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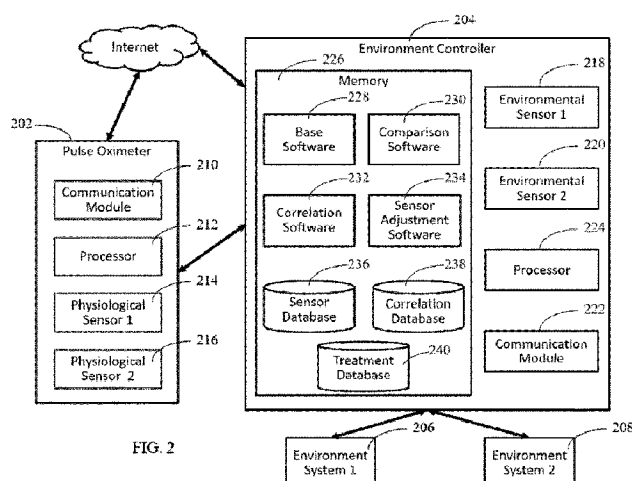


FIG. 2

(57) Abstract: A method for controlling environmental parameters of a patient environment. The method comprises: acquiring physiological sensor data using at least one physiological sensor in a pulse oximeter; acquiring environmental sensor data corresponding to at least one environmental parameter via at least one environmental sensor; determining by an environment controller if the acquired environmental sensor data satisfy at least one alert criterion; adjusting by the pulse oximeter the physiological sensor data to correct for the effects of the at least one environmental parameter if the acquired at least one environmental sensor data satisfies the at least one alert criterion; determining if an environment controller is capable of adjusting the at least one environmental parameter; adjusting the at least one environmental parameter if the environment controller is capable of adjusting the at least one environmental parameter; correlating the at least physiological sensor data and the at least one environmental sensor data to obtain a correlation data; and updating the at least one alert criterion based on the obtained correlation data.

Pulse oximeter and environment controller

BACKGROUND OF THE INVENTION

Environmental parameters have been known to affect a patient's physiological parameter measurements. In pulse oximetry, for example, temperature can affect blood flow, which then affects the blood oxygen saturation being measured by the pulse oximeter at a specific body part. This means that performing pulse oximetry measurements on a cold finger will yield a different blood oxygen saturation value compared with performing the same measurements on a warm finger.

Variations in the environmental parameter can also affect the operation of the physiological sensor, thereby producing inaccurate results. For example, humidity and temperature can affect the electronics and optics of a physiological sensor. Measurement of other physiological parameters has also been known to be affected by environmental parameters such as ambient light, altitude, air pressure, ambient noise, and vibration.

There is then a need to provide methods for correcting inaccuracies in a measured physiological parameter due to environmental parameters and for controlling environmental parameters that affect the physiological parameter. This can be done by determining relationships between environmental and physiological parameters. Furthermore, by configuring environmental sensors to detect certain parameters that are detrimental to a patient's health, such methods may also be useful in detecting noncompliance, "cheating," or undesired health risks for a patient undergoing a treatment program.

U.S. patent application number 2009/0112114 discloses a monitoring system for environment-related respiratory ailments that includes a plurality of physiological sensors (e.g., pulse oximeter) and a plurality of environmental sensors. The physiological data and environmental data are correlated to generate health alerts and to send a command to an environment control system. U.S. patent application number 2002/0156654 discloses a patient care management system for acquiring physiological sensor data and environmental sensor data. The patient care management system correlates the physiological sensor data and the environmental sensor data to identify and predict asthma attack triggers.

SUMMARY OF THE INVENTION

The present invention relates to system systems and methods for controlling environmental parameters of a patient environment. Physiological sensor data are acquired using a pulse oximeter and environmental sensor data using environmental sensors. When an environmental sensor data has satisfied an alert criterion, the physiological sensor data are adjusted to correct the effects of the environmental parameter measured by the environmental sensor. An environment controller then proceeds to adjust the environmental parameter. The alert criteria is then updated by correlating environmental and physiological sensor data.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention, are incorporated herein to illustrate embodiments of the invention. Along with the description, they also serve to explain the principle of the invention. In the drawings:

FIG. 1 illustrates a flow diagram of a preferred embodiment of the present invention.

FIG. 2 illustrates a block diagram of a preferred embodiment of the present invention.

FIG. 3 illustrates a flow diagram of a preferred embodiment of the present invention.

FIG. 4 illustrates a database of an embodiment of the present invention.

FIG. 5 illustrates a flow diagram of a preferred embodiment of the present invention.

FIG. 6 illustrates a database of an embodiment of the present invention.

FIG. 7 illustrates a flow diagram of a preferred embodiment of the present invention.

FIG. 8 illustrates a database of an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The following are definitions of terms as used in the various embodiments of the present invention.

The term “physiological parameter” as used herein refers to one or more variables that measure a physiological function. The term “environmental parameter” as used herein refers to one or more variables that measure a certain characteristic of an environment.

The term “environment controller” as used herein refers to a device capable of controlling an environmental parameter, such as temperature, ventilation, air condition, ambient light, noise level, and humidity, among others.

The term “sensor” is used herein to collectively refer to a physiological sensor, environmental sensor, or any combination thereof. The term “sensor data” as used herein refers to data acquired by a sensor. The term “physiological sensor data” as used herein refers to sensor data acquired by a physiological sensor. The term “environmental sensor data” as used herein refers to data acquired by an environmental sensor.

The term “dataset” as used herein refers to a set of data obtained from a physiological sensor, an environmental sensor, or any combination thereof.

The term “correlate” as used herein refers to determining a relationship between two or more datasets. The term “correlation data” as used herein refers to a value obtained from correlating two or more datasets. Correlation data can be an R-squared number, Pearson correlation coefficient, Rank correlation coefficient, or any quantity that indicates how well two or more datasets are correlated.

The term “database” as used herein refers to as used herein refers to a collection of data and information organized in such a way as to allow the data and information to be stored, retrieved, updated, and manipulated and to allow them to be presented into one or more formats such as in table form or to be grouped into text, numbers, images, and audio data. The term “database” as used herein may also refer to a portion of a larger database, which in this case forms a type of database within a database. “Database” as used herein also refers to conventional databases that may reside locally or that may be accessed from a remote location, e.g., remote network servers. The database typically resides in computer memory that includes various types of volatile and non-volatile computer memory. Memory wherein the database resides may include high-speed random access memory or non-volatile memory such as magnetic disk storage devices, optical storage devices, and flash memory. Memory where the database resides may also comprise one or more software for processing and organizing data received by and stored into the database.

The term “communication module” as used herein refers to a device or a component of a device that allows communication—e.g., sending and receiving of commands, triggers, notifications, prompts, acknowledgments, information, messages, forms, and various types of data.

The present invention relates to a method of controlling environmental parameters of a patient’s environment comprising: acquiring physiological sensor data using

at least one physiological sensor in a pulse oximeter; acquiring environmental sensor data corresponding to at least one environmental parameter via at least one environmental sensor; determining by an environment controller if the acquired environmental sensor data satisfy at least one alert criterion; adjusting by the pulse oximeter the physiological sensor data to
5 correct for the effects of the at least one environmental parameter if the acquired environmental sensor data satisfies the at least one alert criterion; determining if an environment controller is capable of adjusting the at least one environmental parameter; adjusting the at least one environmental parameter if the environment controller is capable of adjusting the at least one environmental parameter; correlating the physiological sensor data
10 and the environmental sensor data to obtain a correlation data; and updating the at least one alert criterion based on the obtained correlation data.

The present invention also relates to a system for controlling environmental parameters in a patient's environment comprising: a pulse oximeter having a first communication module and at least one physiological sensor; an environment controller
15 having a second communication module and at least one environmental sensor, wherein the environment controller is configured to control at least one environment system; and at least one memory unit comprising a first software for obtaining at least one correlation data between at least one physiological sensor data and at least one environmental sensor data and a second software for adjusting at least one physiological sensor data based on the obtained at
20 least one correlation data, wherein the at least one memory unit is included in at least one of the pulse oximeter and the environment controller.

The physiological sensors comprise a couple of small light-emitting diodes (LEDs) and a light sensor for use in pulse oximetry. The physiological sensors preferably also includes other physiological sensors for measuring a patient's at least one physiological
25 parameter. These physiological parameters include, for example, body temperature, heart rate, blood pressure, and skin conductance. The physiological sensor is preferably integrated in the pulse oximeter. In another embodiment, the physiological sensor is included in a sensor network, such as a wireless sensor network, body area network, wireless body area network, and body sensor network. In yet another embodiment, the physiological sensor is a
30 physiological sensor implanted in the patient's body.

Fig. 1 illustrates a flow diagram of a preferred method of the present invention. A physiological sensor in the pulse oximeter acquires physiological sensor data (step 102), and an environmental sensor acquires environmental sensor data corresponding to at least one environmental parameter (step 104). A decision is made to determine if the

environmental sensor data satisfies at least one alert criterion (step 106). If so, the physiological sensor data are adjusted to correct for the effects of the at least one environmental parameter (step 108). A decision is then made to determine if the environment controller is capable of adjusting the environmental parameter (step 110). If so, the environmental parameter is adjusted based on the at least one alert criterion (step 112). Afterwards, the physiological sensor data and the environmental sensor data are correlated to obtain at least one correlation data (step 114). The alert criteria are then updated based on the obtained at least one correlation data (step 116). Finally, the process returns to step 102 to measure another physiological parameter. In the alternative case where the environmental sensor data does not satisfy at least one alert criterion (step 106), the process skips to step 114 to obtain at least one correlation data, after which the alert criteria are updated based on the correlation data (step 116).

The alert criteria indicate one or more conditions for each sensor. An alert criterion can be a minimum threshold value or a maximum threshold value for a physiological parameter or environmental parameter. The alert criteria may also be a combination of values and conditions for one or more sensors. For example, the alert criteria may indicate a minimum temperature of 65 °F (18 °C) and a maximum temperature of 85 °F (29 °C). The alert criteria are preferably set by a medical personnel, medical institution, or manufacturer. Alternatively, the alert criteria are set by the patient.

Correlation data is preferably obtained from a simple linear regression step to determine the relationship between two datasets. An R-squared value is determined from the simple linear regression step to indicate the degree of correlation between the two datasets. An R-squared value close to one indicates a high degree of correlation while an R-squared value close to zero indicates otherwise. More than two datasets may also be correlated. Other statistical tools may also be utilized to determine the correlation of datasets obtained from the sensors in the present invention.

In an embodiment, one or more environmental parameters monitored by the at least one environmental sensor cannot be controlled by the environment controller. A notification system is included in the environment controller to notify the user that the environmental parameter has satisfied at least one alert criterion but the environment controller is not capable of controlling the environmental parameter. For example, the environment controller comprises a microphone that measures ambient noise. When the ambient noise exceeds a threshold, the environment controller determines that it cannot modulate the ambient noise because, for example, the source of the ambient noise is from an

animal or from a source outside the patient's immediate environment. The patient may then be recommended, for example, to move to a different environment. Notification systems can incorporate visual notifications, tactile notifications, audible notifications, or any combination thereof. The notification system can also communicate with an external device to alert a third-party, such as a medical personnel in a remote hospital.

Fig. 2 illustrates a preferred system of the present invention comprising a pulse oximeter 202 and an environment controller 204 for controlling environment systems 206 and 208. The pulse oximeter 202 comprises communication module 210, processor 212, and physiological sensors 214 and 216. The environment controller 204 comprises environment sensors 218 and 220, communication module 222, processor 224, and memory 226 with base software 228, comparison software 230, correlation software 232, sensor adjustment software 234, sensor database 236, correlation database 238, and treatment database 240. Pulse oximeter 202 and environment controller 204 are further capable of connecting to the internet.

Fig. 3 illustrates a flow diagram of the base software 228 according to a preferred embodiment of the present invention. The base software 228 first collects sensor data obtained from the environment controller's environmental sensors and the pulse oximeter's physiological sensors (step 302). The acquired data are then stored in the sensor database 234 (step 304). Afterwards, the base software 228 executes the comparison software 230 to determine whether a sensor data has satisfied an alert criterion (step 306). The correlation software 232 is then executed to correlate datasets obtained from the environmental sensors and physiological sensors and then to update the alert criteria.

Fig. 4 shows an example of the sensor database 236. The sensor database is a record of all sensor data obtained from one or more physiological sensors and environmental sensors. The sensor database 236 may comprise a "date" column 402, "time" column 404, "sensor" column 406, "data type" column 408, and "value" column 410. For example, row 412 represents an entry for an SpO2 reading of 98% obtained from an oximeter at 08:55 AM of November 19, 2015.

Fig. 5 illustrates a flow diagram of a comparison software 230 for comparing sensor data with alert criteria according to a preferred embodiment of the present invention. An environmental sensor is first selected (step 502). The correlation database 238 is searched for an entry for the selected environmental sensor (step 504). If an entry exist, it is determined if the environmental sensor data satisfies a corresponding alert criterion (step 506). If so, the sensor adjustment software 234 is executed to correct physiological sensor

data that are affected by the environmental parameter (step 508). A decision is then made to determine if the environment controller 204 is capable of controlling the environmental parameter (step 510). If so, an environmental system is controlled to modulate the environmental parameter (step 512). Otherwise, a notification is generated (step 514).

- 5 Afterwards, a decision is made to determine if all environmental sensors has been selected (step 516). If so, the process ends by returning to the base software 228. Otherwise, a next environmental sensor is selected (step 520) and the process loops back to step 504.

The sensor adjustment software 234 adjusts the physiological sensor data based on effects of the environmental parameters. A lookup table may be used to determine
10 the amount of correction necessary. Alternatively, a correction model or function may be used. For example, the correction function may be linear and conforms to the general expression " $y=mx+b$," where " y " is the corrected physiological sensor data, " m " is a correction factor, " x " is the original physiological sensor data, and " b " is a baseline correction parameter. The correction factor may be another function or a value obtained from
15 a table. The correction function may be obtained from a calibration step, correlation step, or from historical analysis for a specific patient. The correction function may also be obtained from a statistical analysis of a population of patients. Alternatively, the correction function may be provided by a medical personnel, health network, or the manufacturer of the pulse oximeter and environment controller.

- 20 Fig. 6 shows an example of the correlation database 238. The correlation database 238 stores sensor data with corresponding one or more alert criteria. The correlation database 238 tabulates environmental parameters under the "Cause Type" column 602, the correlated physiological parameter under "Effect type" column 604, the correlation coefficient value under "Correlation Coefficient" column 606, and the alert criteria under the
25 "Cause Criterion" column 608. For example, the correlation database 238 may include one or more entries for the effect of noise on oxygen saturation (SpO₂). Row 610 indicates that noise and SpO₂ may be correlated with a correlation coefficient of 0.95. An alert criterion of ">80 dB" has been set such that when succeeding noise measurements exceed 80 dB, for example, the noise level will be adjusted or an alert will be generated. The correlation
30 database 234 is preferably updated regularly since new sensor data can cause a change in the correlation between two or more datasets. In one embodiment, the correlation 234 database is updated whenever datasets from a pair of physiological and environmental sensors are analyzed. Alternatively, the update is performed at an interval of 10 minutes, 1 hour, or 24 hours, for example.

Illustrated in Fig. 7 is a flow diagram of the correlation software 232 according to a preferred embodiment. The correlation software 232 correlates preferably all possible combinations of an environmental sensor and a physiological sensor. A first pair of environmental sensor and physiological sensor is selected (step 502) and the sensor datasets are correlated to obtain a correlation data (step 704). A decision is made whether the correlation data exceed at least one alert criterion (step 706). If it does, the environmental parameter measured by the selected environmental sensor, the physiological parameter measured by the physiological sensor, and the correlation data are recorded in the correlation database 238 (step 708). Afterwards, a decision is to determine if all combinations of an environmental sensor and a physiological sensor have been selected (step 710). If so, the software ends and returns to base software 228 (step 712). Otherwise, a next combination of environmental sensor and physiological sensor is selected (step 714) and the process returns to step 702.

In an embodiment of the present invention, a patient suffering from chronic obstructive pulmonary disease (COPD) is admitted to a hospital. As COPD is known to be exacerbated by extreme temperatures, an environment controller in the hospital room carefully monitors the room temperature and regulates the room's HVAC system to avoid exacerbating the patient's symptoms. Initially, an R-squared value of 0.95 is stored in the correlation database of the environment controller's memory to represent the correlation between the room temperature and oxygen saturation. A pulse oximeter is attached to the patient to monitor the patient's oxygen saturation. Outside the hospital, the ambient temperature is 95 °F (35 °C). When the room temperature reaches 91°F (33 °C), for example, the environment controller determines that the temperature has exceeded the temperature threshold of 90°F (32 °C). An alert is then generated and transmitted to the nurse's station regarding the status of the HVAC system and of the patient. Based on the R-squared value of 0.95, it is also presumed that oxygen saturation will decrease as a result of the increased room temperature and that one can calculate the predicted oxygen saturation level at the current room temperature of 91 °F (33 °C). The HVAC system is then operated to adjust the room temperature to a more comfortable level of 85 °F (29 °C). As the temperature drops from 91 °F (33 °C) to 85 °F (29 °C), oxygen saturation is measured again. Finally, data from the sensors are correlated with each other to update the correlation database. A newly-acquired pulse oximetry dataset is then correlated again as a function of temperature from 91 °F (33 °C) to room temperature, and the R-squared value based on the new correlated datasets is

computed to be equal to 0.97. The correlation database may be update to remove the entry, for example, or modify the alert criteria.

The present invention also provides utility in the detection of noncompliance or health risk of a patient undergoing treatment. In one embodiment, the comparison software 230 also searches the treatment database 240 to determine whether an environmental parameter must be regulated to comply with a treatment plan. Fig. 8 shows an example of the treatment database 240, which stores information relating to a treatment plan. The treatment database tabulates sensors for detecting compliance, noncompliance, and health risks of a patient undergoing a treatment plan. The treatment database 240 may include a “sensor” column 802, a “match file” column 804, and a “context” column 806. Rows 808-814 show embodiments wherein a patient’s treatment plan involves avoiding cigarettes to alleviate a respiratory complication (row 808), loud noises to prevent hearing loss (row 810), high temperatures to prevent heat strokes (row 812), and excessive movement to prevent ankle injury (row 814).

In one embodiment, a patient diagnosed with COPD is prescribed to avoid exposure to cigarette smoke. The patient’s room is installed with smoke sensors to detect the presence of cigarette smoke, a microphone to detect sounds associated with smoking, and a heat sensor to detect the heat generated by a lit cigarette. The smoke sensors, microphone, and heat sensors are controlled and monitored by an environment controller. When the patient or a visitor lights a cigarette, the smoke sensor senses the smoke and identifies the type of smoke; the environment controller analyzes the microphone recording to detect the sound of a lighter being used to light the cigarette; and the heat sensor detects the heat generated by the lighter and the glowing cigarette tip. The environment controller then determines that the patient is either smoking or exposed to cigarette smoke. Afterwards, the environment controller may generate an alarm, send a notification to a medical personnel, and improve the ventilation of the room.

In another embodiment, the pulse oximeter 202 comprises the memory 226 having base software 228, comparison software 230, correlation software 232, sensor adjustment software 234, sensor database 236, correlation database 238, and treatment database 240. Thus, most of the processing is performed by the pulse oximeter’s processor 212 rather than by the environment controller’s processor 224.

In another embodiment, when the environmental controller 204 satisfies an alert criterion, the environment controller can trigger the pulse oximeter 202 to acquire additional physiological sensor data to improve the correlation data. Alternatively, when a

physiological sensor data satisfies an alert criterion, the pulse oximeter 202 can trigger the environment controller 204 to acquire additional environment sensor data to determine a possible cause for the notable change in physiological sensor data.

In other embodiments, the present invention may also be used to determine a patient context, such as health condition, symptoms, physical activity, psychological state, and emotional state, among others. The correlation data may be used to search a database of patient contexts stored in memory 226 or in a remote location. For example, if a correlation data for a patient indicates that heart rate and noise level are correlated with an R-squared value of 0.95, this may indicate an increased sensitivity to sound, which may further indicate an auditory complication, a high stress level, or paranoia, for example.

In various embodiment of the present invention the communication modules 210 and 222 enables the pulse oximeter 202 and environment controller 204 to communicate with each other or with a remote device or server. The pulse oximeter 202 and environment controller 204 can, for example, connect to the internet, a health network, or a manufacturer's server to update firmware, driver, software, algorithms, protocols, and databases, as well as to upload data regarding the pulse oximeter, the environment controller, the patient, or any combination thereof.

The present invention is not intended to be restricted to the several exemplary embodiments of the invention described above. Other variations that may be envisioned by those skilled in the art are intended to fall within the disclosure.

CLAIMS:

1. A method for controlling environmental parameters of a patient environment, the method comprising:

monitoring physiological sensor data using at least one physiological sensor in a pulse oximeter;

5 monitoring environmental sensor data corresponding to at least one environmental parameter via at least one environmental sensor;

identifying by an environment controller that the monitored environmental sensor data satisfies at least one alert criterion;

10 adjusting by the pulse oximeter the physiological sensor data to correct for effects of the at least one environmental parameter based on the environmental sensor data satisfying the at least one alert criterion;

determining if an environment controller is capable of adjusting the at least one environmental parameter;

15 adjusting the at least one environmental parameter if the environment controller is capable of adjusting the at least one environmental parameter;

correlating the physiological sensor data and the environmental sensor data to obtain a correlation data; and

updating the at least one alert criterion based on the obtained correlation data.

20 2. The method of claim 1, wherein the at least one alert criterion is based on a compliance and noncompliance with a treatment plan.

3. The method of claim 1, further comprising determining a patient context based on the obtained correlation data.

25 4. The method of claim 1, wherein correlating the physiological sensor data and the environmental sensor data comprises performing a simple linear regression.

5. The method of claim 1, wherein the correlation data is at least one of an R-squared number, Pearson correlation coefficient, rank correlation coefficient, or a score that indicates a level to which two or more datasets are correlated.

5 6. The method of claim 1, wherein the alert criterion indicates one or more conditions for at least one physiological or environmental sensor.

7. The method of claim 6, wherein the conditions include a minimum threshold value or a maximum threshold value.

10

8. A system for controlling environmental parameters in a patient's environment, the system comprising:

a pulse oximeter having a first communication module and at least one physiological sensor;

15

an environment controller having a second communication module and at least one environmental sensor, wherein the environment controller is configured to control at least one environment system; and

20

at least one memory unit comprising a first software for obtaining at least one correlation data between at least one physiological sensor data and at least one environmental sensor data and a second software for adjusting at least one physiological sensor data based on the obtained at least one correlation data, wherein the at least one memory unit is included in at least one of the pulse oximeter and the environment controller.

25

9. The system of claim 8, wherein the at least one alert criterion is based on a compliance and noncompliance with a treatment plan.

10. The system of claim 8, further comprising a processor that executes instructions stored in memory to determine a patient context based on the obtained correlation data.

30

11. The system of claim 8, further comprising a processor that executes instructions stored in memory to correlate the physiological sensor data and the environmental sensor data by performing a simple linear regression.

12. The system of claim 8, wherein the correlation data is at least one of an R-squared number, Pearson correlation coefficient, rank correlation coefficient, or a score that indicates a level to which two or more datasets are correlated.

5 13. The system of claim 8, wherein the alert criterion indicates one or more conditions for at least one physiological or environmental sensor.

14. The system of claim 13, wherein the conditions include a minimum threshold value or a maximum threshold value.

10

15. A non-transitory computer-readable storage medium, having embodied thereon a program executable by a processor to perform a method for controlling environmental parameters of a patient environment, the method comprising:

15 monitoring physiological sensor data using at least one physiological sensor in a pulse oximeter;

monitoring environmental sensor data corresponding to at least one environmental parameter via at least one environmental sensor;

identifying by an environment controller that the monitored environmental sensor data satisfies at least one alert criterion;

20 adjusting by the pulse oximeter the physiological sensor data to correct for effects of the at least one environmental parameter based on the environmental sensor data satisfying the at least one alert criterion;

determining if an environment controller is capable of adjusting the at least one environmental parameter;

25 adjusting the at least one environmental parameter if the environment controller is capable of adjusting the at least one environmental parameter;

correlating the physiological sensor data and the environmental sensor data to obtain a correlation data; and

updating the at least one alert criterion based on the obtained correlation data.

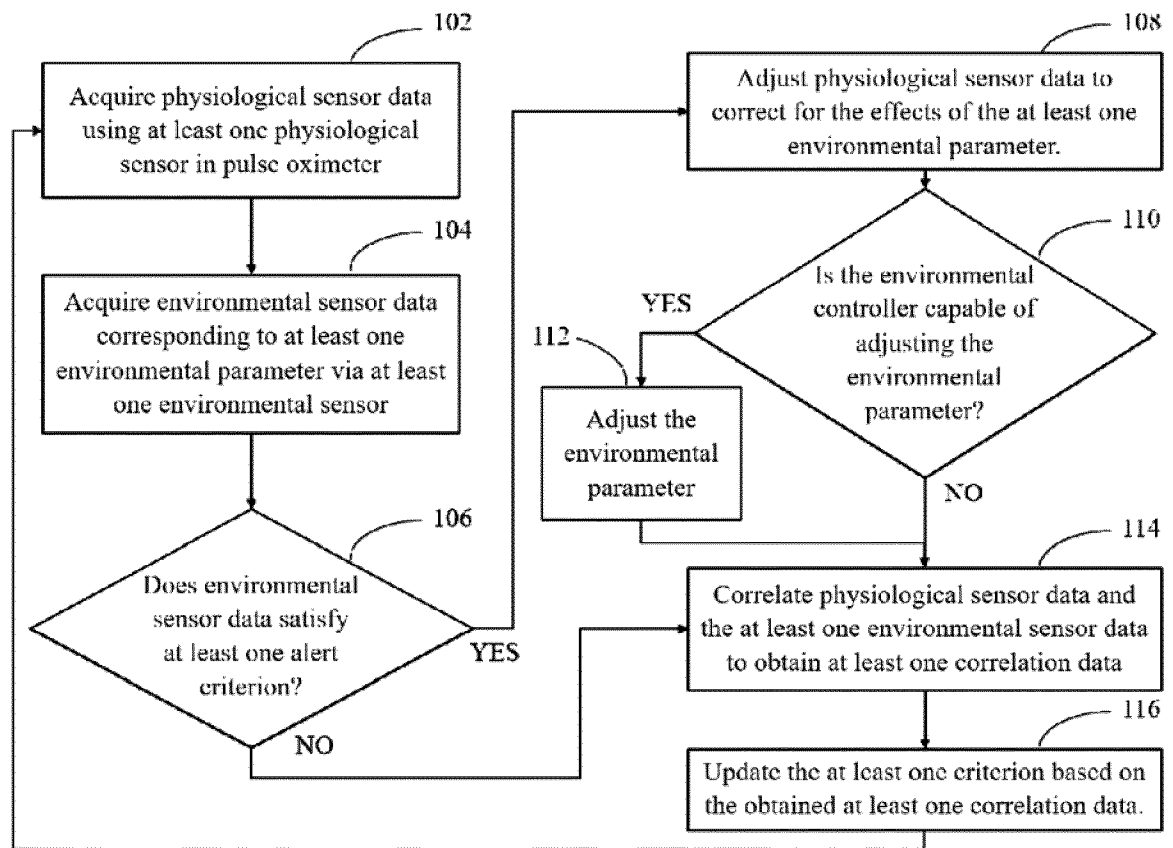


FIG. 1

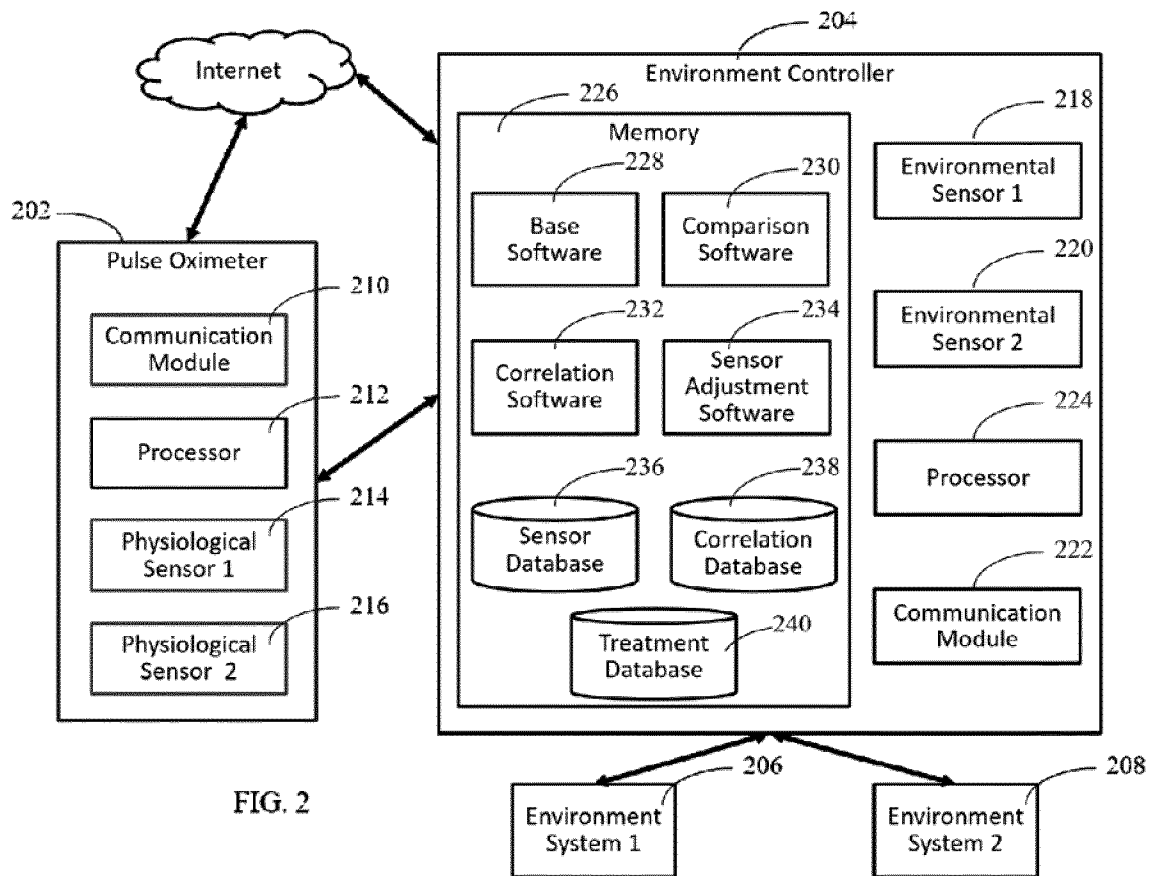


FIG. 2

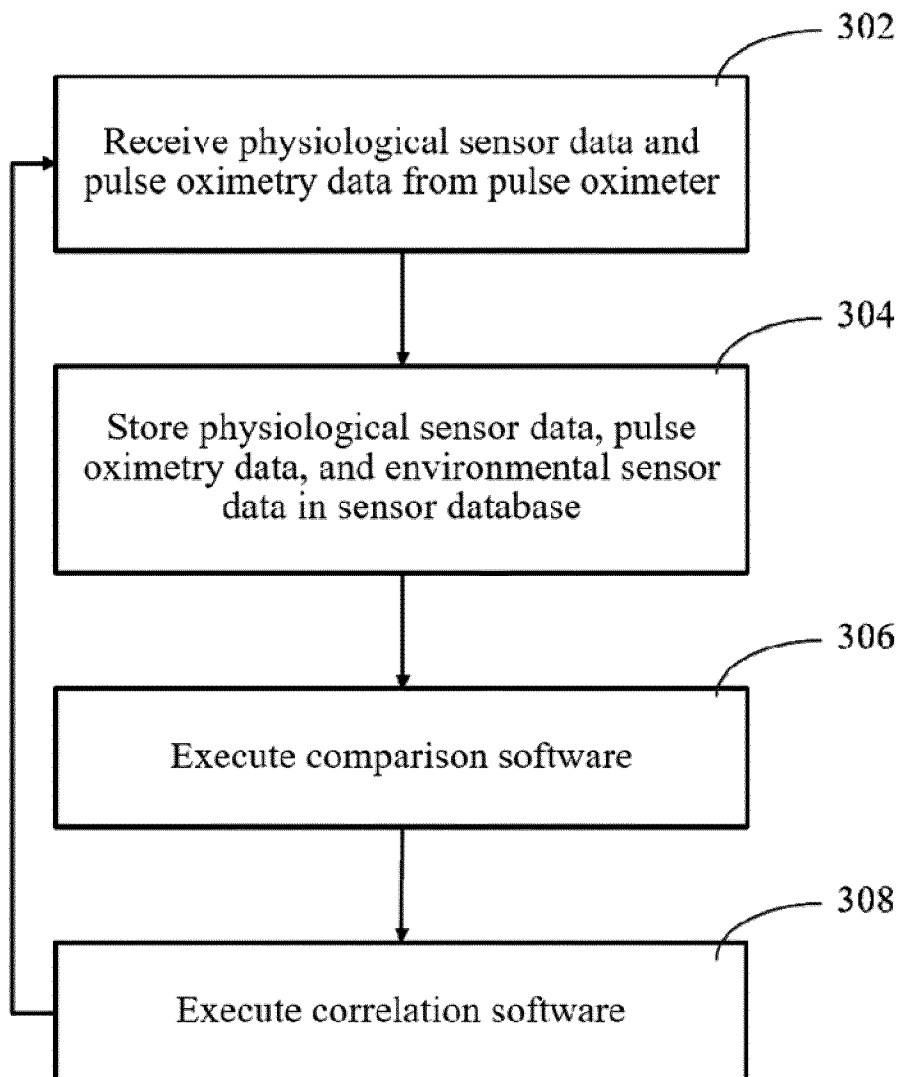


FIG. 3

412	402		404		406		408		410
	Date	Time	Sensor	Data Type	Value				
	19112015	0855	Oximeter	SpO2	98				
	19112015	0855	Thermometer (Ambient)	Temperature (°F)	85				
	19112015	0856	Thermometer (Body)	Temperature (°F)	99				
	19112015	0856	Smoke Detector	% optical density	91				
	19112015	0856	Smoke Detector	Presence of cigarette smoke	positive				
	...								

FIG. 4

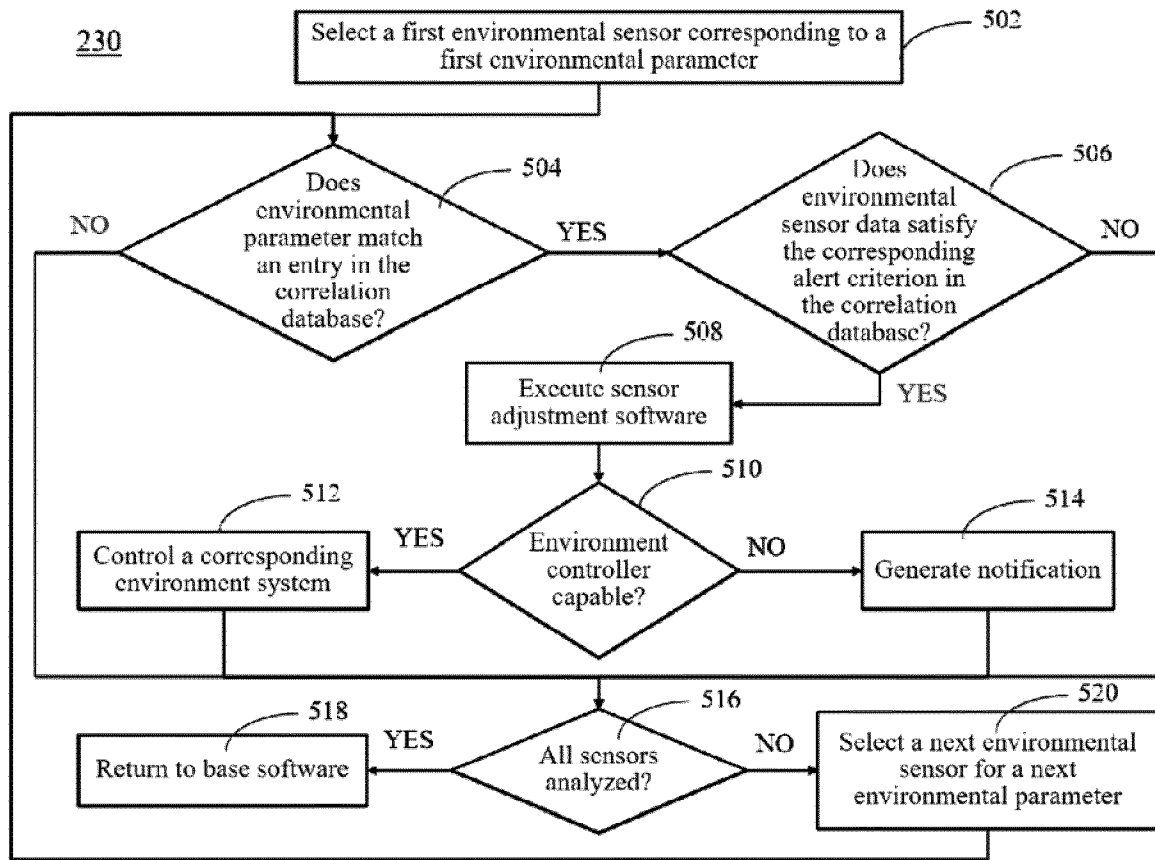


FIG. 5

	602	604	606	608
	Cause Type	Effect Type	Correlation Coefficient	Cause Criterion
610	Noise	SpO2	0.95	> 80Db
612	Noise	Pulse	0.99	> 80Db
614	Temperature	SpO2	0.98	< 50°F

FIG. 6

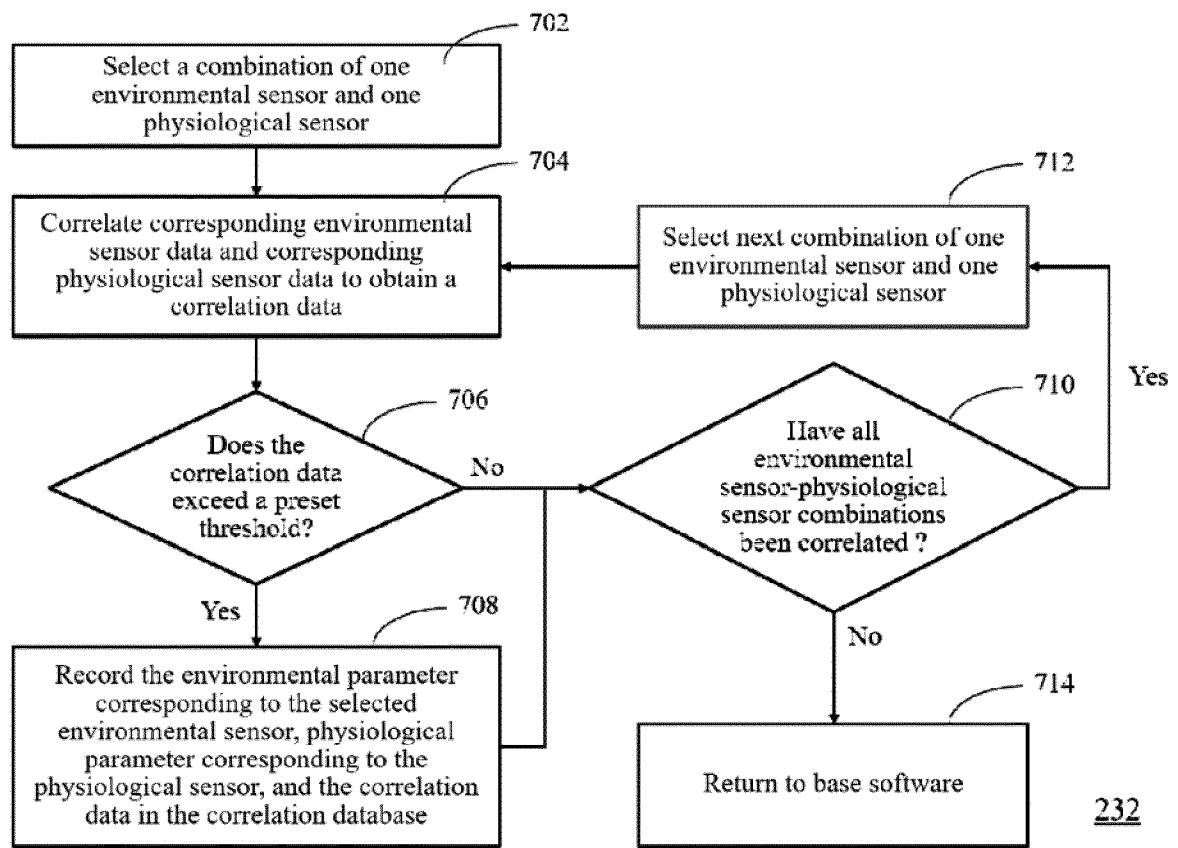


FIG. 7

802			804			806		
Sensor			Match File			Context		
808	Smoke Detector		Cigarette.dat			Smoking		
810	Microphone		LoudNoise.dat			Hearing Loss Risk		
812	Thermostat		HeatStroke.dat			Heat Stroke Risk		
814	Motion Sensor		AnkleSprain.dat			Jumping		

FIG. 8

240

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER

INV. A61B5/1455 A61B5/00 A61B5/0215
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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 A61M

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 practicable, 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	US 2009/112114 A1 (Ayyagari Deepak V [US] ET AL) 30 April 2009 (2009-04-30) cited in the application paragraphs [0006], [0016], [0029], [0033], [0035], [0037], [0045] - [0046], [0051], [0053] - [0055] figures 1-2, 4	1-7, 15
A	US 2015/164376 A1 (HUANG JUNG-TANG [TW]) 18 June 2015 (2015-06-18) the whole document	1-7, 15
A	CN 104 814 723 A (HISENSE GROUP CO LTD) 5 August 2015 (2015-08-05) * Machine-translation used"; the whole document	1-7, 15



Further documents are listed in the continuation of Box C.



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

"E" earlier application or patent but published on or after the international filing date

"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

27 January 2017

Date of mailing of the international search report

18/04/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Faymann, Juan

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2016/078217

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-7, 15

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-7, 15

A method and computer-implemented method for controlling environmental parameters using physiological sensor data which has been adjusted using environmental sensor data, wherein the environmental sensor data is used only when it passes a given threshold.

2. claims: 8-14

A system for controlling environmental parameters comprising a pulse oximeter and an environment controller, and software used to correct physiological sensor data according to environmental data, said software being stored on a memory unit located on the pulse oximeter or the environment controller.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/078217

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009112114 A1	30-04-2009	CN 101835417 A	15-09-2010
		EP 2203109 A1	07-07-2010
		JP 5005819 B2	22-08-2012
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		CN 104814722 A	05-08-2015
		CN 104814723 A	05-08-2015

专利名称(译)	脉搏血氧仪和环境控制器		
公开(公告)号	EP3380013A1	公开(公告)日	2018-10-03
申请号	EP2016808576	申请日	2016-11-20
[标]申请(专利权)人(译)	皇家飞利浦电子股份有限公司		
申请(专利权)人(译)	皇家飞利浦N.V.		
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[标]发明人	CRONIN JOHN DANDREA MICHAEL		
发明人	CRONIN, JOHN D'ANDREA, MICHAEL		
IPC分类号	A61B5/1455 A61B5/00 A61B5/0215 A61B5/03 A61M25/09		
CPC分类号	A61B5/0215 A61B5/036 A61B5/14552 A61B5/4833 A61B5/4836 A61B5/6851 A61B5/7246 A61B5/746 A61B2560/0247 A61B2560/0252 A61M2025/09166 A61B5/0008 A61B5/0024 A61B5/14551 A61B5 /7207 A61B2560/0242 A61M25/09 G05B19/042 G05B2219/2614 G16H40/63		
优先权	62/259053 2015-11-23 US 2016158640 2016-03-04 EP		
外部链接	Espacenet		

摘要(译)

一种用于控制患者环境的环境参数的方法。该方法包括：使用脉搏血氧计中的至少一个生理传感器获取生理传感器数据；通过至少一个环境传感器获取对应于至少一个环境参数的环境传感器数据；由环境控制器确定所获取的环境传感器数据是否满足至少一个警报标准；如果所获取的至少一个环境传感器数据满足所述至少一个警报标准，则通过脉冲血氧计调整生理传感器数据以校正至少一个环境参数的影响；确定环境控制器是否能够调整至少一个环境参数；如果环境控制器能够调整至少一个环境参数，则调整至少一个环境参数；将至少生理传感器数据与至少一个环境传感器数据相关联以获得相关数据；并基于所获得的相关数据更新至少一个警报标准。