitting device 500 may selectively emit radiation responsive to a signal received from the processing circuitry 700. The radiation emitting device 500 may be configured to emit radiation responsive to various characteristics of the signal from the

processing circuitry 700, including duty cycle, intensity, spectral power distribution, and any other characteristics of light as is known in the art.

[0026] The radiation sensing device 600 will now be discussed in greater detail. The radiation sensing device 600 may be any device capable of sensing electromagnetic radiation within the wavelength ranges recited hereinabove. Such devices may include, but are not limited to, semiconductor devices such as photodiodes, avalanche photodiodes, active-pixel sensors, charge-coupled devices, and LEDs, photomultiplier tubes, and any other sensing devices as are known in the art. In some embodiments, the radiation sensing device 600 may be configured to sense electromagnetic radiation corresponding to one or more peak wavelength intensities associated with the radiation emitting device 500. Additionally, the radiation sensing device 600 may be configured to sense electromagnetic radiation from the ambient environment surrounding the ear-mounted device 100.

[0027] Additionally, the radiation sensing device 600 may be positioned proximate to and in optical communication with at least one of the proximal aperture 206 of the proximal housing 200 and the distal aperture 408 of the distal housing 400. Generally, the radiation sensing device 600 may be positioned proximate to the aperture other than the aperture that the radiation emitting device 500 is proximate to. More specifically, the radiation sensing device 600 may be positioned such that radiation may propagate through at least one of the proximal aperture 206 and the distal aperture 408 and then be incident upon the radiation sensing device 600. Additionally, the radiation sensing device 600 may be configured to cooperate with at least one of the proximal optic 208 and the distal optic 410 such that radiation passing therethrough may be increasingly sensible by the radiation sensing device 600. For example, either of the proximal optic 208 and the distal optic 410 may be configured to at least one of collimate and focus radiation so as to be sensed by the radiation sensing device 600.

[0028] The radiation sensing device 600 may be configured to have a sampling rate that generates a certain number of measurements of radiation sensed per second. The sampling rate may be sufficient to obtain the cycle of blood oxygen absorption. In the present embodiment, the radiation sensing device 600 may generate at least 500 samples per second of measured radiation. Moreover, the radiation sensing device 600

may generate at least 500 samples per second of measured radiation per peak wavelength intensity, such that each peak intensity associated with the radiation emitting device 500 has an associated sampling rate of at least 500 samples per second. In some embodiments, the number of samples per second for each peak wavelength intensity may be equal, or they may vary. Additionally, the radiation sensing device 600 may generate ambient light measurements at a rate of at least 500 samples per second. In some embodiments, the sampling frequency for the ambient light may be equal to the sampling frequency of the peak wavelength intensity associated therewith.

[0029] When radiation is incident upon the radiation sensing device 600, it may generate a signal responsive to the incident radiation, the signal comprising sensed data. The signal generated thereby may be transmitted to the processing circuitry 700 and may provide an indication of a biometric characteristic of the user. The processing circuitry 700 may be configured to analyze the signal generated by the radiation sensing device 600 so as to determine the biometric characteristic indicated thereby, which will be discussed in greater detail hereinbelow.

[0030] Each of the proximal aperture 206, the distal aperture 408, the radiation emitting device 500, and the radiation sensing device 600 may be positioned so as to collectively emit electromagnetic radiation that passes through a structure of the ear of the user and is sensed so as to determine a biometric characteristics of the user, such as pulse and/or oxygen saturation. Any structure of the ear through which radiation emitted by the radiation emitting device 500 may pass is contemplated and included within the scope of the invention, including, but not limited to, the concha, such as the concha bowl, antihelix, scapha, helix, superior crus of the antihelix, triangular fossa, inferior crus of the antihelix, crus of the helix, tragus, antitragus, and lobe. In the present embodiment, radiation may be emitted to as to pass through the concha bowl. More specifically, the radiation emitting device 500 may be positioned within the distal housing 400, emit electromagnetic radiation through the distal aperture 408 (and, where present, the distal optic 410), pass through the concha bowl of the user and the proximal aperture 206 (and, where present, the proximal optic 208), and be incident upon the radiation sensing device 600.

[0031] The ear-mounted device 100 may be removably attachable to an ear of the user so as to remain attached during periods of athletic activity as described hereinabove. Moreover, the ear-mounted device 100 may be configured so as to reduce relative motion between the ear of the user and the device 100. Referring specifically to FIG. 5, the ear-mounted device 100 may be configured to interface with the ear of the user at four points, namely, at an upper point of the helix 1, at upper and lower points on the rear of the auricle 2 and 3, and within the concha bowl 4. By minimizing relative motion, the ear-mounted device 100 may minimize the migration thereof with respect to the ear of the user, such that approximately the same structure of the ear is intermediate the radiation emitting device 500 and the radiation sensing device 600, maintaining a consistent absorptive structure therebetween.

[0032] In some embodiments, the ear-mounted device 100 may further comprise an accelerometer 900. The accelerometer 900 may be configured to provide an indication of the instantaneous acceleration of the ear-mounted device 100. The accelerometer 900 may be any type of accelerometer device as is known in the art, including multi-axis accelerometers. Additionally, the accelerometer 900 may be communicatively connected to the processing circuitry 700, thereby transmitting a signal to the processing circuitry 700 indicating the acceleration measured thereby. In such embodiments, the processing circuitry 700 may be configured to analyze data generated by the radiation sensing device 600 responsive to an indication of acceleration from the accelerometer 900. More specifically, the processing circuitry 700 may be configured to identify and remove noise from the signal generated by the radiation sensing device 600 responsive to an indication of acceleration from the accelerometer 900 at a given time period. More information regarding the removal of noise associated with acceleration will be discussed in greater detail.

[0033] Additional details regarding the processing circuitry 700 will now be discussed in greater detail. The processing circuitry 700 may be configured to analyze a data signal comprising sensed data generated by the radiation sensing device 600 so as to determine a biometric characteristic of the user, such as pulse and oxygen saturation. The processing circuitry 700 may comprise all necessary electrical components so as to carry out the analysis as described herein. Any supportive

electronic components as are known in the art in furtherance of this analysis are contemplated and included within the scope of the invention, if not recited specifically herein.

[0034] The processing circuitry 700 may comprise a processor, a memory positioned in communication with the processor, and a communication device. The memory may comprise an algorithm configured to be applied to the data generated by the radiation sensing device 600, defined as the sensed data. Any type of processor and memory as are known in the art are contemplated and included within the scope of the invention. The algorithm may be any type of algorithm that may be applied to the sensed data so as to generate related to determining the pulse and/or oxygen saturation of the user, including, but not limited to, matching pursuit algorithms. The algorithm may be operable to generate data related to the sensed data, including, but not limited to, time coefficients, amplitude coefficients, and a reconstructed waveform. The time coefficient may be a scalar factor by which a feature, such as an approximate period of a waveform, of the sensed data deviates from an average time feature, the average time feature being defined and stored on the memory. The amplitude coefficient may be a scalar factor by which a feature, such as an approximate waveform amplitude, of the sensed data deviates from an average amplitude feature, the average amplitude feature being defined and stored on the memory. The reconstructed waveform may be an approximation of the sensed data as the selection of an atom that best matches the sensed data from a dictionary of atoms related to pulse oximetry devices. Accordingly, the memory of the processing circuitry 700 may further comprise the described dictionary of atoms. Furthermore, the dictionary may further comprise amplitude and time coefficients associated with the atoms, such that the dictionary comprises a plurality of atoms that are derived from the manipulation of a reference atom, representing an ideal atom, by amplitude and time coefficients, providing an overcomplete dictionary of pulse oximetry atoms.

[0035] The communication device may be configured to communicate with a remote computerized device, either over a wired connection or a wireless connection. Such remote computerized devices may include, but are not limited to, smart phones, tablet computers, personal computers, notebook computers, and the like. Wireless

transmission standards such as Bluetooth, Zigbee, Wi-Fi, Wi-Fi direct, or any other wireless communication standard as is known in the art. Additionally, in some embodiments, the communication device may be configured to communicate across a network, such as a cellular network, an 802.xx network, or wireless network communication system or standard as is known in the art.

[0036] Additional details regarding various capabilities and function of the processing circuitry 700, including processing and audio playback, as well as the ear-mounted device 100 in general, may be found in U.S. Patent Application Serial No. 12/731,397 titled *Stereo Audio Headphone Apparatus For A User Having Hearing Loss And Related Methods* filed March 25, 2010, the content of which is incorporated herein by reference in its entirety, except to the extent disclosure therein is inconsistent with disclosure herein.

[0037] In embodiments comprising an accelerometer 900, the dictionary may further comprising one or more atoms directed to an atom where noise resulting from motion is included, defined as a motion atom. As such, a signal from the radiation sensing device 600 comprising noise resulting from the measured acceleration may be identified by the matching pursuit algorithm by determining a motion atom from the dictionary most closely matches the signal. Furthermore, for each motion atom, there may be an associated correction factor that may be applied to the signal, the correction factor being configured to eliminate the noise associated with the acceleration. Accordingly, when the decomposition is completed, the noise introduced to the signal as a result of the motion may be removed from the signal by application of the correction factor.

[0038] The memory of the processing circuitry 700 may further comprise a neural network. The neural network may be configured to perform additional analysis and manipulation to identified features of the sensed data. In some embodiments, the neural network may be configured to perform data compression on the identified features, increase Shannon entropy of the sensed data, increase Kurtosis of the sensed data, and performing independent decomposition of the sensed data into additive subcomponents.

[0039] The neural network may be any type of neural network as is known in the art, including, but not limited to, feedforward neural networks. Additionally, in some embodiments, the neural network may be managed by comparison of the sensed data to a basic atom, similar to the basic atom of the dictionary as described above.

[0040] Additional details regarding the analysis of the signal generated by the radiation sensing device 600 will now be presented. In FIG. 6, plots of signals generated by a radiation sensing device according to the present invention are provided. Plot 6010 represents sensed levels of IR radiation while a radiation emitting device is emitting IR radiation. Plot 6020 represents sensed levels of ambient IR radiation, i.e. IR radiation not generated by the radiation emitting device. Plot 6030 represents sensed levels of electromagnetic radiation within the red portion of the visible spectrum, i.e. within the range from 620 nm to 750 nm, while the radiation emitting device is emitting radiation within that wavelength range. Plot 6040 represents sensed levels of ambient red light. Each of the plots 6010, 6020, 6030, 6040 represent raw data generated by the radiation sensing device and transmitted to processing circuitry, as described hereinabove. The rate at which data is generated by the radiation sensing device is discussed above. In the present embodiment, the generation rate is at least 500 samples per second.

[0041] Each of the plots 6010, 6020, 6030, 6040 may comprise therein a plurality of atoms. The atoms may reflect a periodic biological cycle, such as a cardiac cycle. The decomposition of the plots 6010, 6020, 6030, 6040 into identifiable atoms may be performed by the processing circuitry 700 as described hereinabove. The identification atoms within any one of the plots 6010, 6020, 6030, 6040, i.e. the atomic decomposition, may be performed by the processing circuitry 700. More specifically, the atomic decomposition may be performed by the execution of the matching pursuit algorithm as described hereinabove by the processing circuitry 700, applying the algorithm to at least one of the plots 6010, 6020, 6030, 6040. For example, an IR atom 6012 may be identified within the plot 6010, an ambient IR atom 6022 may be identified within plot 6020, a red atom 6032 may be identified within the plot 6030, and an ambient red atom 6042 may be identified within the plot 6040 as a result of the atomic decomposition. It is contemplated that any number of atoms may be identified within a

given segment of a plot. For example, plot 6010 may further have identified therein second and third IR atoms 6014, 6016.

[0042] The processing circuitry 700 may further be configured to determine at least one of a pulse rate indicated by the sensed data, an oxygen saturation indicated by the sensed data, and determination that an acceptable pulse rate and/or oxygen saturation has not been detected. To identify an oxygen saturation of the sensed data, the processing circuitry 700 may refer to a lookup table comprised by the memory of the processing circuitry 700, whereby a given relative intensity of radiation within the visible red spectrum to radiation in the infrared spectrum, as indication of the ratio of the red to infrared light absorption. Such a lookup table is well known in the art. Accordingly, the processing circuitry 700 may be configured to determine the red-to-infrared relative intensity at a given time and determine the oxygen saturation for the determined red-to-infrared relative intensity by referring to the above-described lookup table. Where either the measured red-to-infrared intensity is not defined in the lookup table, or where a red-to-infrared intensity is otherwise indefinable, the processing circuitry 700 may generate an error signal indicating such. Each of the pulse, oxygen saturation, and error signal as may be determined/generated by the processing circuitry 700 may be transmittable by the processing circuitry 700 to an electronic device as described hereinabove. Any method of transmission is contemplated and included within the scope of the invention, including wireless transmission according to wireless transmission standards as are known in the industry, including, but not limited to, Bluetooth, Zigbee, Wi-Fi, and any other IEEE 802.XX standard. The processing circuitry 700 may comprise electronic components necessary to enable such communication.

[0043] Additionally, the processing circuitry 700 may be configured to perform noise reduction. The noise reduction may be affected by referencing an ambient measurement, determining the noise the ambient radiation measurement would apply to the associated emitted radiation measurement, and negating the noised determined to be introduced to the emitted radiation measurement. For example, the processing circuitry 700 may determine the noise that was introduced to the signal represented in plot 6010 from the ambient signal represented in plot 6020 and produce a new plot negating such noise, and the noise introduced to the signal represented in plot 6030

from the ambient signal represented in plot 6040 and produce a new plot negating such noise. The new plot may provide a more accurate estimation of the oxygen saturation by providing a more accurate red-to-infrared relative intensity, from which oxygen saturation may be derived as described hereinabove.

[0044] Referring now to FIG. 7, a flowchart illustrating a method 7000 according to an embodiment of the invention is now presented. Starting at Block 7002, the method 7000 may continue at Block 7004 where radiation may be emitted by a radiation emitting device of an ear-mounted pulse oximetry device. At Block 7006, a radiation sensing device may measure emitted and ambient radiation levels. The measurements may include emitted IR levels, ambient IR levels, emitted red visible light levels, and ambient red visible light levels. At Block 7008, an atomic decomposition may be performed on the measured emitted and ambient radiation levels. The atomic decomposition may be performed as described hereinabove, and may yield the identification of at least one atom, at least one time coefficient of the atom, at least one amplitude coefficient of the atom, and a reconstructed waveform of the waveform.

[0045] In some embodiments, an optional ambient filter may be applied to the sensed data as described hereinabove at Block 7009. An ambient filter may be understood as the application of a filter applied to the sensed data from the emitted radiation signal responsive to the ambient radiation signal.

[0046] At Block 7010 one or more features may be selected. The features may be selected from the data from at least one of the atom identified at Block 7008, the time and amplitude coefficients identified at Block 7008, and/or the reconstructed waveform identified at Block 7008. The selection may be made based on a comparison between the above-recited features and a reference atom, the reference atom representing an ideal atom. Those features that meet a minimum threshold of accuracy when compared to the reference atom, or the feature with the highest degree of accuracy and that is most similar to the reference atom, may be selected at Block 7010. Proceeding at Block 7012, the features selected at Block 7010 may be applied to a neural network, such as a feedforward neural network as described hereinabove. The neural network may at least one of perform data compression on the selected features,

increase Shannon entropy of the sensed data, increase Kurtosis of the sensed data, and perform decomposition of the sensed data into additive subcomponents.

[0047] At Block 7014, it may be determined whether pulse and oxygen saturation are determinable from the output of the neural network. If both are determinable, the method 7000 may continue at Block 7016 where the pulse and oxygen saturation are transmitted to a remote computerized device. If one or neither is determinable, an error indication is transmitted to the remote computerized device at Block 7018. The method may then end at Block 7099

[0048] Referring now to FIG. 8, a flowchart illustrating another method 8000 according to an embodiment of the invention is presented. Starting at Block 8002, the method 8000 may continue at Block 8004 where radiation may be emitted by a radiation emitting device of an ear-mounted pulse oximetry device. At Block 8006, a radiation sensing device may measure emitted and ambient radiation levels. The measurements may include emitted IR levels, ambient IR levels, emitted red visible light levels, and ambient red visible light levels. At Block 8008, an atomic decomposition may be performed on the measured emitted and ambient radiation levels. The atomic decomposition may be performed as described hereinabove, and may yield the identification of at least one atom, at least one time coefficient of the atom, at least one amplitude coefficient of the atom, and a reconstructed waveform of the waveform.

[0049] Continuing at Block 8010, it may be determined whether any of the atoms identified in the atomic decomposition indicates motion of the ear-mounted pulse oximetry device. Alternatively, such an indication may also be indicated from an associated accelerometer. If motion is indicated, the method 8000 may proceed to Block 8011 where motion noise reduction may be performed to the atom identified as a motion atom. Once the motion noise reduction has been performed, or if no motion is indicated at Block 8010, then the method 8000 may proceed to Block 8012 where one or more features may be selected. The features may be selected from the data from at least one of the atom identified at Block 8008, the time and amplitude coefficients identified at Block 8008, and/or the reconstructed waveform identified at Block 8008, as described hereinabove. Proceeding at Block 8014, the features selected at Block 8012 may be applied to a neural network, such as a feedforward neural network as described

hereinabove. The neural network may at least one of perform data compression on the selected features, increase Shannon entropy of the sensed data, increase Kurtosis of the sensed data, and perform decomposition of the sensed data into additive subcomponents.

[0050] At Block 8016, it may be determined whether pulse and oxygen saturation are determinable from the output of the neural network. If both are determinable, the method 8000 may continue at Block 8018 where the pulse and oxygen saturation are transmitted to a remote computerized device. If one or neither is determinable, an error indication is transmitted to the remote computerized device at Block 8020. The method may then end at Block 8099.

[0051] It is contemplated that various aspects of method 7000 and method 8000 may be combined.

[0052] Some of the illustrative aspects of the present invention may be advantageous in solving the problems herein described and other problems not discussed which are discoverable by a skilled artisan.

[0053] While the above description contains much specificity, these should not be construed as limitations on the scope of any embodiment, but as exemplifications of the presented embodiments thereof. Many other ramifications and variations are possible within the teachings of the various embodiments. While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best or only mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the description of the invention. Also, in the drawings and the description, there have been disclosed exemplary embodiments of the invention and, although specific terms may have been employed, they are unless otherwise stated used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention therefore not being so limited. Moreover, the use of

the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another. Furthermore, the use of the terms a, an, etc. do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item.

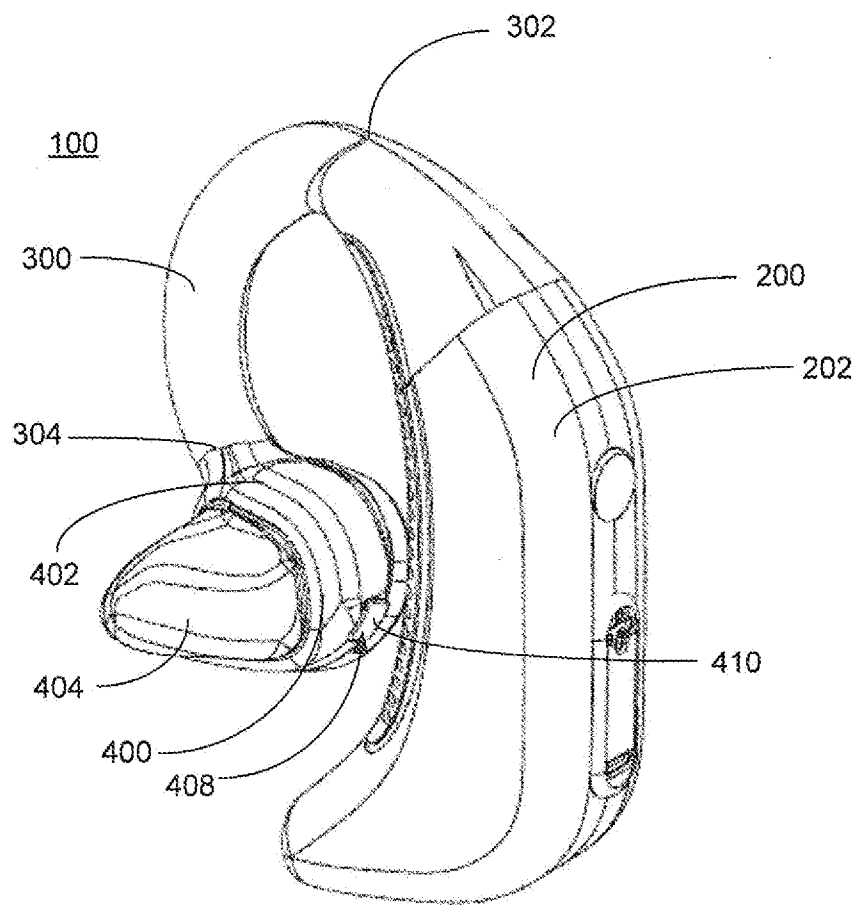


FIG. 1

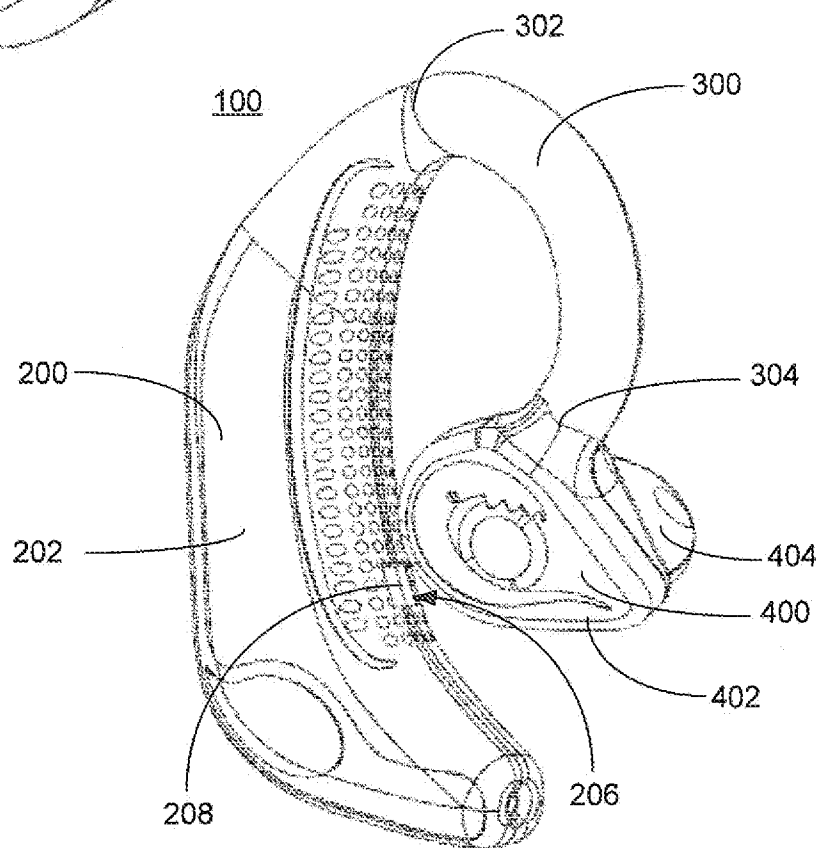


FIG. 2

100

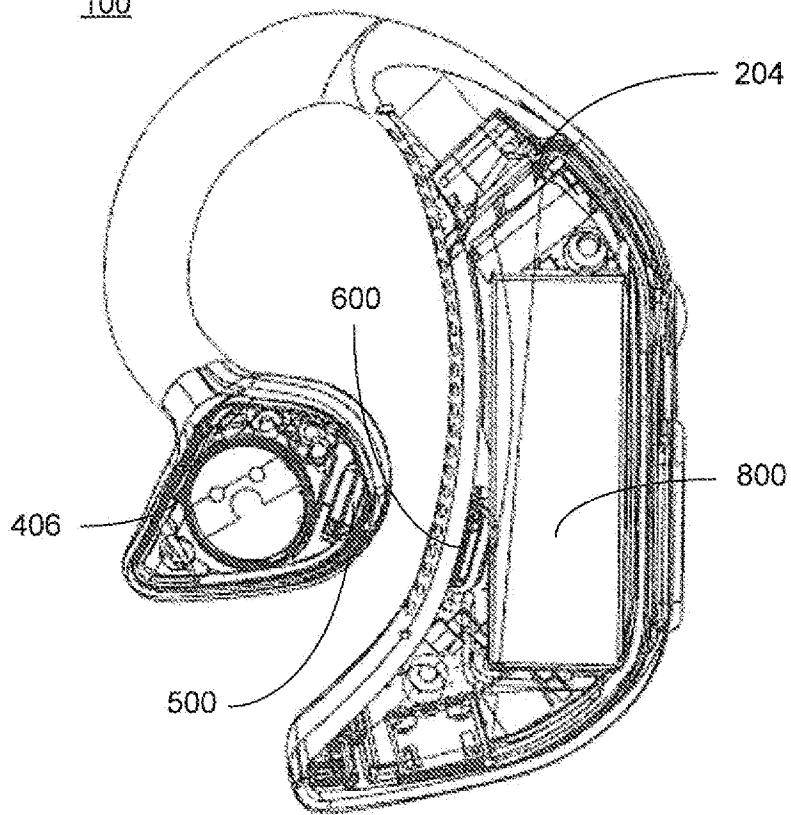


FIG. 3

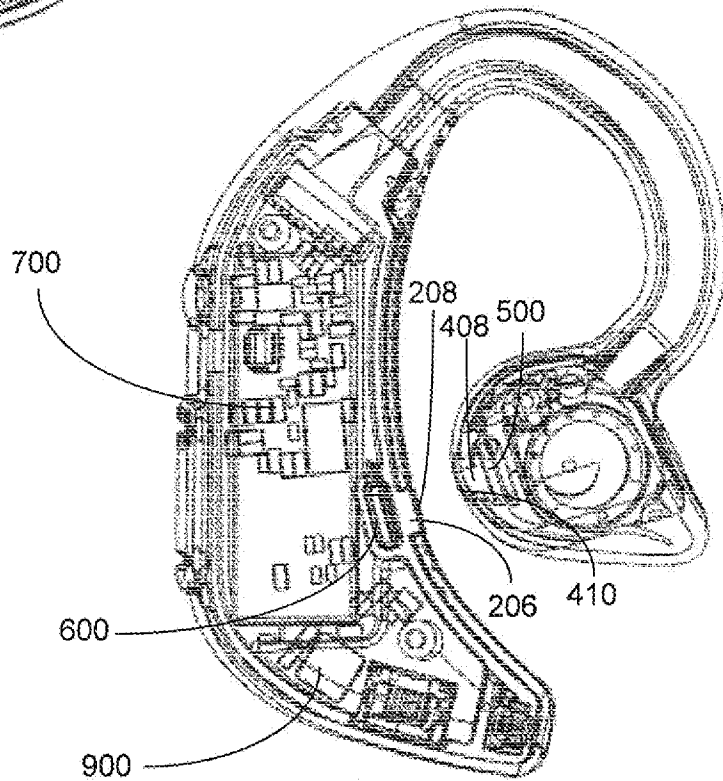


FIG. 4

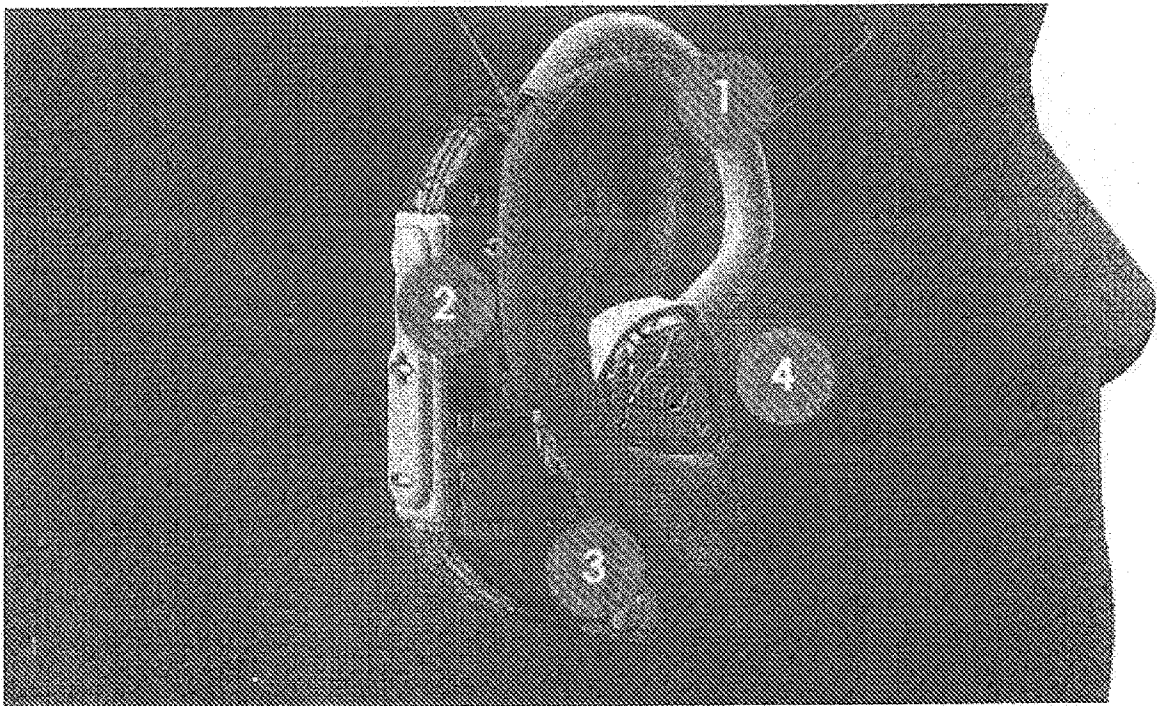


FIG. 5

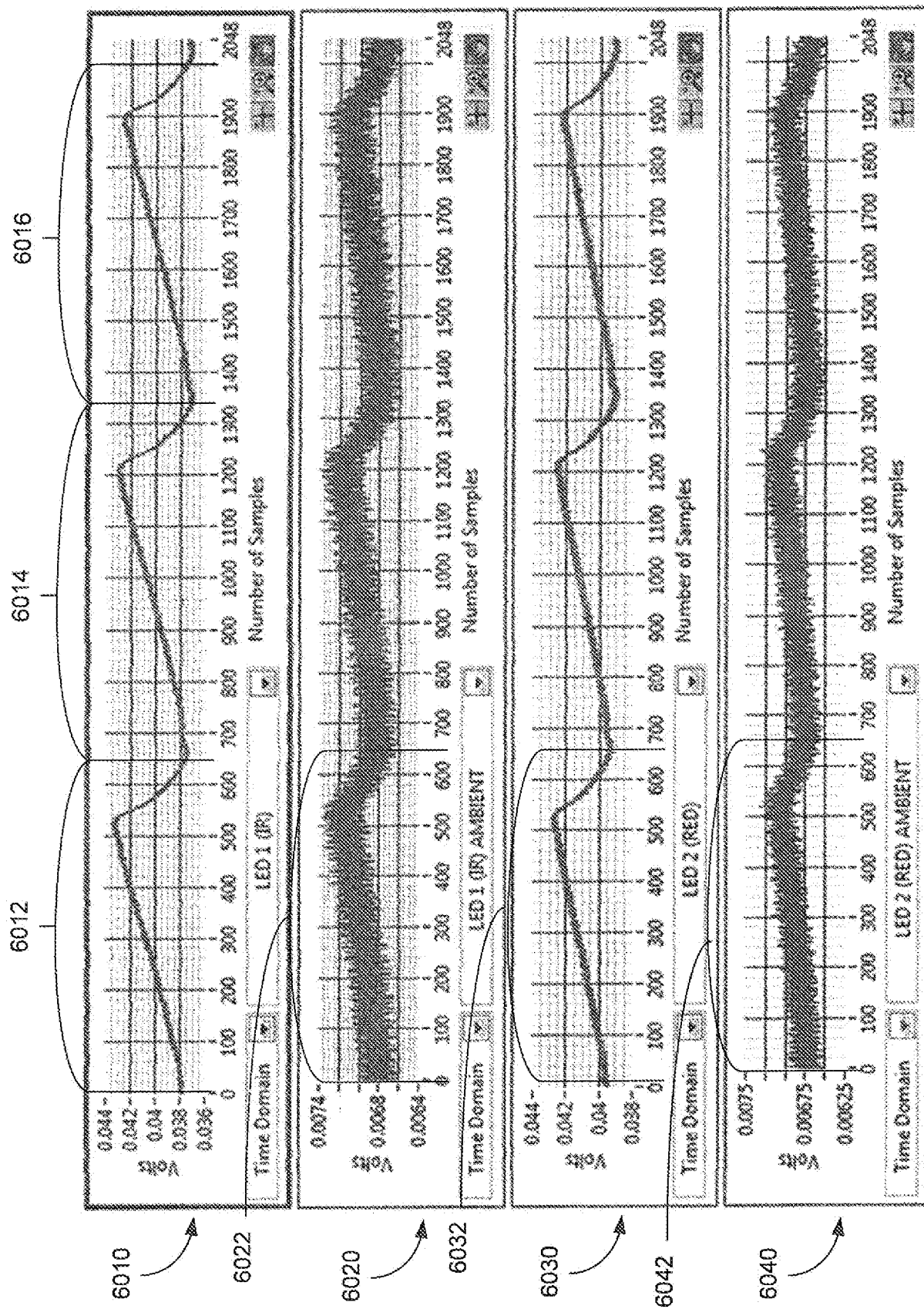


FIG. 6

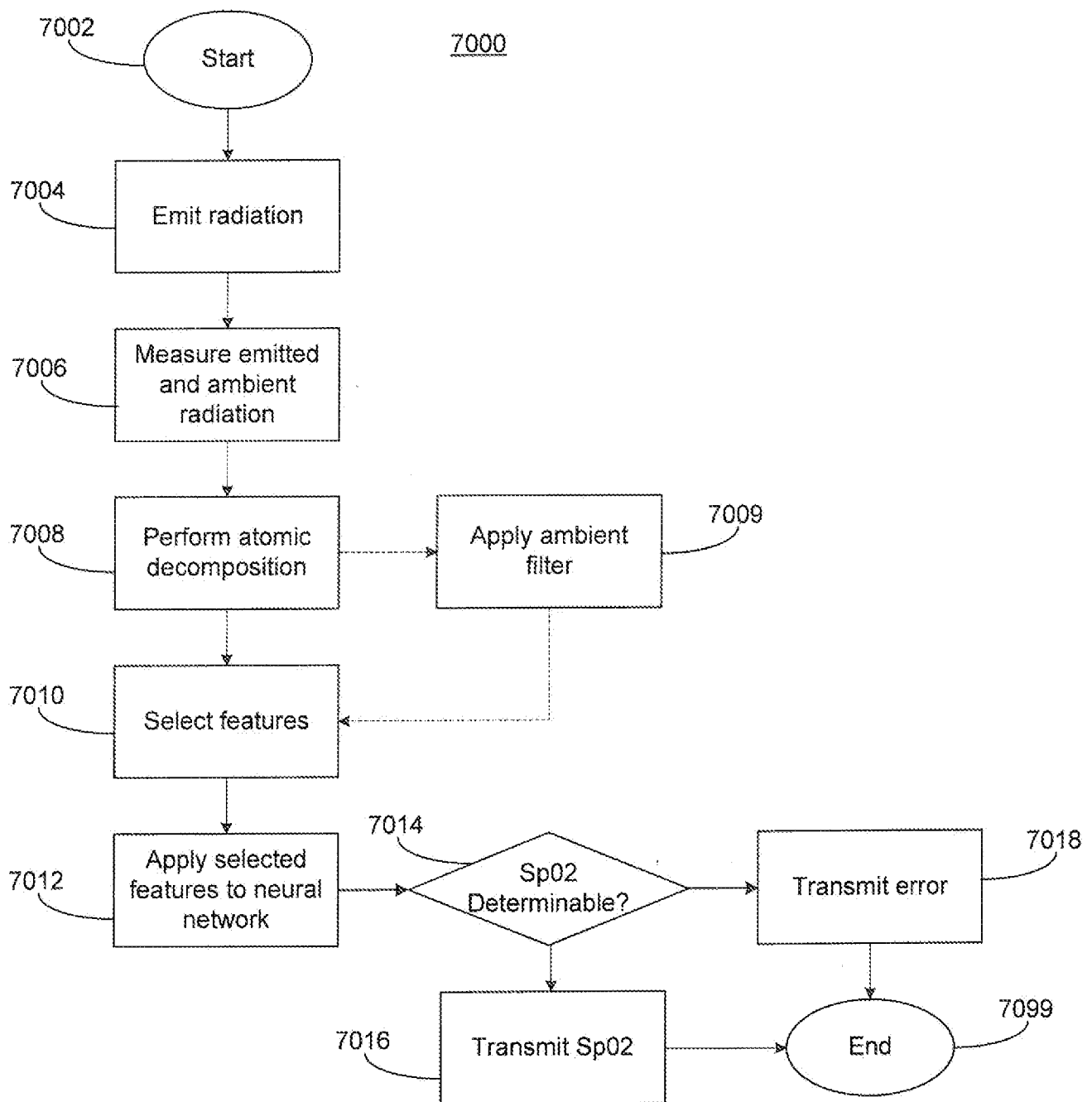


FIG. 7

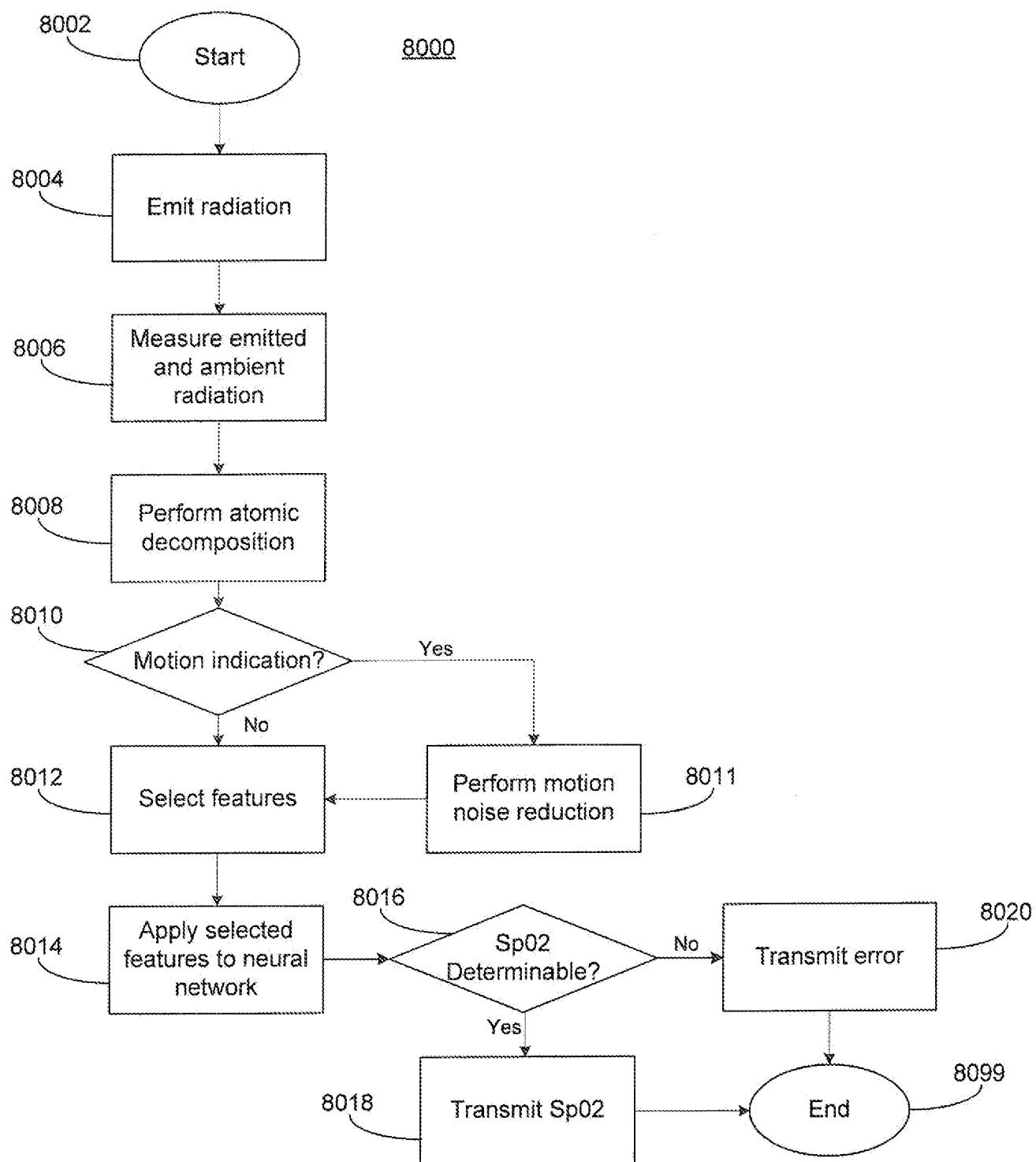


FIG. 8

Electronic Patent Application Fee Transmittal

Application Number:				
Filing Date:				
Title of Invention:	Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods			
First Named Inventor/Applicant Name:	Eric Hensen			
Filer:	Daniel Carl Pierron/Angela Rogers			
Attorney Docket Number:	1095-00006			
Filed as Small Entity				
Provisional Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Provisional Application Filing Fee	2005	1	130	130
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Total in USD (\$)				130

Electronic Acknowledgement Receipt

EFS ID:	20365237
Application Number:	62061497
International Application Number:	
Confirmation Number:	7662
Title of Invention:	Ear-Mounted Device With Integrated Pulse Oximetry And Associated Methods
First Named Inventor/Applicant Name:	Eric Hensen
Customer Number:	39682
Filer:	Daniel Carl Pierron/Angela Rogers
Filer Authorized By:	Daniel Carl Pierron
Attorney Docket Number:	1095-00006
Receipt Date:	08-OCT-2014
Filing Date:	
Time Stamp:	17:15:06
Application Type:	Provisional

Payment information:

Submitted with Payment	yes
Payment Type	Electronic Funds Transfer
Payment was successfully received in RAM	\$ 130
RAM confirmation Number	4119
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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1	Application Data Sheet	2014_10_08_Application_Data_Sheet_1095_00006_DCP.pdf	1561650 2535b8b95eab2a2579826320ef797bd32eebd21a	no	8
Warnings:					
Information:					
2		2014_10_08_ProvisionalPatent_Application_Final.pdf	9374184 047d249914ab646fee095db4034ea9ab5bdc2eb	yes	23
	Multipart Description/PDF files in .zip description				
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3	Fee Worksheet (SB06)	fee-info.pdf	29447 e8164808baa58730785f29608806d32a3e8f9d5b	no	2
Warnings:					
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Total Files Size (in bytes):			10965281		
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