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(54) **Title**: USE OF PHOTODETECTOR ARRAY TO IMPROVE EFFICIENCY AND ACCURACY OF AN OPTICAL MEDICAL SENSOR

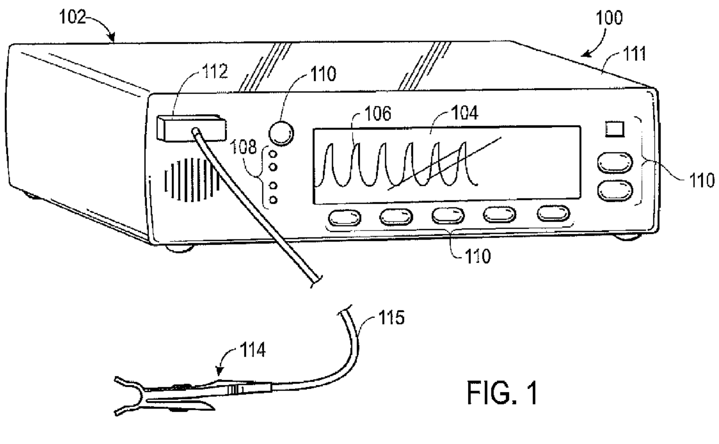

FIG. 1

(57) **Abstract**: A system and method for determining physiological parameters of a patient (117) based on light transmitted through the patient. The light may be transmitted via an emitter (116) and received by a detector array (118) that includes a plurality of detector elements (146). The emitter (116) and the detector (118) may both be located on a flexible substrate (148).

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USE OF PHOTODETECTOR ARRAY TO IMPROVE EFFICIENCY AND ACCURACY OF AN OPTICAL MEDICAL SENSOR

BACKGROUND

The present disclosure relates generally to medical devices and, more particularly, to sensors used for sensing physiological parameters of a patient.

This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the present disclosure, which are described and/or claimed below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present disclosure. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

In the field of medicine, doctors often desire to monitor certain physiological characteristics of their patients. Accordingly, a wide variety of devices have been developed for monitoring many such physiological characteristics. Such devices provide doctors and other healthcare personnel with the information they need to provide the best possible healthcare for their patients. As a result, such monitoring devices have become an indispensable part of modern medicine.

One technique for monitoring certain physiological characteristics of a patient is commonly referred to as pulse oximetry, and the devices built based upon pulse oximetry techniques are commonly referred to as pulse oximeters. Pulse oximetry may be used to measure various blood flow characteristics, such as the blood-oxygen saturation of hemoglobin in arterial blood, the volume of individual blood pulsations supplying the tissue, and/or the rate of blood pulsations corresponding to each heartbeat of a patient. In fact, the "pulse" in pulse oximetry refers to the time varying amount of arterial blood in the tissue during each cardiac cycle.

Pulse oximeters typically utilize a non-invasive sensor that transmits light through a patient's tissue and that photoelectrically detects the absorption and/or scattering of the transmitted light in such tissue. One or more of the above physiological characteristics may then be calculated based upon the amount of light absorbed or scattered. More specifically, the light passed through the tissue is typically selected to be of one or more wavelengths that may be absorbed or scattered by the blood in an amount correlative to the amount of the blood constituent present in the blood. The amount of light absorbed and/or scattered may then be used to estimate the amount of blood constituent in the tissue using various algorithms.

The light sources utilized in pulse oximeters typically are placed in a certain position on a patient. For the sensor to operate properly, this position must be maintained. Accordingly, movement of the sensor due to the movements of a patient, may lead to signal noise.

BRIEF DESCRIPTION OF THE DRAWINGS

Advantages of the disclosed techniques may become apparent upon reading the following detailed description and upon reference to the drawings in which:

FIG. 1 illustrates a perspective view of a pulse oximeter in accordance with an embodiment;

FIG. 2 illustrates a simplified block diagram of a pulse oximeter in **FIG. 1**, according to an embodiment;

FIG. 3 illustrates a top view of a sensor of **FIG. 2**, according to an embodiment;

FIG. 4 illustrates a side view of the sensor of **FIG. 3**, according an embodiment;

FIG. 5 illustrates a top view of a sensor of **FIG. 2**, according to a second embodiment; and

FIG. 6 illustrates a side view of the sensor of **FIG. 5**, according to the second embodiment.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

One or more specific embodiments of the present disclosure will be described below. In an effort to provide a concise description of these embodiments, not all features of an actual implementation are described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

Present embodiments relate to non-invasively measuring physiologic parameters corresponding to blood flow in a patient by emitting light into a patient's tissue with light emitters (e.g., light emitting diodes) and photoelectrically detecting the light after it has passed through the patient's tissue. More specifically, present embodiments are directed to increasing the effective area of photodetectors in a pulse oximetry sensor. Utilization of a photodetector array made up of a plurality of photodetectors may allow for increased efficiency of the overall pulse oximetry system by being able to receive signals at more than one location. Thus, if a path between an emitter and a detector is blocked by tissue, bone, or other constituents, a secondary path between the emitter and a second detector may be used to transmit light signals. Also, a photodetector array may be scanned to determine which individual detectors in the array are receiving the strongest light transmission from an emitter. This detector may then be chosen and signals received from this detector may then be utilized to calculate physiological parameters of a patient. The detector array may also be placed on a flexible substrate so as to allow the sensor to be more form fitting.

Turning to **FIG. 1**, a perspective view of a medical device is illustrated in accordance with an embodiment. The medical device may be a pulse oximeter **100**. The pulse oximeter **100** may include a monitor **102**, such as those available from Nellcor Puritan Bennett LLC. The monitor **102** may be configured to display calculated parameters on a display **104**. As illustrated in **FIG. 1**, the display **104** may be integrated into the monitor **102**. However, the monitor **102** may be configured to provide data via a port to a display (not shown) that is not integrated with the monitor **102**. The display **104** may be configured to display computed physiological data including, for example, an oxygen saturation percentage, a pulse rate, and/or a plethysmographic waveform **106**. As is known in the art, the oxygen saturation percentage may be a functional arterial hemoglobin oxygen saturation measurement in units of percentage SpO_2, while the pulse rate may indicate a patient's pulse rate in beats per minute. The monitor **102** may also display information related to alarms, monitor settings, and/or signal quality via indicator lights **108**.

To facilitate user input, the monitor **102** may include a plurality of control inputs **110**. The control inputs **110** may include fixed function keys, programmable function keys, and soft keys. Specifically, the control inputs **110** may correspond to soft key icons in the display **104**. Pressing control inputs **110** associated with, or adjacent to, an icon in the display may select a corresponding option. The monitor **102** may also include a casing **111**. The casing **111** may aid in the protection of the internal elements of the monitor **102** from damage.

The monitor **102** may further include a sensor port **112**. The sensor port **112** may allow for connection to an external sensor **114**, via a cable **115** which connects to the sensor port **112**. Alternatively, the external sensor **114** may be wirelessly coupled the monitor **102**. Furthermore, the sensor **114** may be of a disposable or a non-disposable type. The sensor **114** may obtain readings from a patient, which can be used by the monitor to calculate certain physiological characteristics such as the blood-oxygen saturation of hemoglobin in arterial blood, the volume of individual blood pulsations supplying the tissue, and/or the rate of blood pulsations corresponding to each heartbeat of a patient.

Turning to **FIG. 2**, a simplified block diagram of a pulse oximeter **100** is illustrated in accordance with an embodiment. Specifically, certain components of the sensor **114** and the monitor **102** are illustrated in **FIG. 2**. The sensor **114** may include an emitter **116**, a detector **118**, and an encoder **120**. It should be noted that the emitter **116** may be capable of emitting at least two wavelengths of light, e.g., RED and infrared (IR) light, into the tissue of a patient **117** to calculate the patient's **117** physiological characteristics, where the RED wavelength may be between about 600 nanometers (nm) and about 700 nm, and the IR wavelength may be between about 800 nm and about 1000 nm. The emitter **116** may include a single emitting device, for example, with two light emitting diodes (LEDs) or the emitter **116** may include a plurality of emitting devices with, for example, multiple LED's at various locations. Regardless of the number of emitting devices, the emitter **116** may be used to measure, for example, water fractions, hematocrit, or other physiologic parameters of the patient **117**. It should be understood that, as used herein, the term "light" may refer to one or more of ultrasound, radio, microwave, millimeter wave, infrared, visible, ultraviolet, gamma ray or X-ray electromagnetic radiation, and may also include any wavelength within the radio, microwave, infrared, visible, ultraviolet, or X-ray spectra, and that any suitable wavelength of light may be appropriate for use with the present disclosure.

In one embodiment, the detector **118** may be an array of detector elements that may be capable of detecting light at various intensities and wavelengths. In operation, light enters the detector **118** after passing through the tissue of the patient **117**. The detector **118** may convert the light at a given intensity, which may be directly related to the absorbance and/or reflectance of light in the tissue of the patient **117**, into an electrical signal. That is, when more light at a certain wavelength is absorbed or reflected, less light of that wavelength is typically received from the tissue by the detector **118**. After converting the received light to an electrical signal, the detector **118** may send the signal to the monitor **102**, where physiological characteristics may be calculated based at least in part on the absorption of light in the tissue of the patient **117**.

Additionally the sensor **114** may include an encoder **120**, which may contain information about the sensor **114**, such as what type of sensor it is (e.g., whether the sensor is intended for placement on a forehead or digit) and the wavelengths of light emitted by the emitter **116**. This information may allow the monitor **102** to select appropriate algorithms and/or calibration coefficients for calculating the patient's **117** physiological characteristics. The encoder **120** may, for instance, be a memory on which one or more of the following information may be stored for communication to the monitor **102**: the type of the sensor **114**; the wavelengths of light emitted by the emitter **116**; and the proper calibration coefficients and/or algorithms to be used for calculating the patient's **117** physiological characteristics. In one embodiment, the data or signal from the encoder **120** may be decoded by a detector/decoder **121** in the monitor **102**.

Signals from the detector **118** and the encoder **120** may be transmitted to the monitor **102**. The monitor **102** may include one or more processors **122** coupled to an internal bus **124**. Also connected to the bus may be a RAM memory **126** and a display **104**. A time processing unit (TPU) **128** may provide timing control signals to light drive circuitry **130**, which controls when the emitter **116** is activated, and if multiple light sources are used, the multiplexed timing for the different light sources. TPU **128** may also control the gating-in of signals from detector **118** through an amplifier **132** and a switching circuit **134**. These signals are sampled at the proper time, depending at least in part upon which of multiple light sources is activated, if multiple light sources are used. The received signal from the detector **118** may be passed through an amplifier **136**, a low pass filter **138**, and an analog-to-digital converter **140** for amplifying, filtering, and digitizing the electrical signals the from the sensor **114**. The digital data may then be stored in a queued serial module (QSM) **142**, for later downloading to RAM **126** as QSM **142** fills up. In an embodiment, there may be multiple parallel paths for separate amplifiers, filters, and A/D converters for multiple light wavelengths or spectra received.

In an embodiment, based at least in part upon the received signals corresponding to the light received by detector **118**, processor **122** may calculate the oxygen saturation using various algorithms. These algorithms may require coefficients, which may be empirically determined. For example, algorithms relating to the distance between an emitter **116** and various detector elements in a detector **118** may be stored in a ROM **144** and accessed and operated according to processor **122** instructions. The processor **122** may also be utilized to scan for a particular signal from a detector element in a detector array of the detector **118**, as will be described in greater detail below.

FIG. 3 illustrates an embodiment of the sensor **114** that may include an emitter **116** and a detector **118** as described above with respect to **FIGS. 1 and 2**. As illustrated, the detector **118** may be a detector array that includes a plurality of detector elements **146**. The detector array may, for example, be arranged in a one dimensional line or in a two dimensional pattern. The use of a plurality of detector elements **146** may allow for capture of more of the photons emitted by the emitter **116**. In this manner, the efficiency of the sensor **114** may be increased. In one embodiment, the emitter **116** and/or the detector **114** may be printed directly onto a flexible substrate **148**. The flexible substrate **148** may, for example, be a silicon-based substrate or may be a thermoplastic polymer such as polyethylene terephthalate (PET) foil. Accordingly, the flexible substrate **148** may be a form fitting material that is malleable and maintains its shape once adjusted. In this manner, the flexible substrate **148** may be useful in increasing its tolerance to changing form in response to certain types of motion, such as finger movements, by maintaining a relatively rigid or fixed shape once the sensor has been fitted to the patient. Alternatively, the flexible substrate **148** may be designed to be flexible such that the flexible substrate may maintain contact with a patient **117** as the patient **117** moves. For example, the flexible substrate **148** may be implemented as part of a neonatal forehead probe and as such, the flexible substrate **148** may remain flexible in response to movements of the patient **117**.

As described above, the flexible substrate **148** may be part of the sensor **114**. As such, the flexible substrate **148** may be affixed to a bandage **150** via, for example, an adhesive. The bandage **150** also may include an adhesive or other affixation element that may be used to affix the sensor **114** to a patient **117**. Alternatively, the bandage **150** may include, for example, a soft, pliable, low-profile foam material that allows the sensor **114** to remain in place on a patient **117** without the use of adhesives. The bandage **150** may also be flexible, such that any change in shape of the flexible substrate **148** will be accompanied by a corresponding change in shape of the bandage **150**. In one embodiment, the flexible substrate **148** and the bandage **150** may be bent around a center axis **152** such that the emitter **116** is brought into proximity with the detector elements **146**. In one embodiment, an extremity of a patient **117**, (e.g., an ear, a finger, or a toe) may be placed between the emitter **116** and the detector **118**. Thus, the sensor **114** may be bent into shape around a given tissue area of a patient **117**, and because of the malleable nature of both the flexible substrate **148** and the bandage **150**, the detector array may conform to patient **117** tissue to maximize the light received from the emitter **116** in a manner described in further detail below.

FIG. 4 illustrates the sensor **114** disposed on the tissue of a patient **117** as set forth above. As may be seen, the emitter **116** may, for example, be positioned above the detector elements **146A-N** of the detector **118** such that light may pass through the patient **117** via one or more light paths **154**. As described above, the emitter **116** may include one or more light emitting diodes (LEDs) that may be used to measure, for example, oxygen saturation, water fractions, hematocrit, or other physiologic parameters of the patient **117**. While these detector elements **146A-N** are illustrated in a single line, it should be noted that these elements **146A-N** may, for example, be arranged in a two dimensional array. In operation, light enters the detector elements **146A-N** after passing through the tissue of the patient

117 via light paths **154**. The detector elements **146A-N** may convert the light at a given intensity, which may be directly related to the absorbance and/or reflectance of light in the tissue of the patient **117,** into an electrical signal.

However, there may be bone **156,** or other constituents, in the tissue of the patient **117** that may undesirably absorb and/or scatter light from the emitter **116.** In this example, the bone **156** may operate to absorb light along given light paths **154** such that given detector elements **146F-I** may not receive sufficient light to generate an electrical signal that may be used to calculate the physiologic parameters of the patient **117**. However, light may be received at other locations, for example at locations **146B-D** and **146J-K**, which may be used by, for example, the processor **122** to calculate the physiologic parameters of the patient **117**.

Other processing of the signals received at the detector **118** may include the determination of which received signals from a location, such as location **146B**, **146C**, or **146K**, should be used to calculate physiological parameters of the patient **117**. As described above, light received at certain locations, such as location **158**, may be too weak to properly generate a useable signal for calculation of physiological parameters of the patient **117**. Accordingly, the processor **122** may be used to scan the photodetector array in the detector **118** to determine which individual detector elements **146A-N** are receiving the strongest light transmission from the emitter **116**. The one or more detector elements **146A-N** receiving the strongest light transmissions may then be chosen and signals received from the chosen detector elements **146A-N** may then be utilized to calculate physiological parameters of a patient **117**. In this manner, alternate light paths **154** are available to calculate physiological parameters of a patient **117** instead of only a single light path that might otherwise be unusable due to interference. Thus, the proper operation of the sensor **114** may be improved.

The scan of the detector elements **146A-N** outlined above may be performed either continuously or intermittently. In this manner, the processor **122** may be able to take into account changing conditions of the sensor **114** in real time during calculation of physiological parameters of a patient. That is, the processor may factor in changing conditions of the sensor **114** while processing data received from the sensor **114** without any intentional delays being added to the time required to perform the processing, i.e., in real time. For example, if a portion of the detector elements **146A-N** previously determined to receive the strongest light transmission from the emitter **116** are exposed to ambient light due to, for example, the bandage **150** becoming loose through movement of the patient **117,** the processor **122** may determine that certain detector elements **146A-N** have been corrupted in their ability to receive light from the emitter **116.** Accordingly, the processor **122** may utilize different detector elements **146A-N** for the calculation of physiologic parameters of the patient **117**. Thus, the detector elements **146A-N** may be scanned in real time so that the best available received light may consistently be selected by the processor **122**.

FIG. 5 illustrates a sensor **114** that may utilize a reflectance method to receive light signals. Accordingly, the sensor **114** may include one or more emitters **116**, such as three emitters **116A, B, and C**, positioned adjacent to the detector elements **146** on the same side of the tissue of a patient **117.** Similar to the transmittance type sensor **114** of **FIGS. 3** and **4** described above, the sensor **114** of **FIG. 5** may include a cable **115** for transmission of signals to and from the sensor **114**. The detector elements **146** may, for example, surround the emitters **116**. The emitters **116** and/or the detector **114** may be printed directly onto a flexible substrate **148** that may be a silicon based substrate or may be a thermoplastic polymer such as polyethylene terephthalate (PET) foil.

As described above, the flexible substrate **148** may be part of the sensor **114**. As such, the flexible substrate **148** may be affixed to a bandage **150** via, for example, an adhesive. The bandage **150** also may include an adhesive or other affixation element that may be used to affix the sensor **114** to a patient **117**. In one embodiment, the sensor may be placed on a patient **117**, (e.g., on the forehead or finger). The flexible substrate **148** and bandage **150** may be bent into shape around a given tissue area of a patient **117**, and because of the nature of both the flexible substrate **148** and the bandage **150**, the detector **118** may conform to patient **117** tissue to maximize the light received from the emitters **116.**

Furthermore, the use of multiple emitters **116** may be advantageous for the overall efficiency of the sensor **114** through measuring multiple physiological concurrently. For example, if the sensor **114** includes three emitters **116A-C**, each of the emitters **116A-C** may each transmit light at a different wavelength to the patient **117**. Thus the first emitter **116A** may transmit light of a given wavelength, such as light in the red spectrum around 660 nm and or light in the infrared spectrum around 900 nm, for determination of the blood oxygen saturation of the patient **117**. Additionally, a second emitter **116B** may be utilized to determine glucose levels of a patient **117** by transmitting light at a wavelength of approximately 1000 nm. A third emitter **116C** may be used to determine hematocrit levels of a patient **117** by transmitting light at a wavelength of approximately 550 nm. Thus, the processor **122** may scan distinct regions near to each of these emitters to receive data relating to multiple tests on a patient **117** simultaneously. Furthermore, the scanning procedure outlined above may be performed for each individual region, such that the strongest signal corresponding to the blood oxygen saturation, glucose level, and hematocrit levels of the patient **117** are being selected.

In another embodiment, the use of multiple emitters **116** may be useful for patients **117** with darkly pigmented skin, because the light is absorbed more completely by the tissue of the patient **117**, thus leading to weak signals received at the detector elements **146**. Accordingly, to overcome this potential issue, if the detector element **146** scan reveals that all detector elements **146** are receiving weak signals, then the processor **122** may initiate a process whereby two or more adjacent emitters **116A-C** may be activated simultaneously to transmit light, for example, at identical wavelengths. In this manner, higher levels of light are transmitted into the patient **117**, which may allow, for example, detector elements **146** located between the simultaneously activated emitters **116A-C** to receive adequate light for the generation of signals that may be utilized in the calculation of physiologic parameters of the patient **117**. Additionally, other efficiencies with respect to the sensor **114** may be obtained, as described below with respect to **FIG. 6**.

FIG. 6 illustrates a portion of the sensor **114** of **FIG. 5** in contact with the tissue of a patient **117**. As may be seen, the emitter **116A** may, for example, be positioned adjacent to the detector elements **146A-K** such that light may pass through the patient **117** via one or more light paths **154**. The light paths **154** may, for example, begin at the emitter **116A** and end at detector elements **146 D-J**, respectively. Accordingly, the light path **154** ending at location **146D** is shorter than the light path **154** ending at location **146G**, which is shorter than the light path **154** ending at location **146J**. Additionally, the light path **154** ending at location **146D** is shallower than the light path **154** ending at location **146G**, which is shallower than the light path **154** ending at location **146J**. Having light paths **154** that pass at different depths and lengths may be advantageous for scanning and selecting signals from detector elements **146** at certain locations **164**, **166**, or **168**. That is, as described above, if, for example, bone or other tissue interferes with the light path **154** to a given location, e.g., **146D**, such that a given detector element **146D** may not receive sufficient light to generate an electrical signal that may be used to calculate the physiologic parameters of the patient **117**, the processor **122** may scan for light received at other locations, for example at locations **146G** and/or **146J**, which may be used by the processor **122** to calculate the physiologic parameters of the patient **117**.

Additionally, the sensor **114** may be utilized to determine physiological parameters for both adults and infants. Adults tend to have thicker skin than infants. Accordingly, light paths **154** typically should go deeper into the skin of an adult patient **117** to properly determine the physiological parameters of the adult patient **117** (e.g., to locations **146G** and/or **146J**) than the light paths utilized to calculate the physiological parameters of the infant patient **117** (e.g., to location **146D**). By having a plurality of detector elements **146A-K**, the processor **122** may scan for the best detector element **146 A-F** for use with either an adult or an infant patient **117**. In this manner, the same sensor **114** may be utilized for both adult and infant patients **117**.

While the disclosure may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. However, it should be understood that the embodiments provided herein are not intended to be limited to the particular forms disclosed. Indeed, the disclosed embodiments may not only be applied to measurements of blood oxygen saturation, but these techniques may also be utilized for the measurement and/or analysis of other blood constituents. For example, using the same, different, or additional wavelengths, the present techniques may be utilized for the measurement and/or analysis of carboxyhemoglobin, met-hemoglobin, total hemoglobin, fractional hemoglobin, intravascular dyes, and/or water content. Rather, the various embodiments may cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure as defined by the following appended claims.

CLAIMS

What is claimed is:

1. A physiological sensor comprising:

an emitter adapted to transmit light;

a detector array comprising a plurality of detector elements each configured to receive the transmitted light via a respective light path; and

a flexible substrate comprising both the emitter and the detector array.

2. The physiological sensor, as set forth in claim 1, comprising a second emitter configured to transmit light at a wavelength different from a wavelength of the emitter.

3. The physiological sensor, as set forth in claim 2, wherein the plurality of detector elements are arranged around the emitter and the second emitter and wherein the plurality of detector elements are configured to receive the transmitted light from each of the emitter and the second emitter.

4. The physiological sensor, as set forth in claim 1, wherein the flexible substrate comprises a material capable of maintaining its shape once adjusted.

5. The physiological sensor, as set forth in claim 4, wherein the material comprises a thermoplastic polymer.

6. The physiological sensor, as set forth in claim 1, wherein the detector elements are organized into a line or into a two dimensional grid.

7. A pulse oximetry system comprising:

a pulse oximetry monitor; and

a sensor assembly configured to be coupled to the monitor, the sensor assembly comprising:

an emitter configured to transmit light;

an array of detector elements each configured to receive the transmitted light from the emitter; and

a flexible substrate comprising both the emitter and the array of detector elements.

8. The pulse oximetry system, as set forth in claim 7, wherein each of the detector elements is configured to transmit an electrical signal to the pulse oximetry sensor based on the light received from the light emitter.

9. The pulse oximetry system, as set forth in claim 8, comprising a processor configured to scan each of the detector elements for the electrical signal corresponding to the strongest light transmission received from the emitter.

10. The pulse oximetry system, as set forth in claim 9, wherein the processor is configured to select in real time the electrical signal corresponding to the strongest light transmission received from the emitter for calculation of physiological parameters.

11. The pulse oximetry system, as set forth in claim 7, comprising a second emitter configured to transmit light at a wavelength different from a wavelength of the emitter.

12. The pulse oximetry system, as set forth in claim 11, comprising a processor configured to determine a first physiologic parameter based on the light transmitted from the emitter and a second physiologic parameter based on the light transmitted from the second emitter.

13. The pulse oximetry system, as set forth in claim 7, comprising a second emitter configured to transmit light at an identical wavelength to the light transmitted from the emitter, wherein the plurality of detector elements are configured to receive the light from the emitter and the second emitter.

14. A method comprising:

transmitting light via a light emitter located on a flexible substrate;

receiving the light at a light detector element of a light detector array located on the flexible substrate; and

calculating a physiological parameter based on the received light.

15. The method of claim 14, wherein receiving the light at the light detector element on the flexible substrate comprises receiving the light at a plurality of light detector elements surrounding the light emitter.

16. The method of claim 15, comprising generating electrical signals corresponding to the light received at the light detector element of the light detector array and to the light received at a second light detector element of the light detector array.

17. The method of claim 16, comprising scanning the light detector elements to determine the strongest signal and calculating physiological parameters based on the determination.

18. The method of claim 14, comprising generating second light via a second emitter on the on the flexible substrate, wherein the second light comprises light at a wavelength different from a wavelength of the first light.

19. The method of claim 18, comprising calculating a second physiologic parameter based on the second light generated from the second emitter.

20. The method of claim 14, comprising generating second light at a wavelength identical to a wavelength of the first light via a second emitter on the on the flexible substrate, wherein calculating the physiological parameter based on the received light comprises calculating the physiological parameter based on the light generated from the emitter and the second light generated from the second emitter.

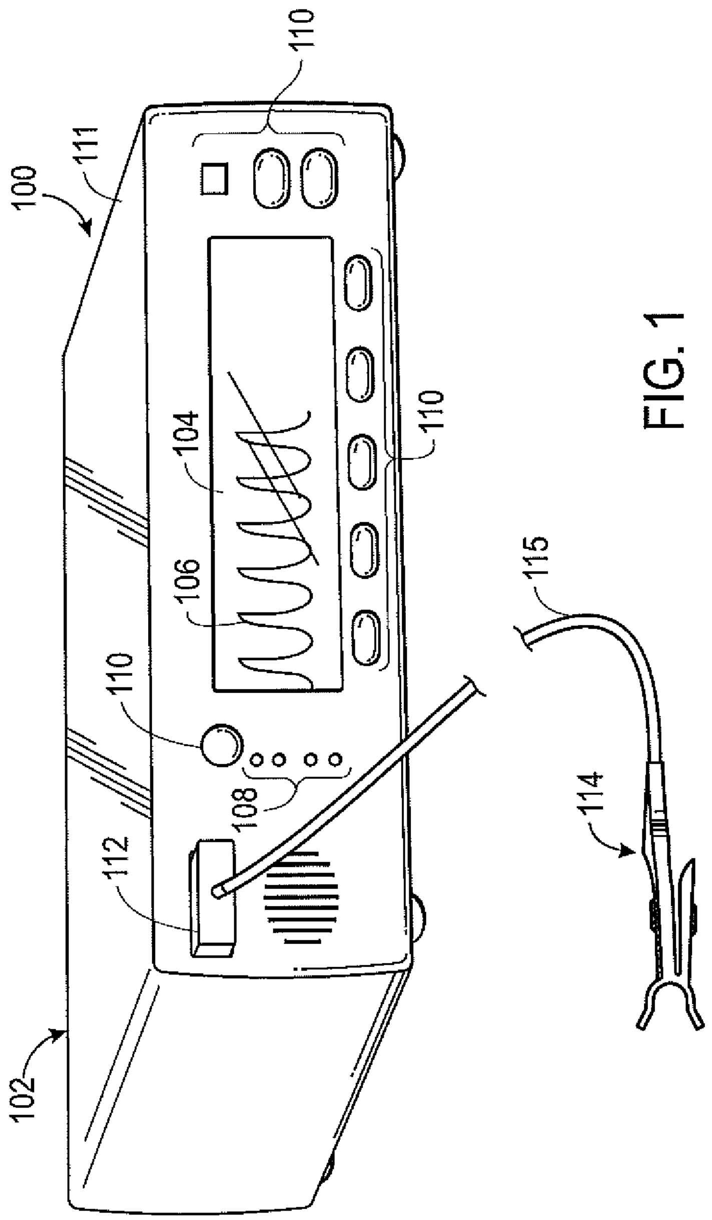
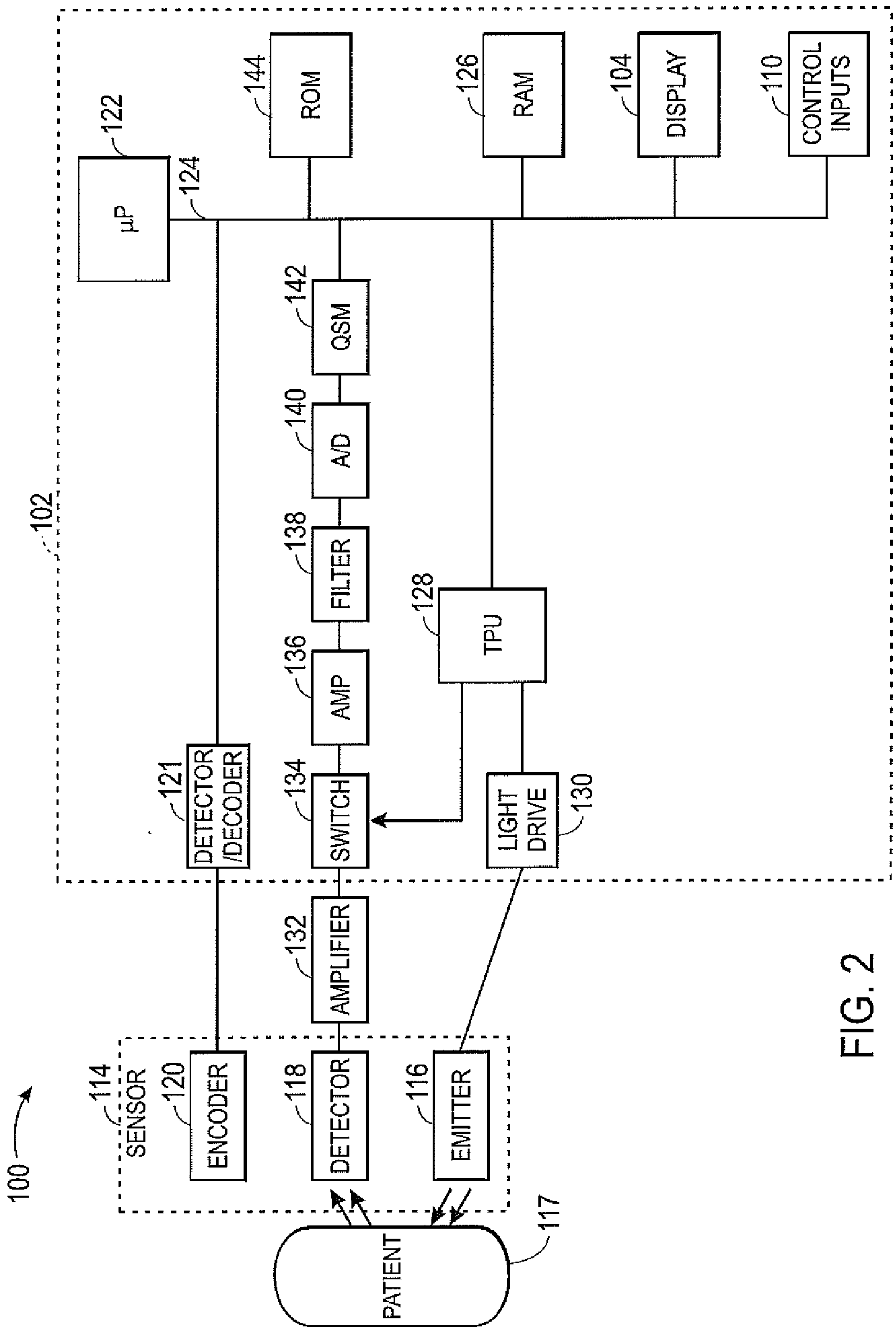


FIG. 1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102
μP
122
124
ROM
144
RAM
126
DISPLAY
104
CONTROL INPUTS
110
QSM
142
A/D
140
FILTER
138
AMP
136
TPU
128
DETECTOR /DECODER
121
SWITCH
134
LIGHT DRIVE
130
AMPLIFIER
132
SENSOR
114
ENCODER
120
DETECTOR
118
EMITTER
116
PATIENT
117

FIG. 2

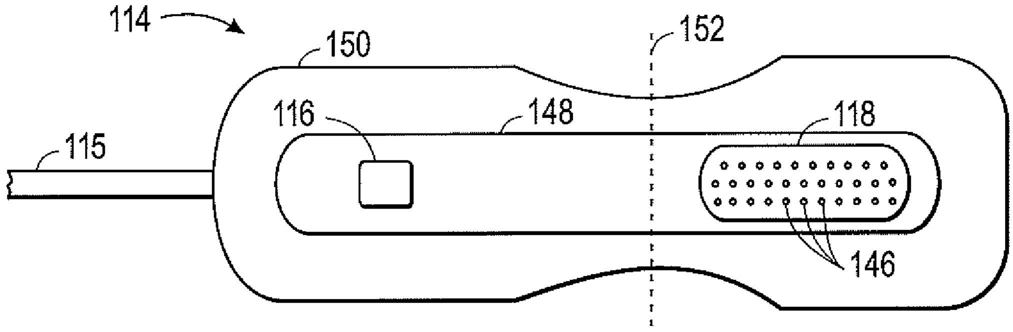
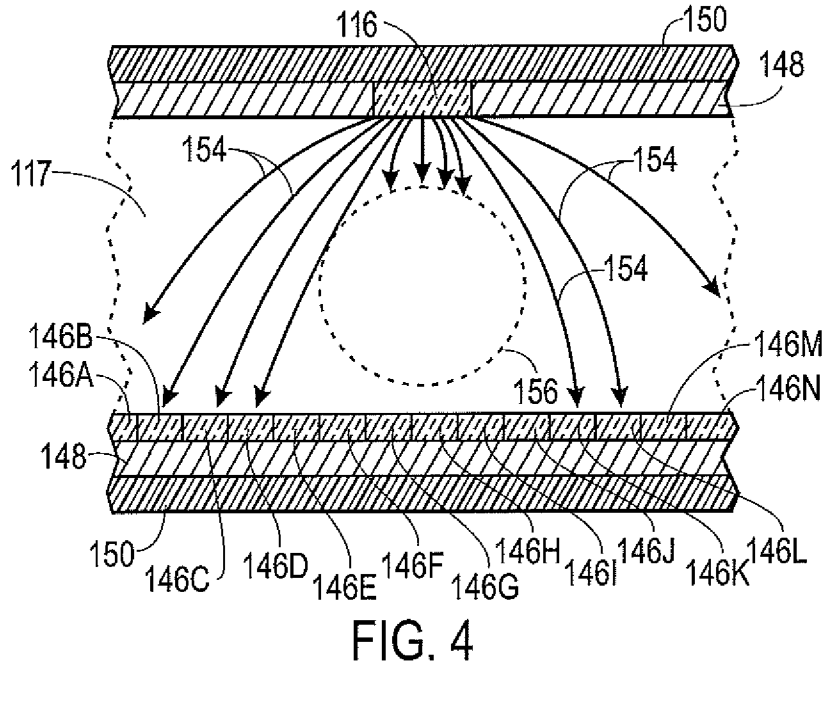

114
150
152
116
148
118
115
146

FIG. 3


116
150
148
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117
154
154
146B
146A
156
146M
146N
148
150
146C
146D
146E
146F
146G
146H
146I
146J
146K
146L

FIG. 4

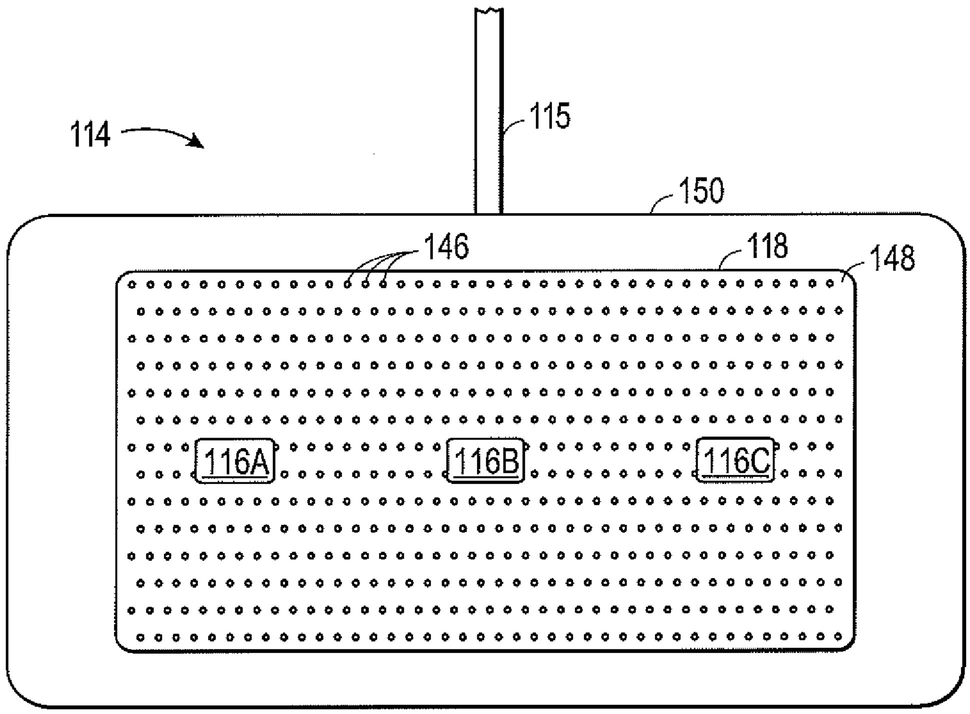
114
115
150
146
118
148
116A
116B
116C

FIG. 5

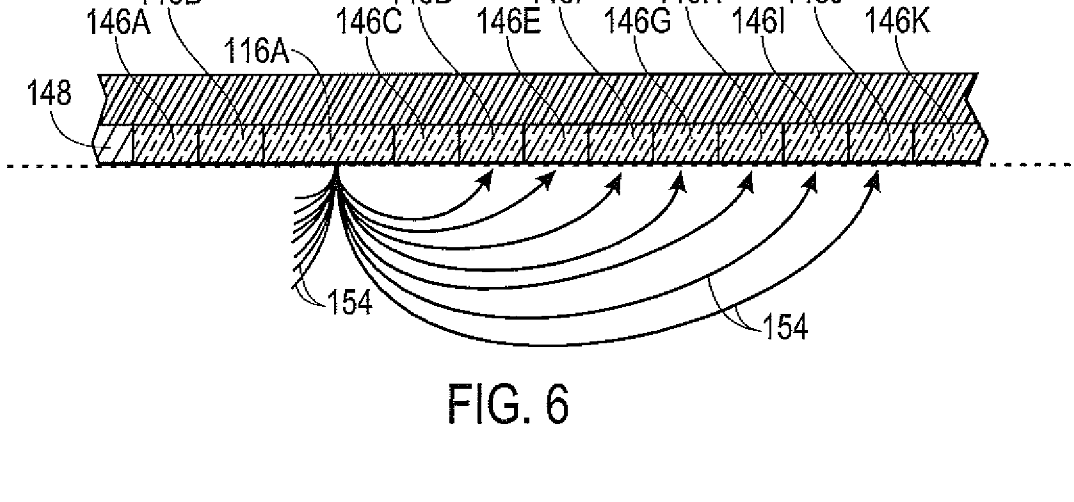
146B
146A
116A
146D
146C
146F
146E
146H
146G
146J
146I
146K
148
154
154

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/037065

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009/062189 A1 (SOMANETICS CORP [US]; GONOPOLSKIY OLEG [US]; SCHEUING RICK [US]; ANDER) 14 May 2009 (2009-05-14)	1-4,6-8, 11-16, 18-20
Y	paragraph [0002] paragraph [0013] - paragraph [0014] paragraph [0019] - paragraph [0020] figures 1-6	5,9,10, 17
X	WO 2006/097910 A1 (OR NIM MEDICAL LTD [IL]; BALBERG MICHAL [IL]; PERY-SHECHTER REVITAL [I) 21 September 2006 (2006-09-21)	1-4,6-8, 11,12, 14-16, 18,19
Y	page 9, line 28 - page 12, line 26 page 16, line 27 - page 17, line 7 figures 1A-1C	5,9,10, 17

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 September 2010	01/10/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Gärtner, Andreas

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5 524 617 A (MANNHEIMER PAUL D [US]) 11 June 1996 (1996-06-11) * abstract column 2, line 63 - column 3, line 17 column 4, line 42 - column 5, line 8 column 6, line 7 - line 23 column 7, line 55 - column 8, line 3 figures 1A, 2	1-4,6-8, 11-16, 18-20 5,9,10, 17
Y	US 2003/166998 A1 (LOWERY GUY RUSSELL [US] ET AL) 4 September 2003 (2003-09-04) paragraph [0032] paragraph [0039] figure 1	5
Y	US 2004/082841 A1 (FURNARY ANTHONY P [US] ET AL) 29 April 2004 (2004-04-29) paragraph [0038] figures 5, 6	5
X Y A	WO 2007/093804 A2 (DIALOG DEVICES LTD [GB]; SIMPSON TERRY ANTHONY [GB]; CRABTREE VINCENT) 23 August 2007 (2007-08-23) page 20, line 16 - page 21, line 13 figures 1, 9 page 7, line 37 - page 8, line 3	1-4,6, 14-20 5,9,10 7,8, 11-13
A,P	US 2009/326347 A1 (SCHARF BENNETT [US]) 31 December 2009 (2009-12-31) figures 2, 3 paragraph [0023] paragraph [0033] - paragraph [0037]	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2010/037065

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
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WO 2006097910	A1	21-09-2006	EP	1863387	A1	12-12-2007
			US	2008312533	A1	18-12-2008
US 5524617	A	11-06-1996	CA	2215163	A1	19-09-1996
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			DE	69632628	D1	08-07-2004
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			ES	2342215	T3	02-07-2010
			JP	2009526590	T	23-07-2009
			KR	20080110752	A	19-12-2008
			PT	1996072	E	16-06-2010
			US	2010016733	A1	21-01-2010
US 2009326347	A1	31-12-2009	NONE			

patsnap

专利名称(译)	使用光电探测器阵列来提高光学医疗传感器的效率和准确度		
公开(公告)号	EP2445392A1	公开(公告)日	2012-05-02
申请号	EP2010727582	申请日	2010-06-02
[标]申请(专利权)人(译)	内尔科尔普里坦贝内特公司		
申请(专利权)人(译)	NELLCOR PURITAN BENNETT LLC		
当前申请(专利权)人(译)	COVIDIEN LP		
[标]发明人	MEDINA CASEY		
发明人	MEDINA, CASEY		
IPC分类号	A61B5/00 A61B5/1455 A61B5/145		
CPC分类号	A61B5/14552 A61B5/14532 A61B5/14535 A61B5/6816 A61B5/6826 A61B5/6833 A61B5/6838 A61B2562/0233 A61B2562/043 A61B2562/046 A61B2562/164		
优先权	12/492377 2009-06-26 US		
外部链接	Espacenet		

摘要(译)

一种用于基于透过患者的光确定患者（117）的生理参数的系统和方法。光可以通过发射器（116）传输，并由包括多个探测器元件（146）的探测器阵列（118）接收。发射器（116）和检测器（118）都可以位于柔性基板（148）上。