

(19)



(11)

**EP 1 420 686 B1**

(12)

**EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:  
**02.07.2008 Bulletin 2008/27**

(51) Int Cl.:  
**A61B 5/00 (2006.01)**

(21) Application number: **02759415.9**

(86) International application number:  
**PCT/US2002/026524**

(22) Date of filing: **21.08.2002**

(87) International publication number:  
**WO 2003/020128 (13.03.2003 Gazette 2003/11)**

(54) **PATIENT MONITORING AND ALARM PROCESSING SYSTEM AND USER INTERFACE**

PATIENTENÜBERWACHUNG AND ALARMVERARBEITUNG

SYSTEME DE SURVEILLANCE DE PATIENT ET DE TRAITEMENT D'ALARME ET INTERFACE UTILISATEUR

(84) Designated Contracting States:  
**DE FR GB**

- **HUANG, Johnnie, W.**  
**Peabody, MA 01960 (US)**
- **KELLY, Clifford, Mark**  
**Windham, NH 03087 (US)**

(30) Priority: **31.08.2001 US 316605 P**  
**19.08.2002 US 223311**

(74) Representative: **Vinsome, Rex Martin**  
**Urquhart-Dykes & Lord LLP**  
**Cale Cross House**  
**Pilgrim Street**  
**Newcastle upon Tyne NE1 6SU (GB)**

(43) Date of publication of application:  
**26.05.2004 Bulletin 2004/22**

(73) Proprietor: **Draeger Medical Systems, Inc.**  
**Andover, MA 01810 (US)**

(56) References cited:  
**EP-A- 1 034 734 EP-A- 1 099 406**  
**WO-A-99/04685 US-A- 4 370 727**  
**US-A- 5 692 220 US-A- 5 819 007**

(72) Inventors:  
 • **SANTOSO, Nugroho, Iwan**  
**Plainsboro, NJ 08536 (US)**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

**EP 1 420 686 B1**

**Description**

TECHNICAL FIELD

5 **[0001]** The present invention relates to medical systems and in particular to systems for monitoring patient physiological parameters.

BACKGROUND

10 **[0002]** Patient treatment often includes monitoring of various physiological parameters. Conventionally, such monitoring begins by attaching sensors to several locations on a patient's body. The sensors transmit signals to one or more devices, which in turn determine the values of subject parameters based on the signals. In this regard, a particular parameter value may be determined based on a signal received from one or more of the attached sensors.

15 **[0003]** Most conventional monitoring devices include alarm functions. Generally, a device issues an audible and/or visual alarm after determining that a particular parameter value has fallen outside a specified range. This arrangement presents numerous difficulties. First, a monitoring device may issue an alarm in a case that an associated sensor detaches from the patient or in case of other non-emergency situations. Several monitoring devices are often used to monitor a single patient, with each device presenting a possibility of a false alarm. These possibilities condition caregivers to reduce their sensitivity to the alarms.

20 **[0004]** A caregiver's decision-making processes are often prolonged during critical events due to a barrage of corresponding alarms from multiple monitoring devices, some of which may be false alarms. Additionally, an alarm usually fails to provide sufficient information to a caregiver. Most patient complications are evidenced by several physiological parameters, so an alarm-triggering value of one parameter is insufficient to identify a particular complication.

25 **[0005]** The patent publication US-A-5,819,007 discloses such a monitoring device comprising alarms and generating notifications of the patient condition to an operator. The features defined in the preamble of claim 1 are known from said publication.

**[0006]** In view of the foregoing, a more efficient system to process patient alarms is desired.

SUMMARY

30 **[0007]** Some embodiments of the invention provide a system to monitor a patient. In some aspects, a signal representing a value of a physiological parameter is received from a monitoring device. The received value is a value that caused the monitoring device to trigger an alarm associated with the physiological parameter. A notification is determined based on the received signal and on a second signal that represents a value of a second physiological parameter. The notification is then presented to an operator.

35 **[0008]** According to some aspects, probabilities associated with the notification are presented to the operator. The probabilities indicate a calculated likelihood that the notification describes the patient's condition. Some aspects also allow the operator to issue an instruction to suppress a particular notification, in response to which a notification is determined based on an assumption that the particular notification is not indicative of the patient's condition.

40 **[0009]** The present invention should not be deemed limited to the disclosed embodiments, however, as those of ordinary skill in the art can readily adapt the teachings of the present invention to create other embodiments and applications.

BRIEF DESCRIPTION OF THE DRAWINGS

45 **[0010]** The exact nature of this invention, as well as its advantages, will become readily apparent from consideration of the following specification as illustrated in the accompanying drawings, wherein:

50 FIG. 1 is diagram illustrating patient monitoring according to some embodiments of the present invention;

FIG. 2 is a flow diagram illustrating process steps according to some embodiments of the present invention;

55 FIGS. 3a and 3b comprise expert-Bayesian networks for use in conjunction with some embodiments of the present invention; and

FIGS. 4a and 4b are outward views of displays presenting notifications and associated probabilities according to some embodiments of the present invention.

## DETAILED DESCRIPTION

5 [0011] The following description is provided to enable any person of ordinary skill in the art to make and use the invention and sets forth the best modes contemplated by the inventor for carrying out the invention. Various modifications, however, will remain readily apparent to those in the art.

[0012] FIG. 1 illustrates a patient monitoring system according to some embodiments of the present invention. The system illustrated in FIG. 1 may be used in any number of locations and in any number of situations. Possible locations include a hospital, an office, and an ambulance, and possible situations include during an operation, during a checkup, and during a recovery period.

10 [0013] Attached to patient 1 are monitoring devices such as sensors for producing signals associated with physiological parameters. The produced signals are received by monitoring devices such as monitors for determining a value of a physiological parameter therefrom. More specifically, blood oxygen saturation level (SP02) monitor 10 receives a signal associated with an SP02 parameter from sensor 11, electrocardiogram (ECG) monitor 20 receives a signal associated with a heart rate (HR) parameter from sensor 21, respiration (RESP) monitor 30 receives a signal associated with a  
15 RESP parameter from sensor 31, and invasive blood pressure (IBP) monitor 40 receives a signal associated with an IBP parameter from sensor 41. Each of sensors 11, 21, 31 and 41 is a sensor suitable to produce a signal representing an associated parameter. Accordingly, each monitor is used to determine a value of an associated parameter. In some embodiments, the signal received from SP02 monitor 10 may also be used to determine a value of a pulse (PLS) parameter.

20 [0014] It should be noted that, according to some embodiments, one or more of monitors 10 through 40 may receive signals from more than one sensor and/or two or more of monitors 10 through 40 may receive signals from a same sensor. In addition, each sensor may transmit a signal using any currently or hereafter-known system for transmitting data, including RF, infrared, or fiber-optic. Moreover, the signals may be transmitted over one or more of an IP network, an Ethernet network, a Bluetooth network, a cellular network, and any other suitable network.

25 [0015] Monitors 10 through 40 are in communication with communication bus 50. Again, communication bus 50 may comprise any type of network, and communication therewith may proceed in accordance with any hardware and/or software protocol. It should be noted that the elements described herein as being in communication with one another need not be continuously exchanging data. Rather, in some embodiments, a connection is established prior to each exchange of data and is severed thereafter.

30 [0016] Also in communication with communication bus 50 is alarm server 60. According to some embodiments, alarm server 60 operates to receive a signal representing a value of a physiological parameter, wherein the value has triggered an alarm associated with the physiological parameter, to determine a notification based at least on the received signal and on a second signal representing a value of a second physiological parameter, and to present the notification to an operator.

35 [0017] In some embodiments, alarm server 60 includes a communication interface for receiving physiological parameter values from monitors 10 through 40, a prediction unit for providing data representing an extrapolated patient condition based on the values, a decision processor for applying a decision rule to the extrapolated patient condition to identify an alert condition, and an alert generator for generating an alert indication in response to the alert condition. The prediction unit may use patient record information for extrapolating the patient condition. In some embodiments, the generator provides treatment and/or diagnostic suggestions based on the extrapolated condition. The generator may also provide user-selectable suggestion information of different degrees of detail with respect to the extrapolated condition, and may also associate different reliability weighting with corresponding suggestion information of different degrees of detail.

40 [0018] More specifically, according to some embodiments, alarm server 60 receives signals from monitors 10 through 40. Each of the signals represents a value of a respective physiological parameter. At least one of the values has triggered an alarm of its respective monitor because the value falls outside of a range of predetermined values. For example, SP02 monitor 10 has been programmed to issue an alarm if it determines an SP02 value that is less than 80%. SP02 monitor 10 receives a signal from sensor 11, determines an SP02 value of 70% based on the signal, and issues an alarm because the determined value is less than 80%. SP02 monitor 10 transmits a signal representing the value to alarm server 60 via communication bus 50. One or more of monitors 20 through 40 also sends a signal representing a  
45 value of a physiological parameter to alarm server 60. The signals received from the one or more monitors may or may not have triggered an alarm of their respective monitors. In this regard, SP02 monitor 10 may also transmit signals representing parameter values that do not trigger an alarm to alarm server 60.

50 [0019] Alarm server 60 determines one or more notifications based on the received signals and presents the one or more notifications to an operator. The notifications indicate a condition of patient 1 based on the received signals. According to some embodiments, alarm server 60 also determines a probability corresponding to each notification and presents the probabilities in association with their corresponding notifications. Systems for determining the notifications and probabilities will be described in detail below.

55 [0020] In some embodiments, the operator can issue a command to suppress one of the presented notifications. In

such a case, future reception of similar signals would result in alarm server 60 determining subsequent notifications that do not include the suppressed notification. The subsequent notifications are determined in some embodiments based on an assumption that the suppressed notification is not indicative of the patient's condition. Suppression of certain notifications that are known not to describe a patient's condition may result in the determination of more reliable notifications and more accurate associated probabilities. Notification suppression according to some embodiments of the present invention is described below.

**[0021]** FIG. 2 is a flow diagram of process steps 200 according to some embodiments of the present invention. Although process steps 200 are described as being performed by alarm server 60, hardware and/or software for executing process steps 200 may be located in and/or executed by one or more of sensors 11 through 41, monitors 10 through 40, and alarm server 60.

**[0022]** Initially, at step S201, alarm server 60 receives a first signal that represents a value of a physiological parameter. The represented value triggered an alarm prior to step S201 because a device recognized the value as satisfying an alarm condition. The device may be a device that determined the value, a device that issued the alarm, and/or another device. According to the present example, a signal is received in step S201 from SP02 monitor 10 that represents an SP02 value of 70%. This value has triggered an alarm of SP02 monitor 10 because the value is less than 80%.

**[0023]** Next, in step S202, alarm server 60 receives a second signal that represents a value of a second parameter. The value of the second parameter may or may not have triggered an alarm prior to step S202. A signal representing a HR value of 110 is received from ECG monitor 20 in the present example of step S202. Notifications and associated probabilities are determined in step S203 based on the first and second signals. It should be noted that the determination may be based on additional signals representing values of additional physiological parameters. For example, the determination of the present example may also be based on a signal received from monitor 10 that represents a PLS value of 104.

**[0024]** The determined notifications are intended to describe the condition of patient 1, and the associated probabilities are intended to express a likelihood that the notification is accurate. Many systems can be used to determine the notifications and the associated probabilities. These systems may be based on one or more of rules, expert systems, probabilistic networks, predictive networks, neural networks, and the like. According to a specific example, an expert-Bayesian network may be used in step S203.

**[0025]** One known method of creating an expert-Bayesian network begins with the creation of an expert knowledge diagram. Generally, the diagram illustrates the approach an expert would take in making a determination based on various inputs. In the present instance, an expert knowledge map associates physiological values with possible causes of the values via probability distributions. Once an expert knowledge map is created, the probability distributions may be used to derive a corresponding expert-Bayesian network. Known adaptive normalization techniques may be applied to "train" the expert-Bayesian network based on its intended use.

**[0026]** FIG. 3a illustrates an expert-Bayesian network for use in conjunction with some embodiments of step S203. The nodes of the two upper-most levels of the network determine probabilities associated with notifications. The third level includes three nodes representing intermediate determinations that are made based on determined physiological parameters. Each node of the network includes a mathematical function that determines a probability of particular scenarios based on the outputs of nodes from which the node receives input. In a specific example, the "dHR" node of FIG. 3a may include the following mathematical function, which, as shown in FIG. 3a, operates on the outputs of the "Heart\_Condition" and "ECG\_Reliability" nodes:

$$p(dHR | ECG\_Reliability, Heart\_Condition) = (ECG\_Reliability == High \ \&\& \ Heart\_Condition == Bradycardiac) ? NormalDist(dHR, -5,2) : (ECG\_Reliability == High \ \&\& \ Heart\_Condition == Tachycardiac) ? NormalDist(dHR, 5,2) : (ECG\_Reliability == High \ \&\& \ Heart\_Condition == Normal) ? NormalDist(dHR,0,1) : (ECG\_Reliability == Low \ \&\& \ Heart\_Condition == Bradycardiac) ? NormalDist(dHR, -5,15) : (ECG\_Reliability == Low \ \&\& \ Heart\_Condition == Tachycardiac) ? NormalDist(dHR, 5,15) : (ECG\_Reliability == Low \ \&\& \ Heart\_Condition == Normal) ? NormalDist(dHR,0,20) : 0$$

**[0027]** This function determines a probability table as shown below:

		Heart_Condition		
		Bradycardiac	Tachycardiac	Normal
ECG_Reliability	High	n(dHR,-5,2)	n(dHR,5,2)	n(dHR,0,1)
	Low	n(dHR,-5,15)	n(dHR,5,15)	n(dHR,0,20)

Accordingly, the data shown in cell (1,1) indicates that in a state where ECG\_Reliability = High and Heart\_Condition = Bradycardiac, dHR may be expressed by a normal distribution having mean = -5 and standard deviation = 2.

5 [0028] It should be noted that the inputs to a node may themselves consist of probability distributions. For example, one node of the third level represents a probability that a received RESP value has a High reliability and a probability that the received RESP value has a Low reliability based on a probability distribution of the derivative of the RESP value and a probability distribution of the standard deviation of the RESP value.

10 [0029] The grayed-out nodes of FIG. 3a are not associated with probability distributions because the actual values represented by the nodes are known. According to the present example, the grayed-out nodes represent values received by alarm server 60 in steps S201 and S202. Therefore, the probabilities reflected within the other nodes of FIG. 3a are based on the received values and on the mathematical functions included in the nodes. More particularly, based on the received values of 70% SP02, 110 HR and 104 PLS, the notifications and probabilities of the two upper-most levels of the FIG. 3a network are determined in step S203. It should be noted that only one notification and/or no probability is determined in some embodiments of step S203.

15 [0030] The notifications and the associated probabilities are presented to an operator in step S204. FIG. 4a is an outward view of interface 61 of alarm server 60 for use in presenting the notifications and the associated probabilities. Interface 61 of FIG. 4a presents notifications and associated probabilities determined based on the network of FIG. 3a. As shown, all notifications and/or associated probabilities determined in step S203 need not be presented in step S204. For example, presented in step S204 might be only those notifications associated with probabilities of greater than 20% and/or those notifications describing a critical condition and that are associated with a probability of greater than 50%.

20 [0031] Interface 61 also includes buttons 62 and 63 for selecting one of the displayed notifications, button 64 for delaying an alarm, and button 65 for suppressing a selected notification. According to some embodiments, the alarm that was triggered by the value of the signal received in step S201 continues throughout steps S201 through S205. An operator may issue an instruction to temporarily disable the alarm by pressing button 64. In this case, the instruction is detected in step S205 and flow proceeds to step S206, in which the alarm is temporarily disabled for a specified period. 25 Any other alarms issued by monitoring devices 20 through 40 may also be disabled in step S206. The disabled alarms resume after expiration of the specified period.

30 [0032] The operator may issue an instruction to ignore a presented notification by selecting the notification using buttons 62 and/or 63 and by thereafter pressing button 65. In some instances, the operator may issue such an instruction because the operator is confident that the selected notification does not describe the condition of patient 1. According to the present example, the operator selects the "SP02 Sensor Problem" notification and presses button 65. The instruction is received in step S205, and flow thereafter proceeds to step S207.

35 [0033] In step S207, it is assumed that the selected notification is not indicative of the patient's condition. Flow returns to step S203 to re-determine the notifications and associated probabilities based on this assumption. FIG. 3b illustrates this re-determination using the expert-Bayesian network of FIG. 3a. More particularly, the probability associated with the "SP02 Sensor Problem" notifications has been forced to 0% and each other node has been recalculated based thereon and on the original values of the SP02, HR and PLS parameters.

40 [0034] The re-determined notifications and associated probabilities are presented to the operator in step S204. FIG. 4b is a view of interface 61 presenting the re-determined notifications and probabilities according to some embodiments of the present invention. As shown, the "SP02 Sensor Problem" notification has been suppressed.

45 [0035] Those in the art will appreciate that various adaptations and modifications of the above-described embodiments can be configured without departing from the scope and spirit of the invention. In some embodiments, functions attributed above to monitors 10 through 40 are performed by a single monitoring unit, such as the Siemens Infinity Patient Monitoring System™. Some embodiments also incorporate the functions of alarm server 60 into the single monitoring unit.

50 [0036] Embodiments of the present invention may differ from the description of process steps 200. For example, in some embodiments, no probability is determined in step S203 or presented in step S204. According to some embodiments, alarm server 60 may receive a signal from a monitoring device representing a value of a physiological parameter that is not associated with any node of a probabilistic network used by alarm server 60 but that triggered an alarm of the monitoring device. As a result, alarm server 60 presents a notification of the alarm on interface 61 along with other notifications that are determined as described above. Such an arrangement allows alarm server 60 to handle alarms other than those alarms that it has been programmed to analyze in conjunction with other signals.

55 [0037] In some embodiments, the operator may also issue an instruction to discontinue suppression of a notification. The particular arrangement of process steps, 200 is not meant to imply a fixed order to the steps; embodiments of the present invention can be practiced in any order that is practicable. In this regard, flow may proceed from step S207 to step S201 to determine notifications and/or probabilities based on a command to suppress a notification and on newly-received parameter values.

[0038] Therefore, it is to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

Claims

1. A system for monitoring a patient, comprising:

5 a plurality of monitoring devices (10, 20, 30, 40) each of the plurality of monitoring devices for monitoring values of one or more respective physiological parameters, for determining that a value of one of the one or more respective physiological parameters violates an associated alarm threshold, and for issuing an alarm indicating that the value violates the associated alarm threshold;  
 10 a notification system for receiving a signal representing the value and one or more signals representing other monitored values, for determining a notification based at least on the received signal and on the one or more signals, and for presenting the notification to an operator, **characterized in that**  
 an input device is adapted to receive an instruction to suppress a particular notification,

15 wherein the notification system is arranged to re-determine a notification in response to an instruction to suppress a notification.

2. A system according to Claim 1, the notification system being arranged to re-determine the notification based at least on an assumption that the particular notification is not indicative of the patient's condition.

20 3. A system according to Claim 1 or 2, the notification system being arranged to issue an instruction to suppress the alarm.

4. A system according to any of Claims 1 to 3, the system being a medical alarm system for processing information from a plurality of patient monitoring sources to generate an alert message, comprising:

25 a communication interface for receiving patient physiological parameter values from a plurality of patient monitoring devices for a particular patient;  
 a prediction unit for providing data representing an extrapolated patient condition based on the parameter values;  
 30 a decision processor for applying a decision rule to said extrapolated patient condition to identify an alert condition; and  
 an alert generator for generating an alert indication in response to said identified alert condition.

35 5. A system according to Claim 4, wherein said prediction unit uses patient record information for a particular patient in extrapolating patient condition.

6. A system according to any of the preceding claims, further comprising a user interface comprising:

40 a displayed image area to present a notification based at least on a signal representing a value of a physiological parameter, the value having triggered an alarm associated with the physiological parameter, and on a second signal representing a value of a second physiological parameter.

7. A system according to Claim 6, the user interface further comprising:

45 a displayed image area to present a probability associated with the presented notification.

8. A system according to Claim 7, the user interface further comprising:

50 a displayed image area to present a second notification and a second probability associated with the second notification.

9. A system according to Claim 8, wherein the displayed image area presents a second notification based at least on the received signal, on the second signal, and on the instruction to suppress the particular notification.

10. A system according to any of the preceding claims wherein the notification system comprises a probabilistic network.

55 11. A system according to Claim 10 wherein a probability in the probabilistic network is changed in response to an instruction to suppress a notification.

12. A system according to Claim 10 or 11 wherein the probabilistic network is a Bayesian network or a predictive network.

13. A method of providing a notification comprising:

5 receiving a signal representing a value of a physiological parameter, the value having triggered an alarm associated with the physiological parameter;  
determining a notification based at least on the received signal and on a second signal representing a value of a second physiological parameter,  
10 presenting the notification to an operator,  
receiving an instruction to suppress the notification; and  
re-determining the notification in response to the instruction to suppress the notification.

14. A method according to Claim 13, further comprising:

15 determining a second notification based at least on the received signal.

15. A method according to Claim 14, further comprising determining a probability associated with each of the notification and the second notification; and

20 presenting each of the notification and the second notification in conjunction with a respective associated probability.

16. A method according to any of Claims 13 to 15, further comprising:

25 determining the notification based at least on a third received signal; and  
determining that the notification should not be presented based on the received instruction.

17. A method according to any of Claims 13 to 16, wherein the notification is determined using a probabilistic network.

30 18. A method according to Claim 17, wherein the probabilistic network is a Bayesian network.

19. A method according to Claim 17, wherein the probabilistic network is a predictive network.

35 20. A method according to any of Claims 17 to 19, further comprising changing a probability in the probabilistic network in response to the instruction to suppress the notification.

21. A method according to any of Claims 13 to 20, further comprising:

40 issuing an instruction to suppress the alarm.

22. A method according to any of Claims 13 to 21, further comprising:

45 determining a second notification based at least on a third received signal and on an assumption that the notification is not indicative of the patient's condition.

23. A method according to any of Claims 13 to 22, further comprising:

50 receiving an instruction to discontinue suppression of the particular notification;  
receiving a second signal representing a second value of the physiological parameter, the value having triggered an alarm associated with the physiological parameter;  
determining the particular notification based at least on the received second signal; and  
presenting the particular notification to an operator.

24. A method according to Claim 10, wherein the re-determining step comprises:

55 re-determining the notification based at least on an assumption that the particular notification is not indicative of the patient's condition.

Patentansprüche

1. Ein System zur Patientenüberwachung, umfassend:

5 eine Vielzahl von Überwachungseinheiten (10, 20, 30, 40), wobei jede der Vielzahl der Überwachungseinheiten die Werte eines oder mehrerer einzelner physiologischer Parameter überwacht, um zu ermitteln, dass ein Wert des einen oder der mehreren einzelnen physiologischen Parameter eine ihm zugeordnete Alarmschwelle überschreitet, und um einen Alarm auszulösen, der anzeigt, dass dieser Wert die ihm zugeordnete Alarmschwelle überschreitet;

10 ein Meldesystem zum Empfangen eines Signals, welches den Wert wiedergibt und eines oder mehrerer Signale, welche die anderen überwachten Werte wiedergeben, zur Bestimmung einer Meldung auf Basis zumindest des erhaltenen Signals und auf Basis des einen oder der mehreren Signale, und zum Anzeigen der Meldung an den Bediener, **dadurch gekennzeichnet, dass** ein Eingabegerät daran angepasst ist, eine Anweisung zu erhalten, um eine besondere Meldung zu verhindern, wobei das Meldesystem derart ausgestattet ist, um eine Meldung auf eine Anweisung hin nochmals zu untersuchen, um eine Meldung zu unterdrücken.

2. System nach Anspruch 1, wobei das Meldesystem derart ausgestattet ist, um die Meldung, die zumindest auf einer Annahme, dass die besondere Meldung nicht bezeichnend für den Zustand des Patienten ist, beruht, nochmals zu untersuchen.

- 20 3. System gemäß Anspruch 1 oder 2, wobei das Meldesystem derart ausgestattet ist, eine Anweisung zum Unterdrücken des Alarms zu senden.

- 25 4. System gemäß einem der Ansprüche 1 bis 3, wobei das System ein medizinisches Alarmsystem zur Verarbeitung von Informationen einer Vielzahl von patientenüberwachenden Quellen ist, um eine Alarmmeldung zu generieren, umfassend:

eine Kommunikationsschnittstelle, um die physiologischen Patientenparameterwerte einer Vielzahl von patientenüberwachenden Einheiten eines bestimmten Patienten zu empfangen;

30 eine Prognoseeinheit zur Lieferung von Daten, welche einen extrapolierten Zustand eines Patienten auf Basis der Parameterwerte widerspiegeln;

eine Entscheidungsauswerteeinheit zum Anwenden einer Entscheidungsregel gegenüber des extrapolierten Zustandes des Patienten, um einen Alarmzustand zu identifizieren; und

einen Alarmerzeuger zum Erzeugen eines Alarmsignals als Reaktion auf besagten identifizierten Alarmzustand.

- 35 5. System gemäß Anspruch 4, wobei die Prognoseeinheit aufgezeichnete Patienteninformationen für einen bestimmten Patienten verwendet, um einen Zustand eines Patienten zu extrapolieren.

- 40 6. System gemäß einem der vorherstehenden Ansprüche, weiterhin umfassend eine Bedieneroberfläche umfassend:

ein Anzeigenfeld zur Anzeige einer Meldung, die zumindest auf einem Signal, welches einen Wert eines physiologischen Parameters repräsentiert, basiert, wobei der Wert einen Alarm ausgelöst hat, der mit dem physiologischen Parameter verknüpft ist, und auf einem zweiten Signal, welches einen Wert eines zweiten physiologischen Parameters repräsentiert, basiert.

- 45 7. System gemäß Anspruch 6, wobei die Bedieneroberfläche weiterhin umfasst:

ein Anzeigenfeld, um eine Wahrscheinlichkeit, die mit der wiedergegebenen Meldung verknüpft ist, darzustellen.

- 50 8. System gemäß Anspruch 7, wobei die Bedieneroberfläche weiterhin umfasst:

ein Anzeigenfeld, um eine zweite Meldung und eine zweite Wahrscheinlichkeit, die mit der zweiten Meldung verknüpft ist, anzuzeigen.

- 55 9. System gemäß Anspruch 8, wobei das Anzeigenfeld eine zweite Meldung mindestens auf Basis des einen empfangenen Signals, des zweiten Signals und der Anweisung wiedergibt, um die spezielle Meldung zu unterdrücken.

10. System gemäß einem der vorstehenden Ansprüche, wobei das Anzeigensystem ein wahrscheinlichkeitstheoreti-

sches Netzwerk umfasst.

5 11. System gemäß Anspruch 10, wobei eine Wahrscheinlichkeit in dem wahrscheinlichkeitstheoretischen Netzwerk auf eine Anweisung hin verändert wird, um eine Meldung zu unterdrücken.

12. System gemäß Anspruch 10 oder 11, wobei das wahrscheinlichkeitstheoretische Netzwerk ein Bayesianisches Netzwerk oder ein prognostizierendes Netzwerk ist.

10 13. Verfahren zur Generierung einer Meldung, umfassend:

Empfangen eines Signals, welches einen Wert eines physiologischen Parameters repräsentiert, wobei der Wert einen Alarm, der mit dem physiologischen Parameter verbunden ist, ausgelöst hat;

15 Ermitteln einer Meldung basierend zumindest auf dem empfangenen Signal und auf Basis eines zweiten Signals, welches einen Wert eines zweiten physiologischen Parameters widerspiegelt;

Wiedergabe der Meldung an den Bediener;

Empfangen einer Anweisung, um die Meldung zu unterdrücken; und

nochmaliges Untersuchen der Meldung in Antwort auf die Anweisung, um die Meldung zu unterdrücken.

20 14. Verfahren gemäß Anspruch 13, weiterhin umfassend Ermittlung einer zweiten Meldung basierend auf mindestens dem empfangenen Signal.

25 15. Verfahren gemäß Anspruch 14, weiterhin umfassend Ermitteln einer Wahrscheinlichkeit, die mit jeder der Meldung und der zweiten Meldung verknüpft ist, und Wiedergabe jeder der Meldung und der zweiten Meldung in Verbindung mit einer jeweiligen damit verknüpften Wahrscheinlichkeit.

30 16. Verfahren gemäß einem der Ansprüche 13 bis 15, weiterhin umfassend:

Ermitteln der Meldung auf Basis zumindest eines dritten empfangenen Signals; und

Ermitteln, dass die Meldung auf Basis der empfangenen Anweisungen nicht wiedergegeben werden soll.

35 17. Verfahren gemäß einem der Ansprüche 13 bis 16, wobei die Meldung unter Verwendung eines wahrscheinlichkeitstheoretischen Netzwerkes ermittelt wird.

18. Verfahren gemäß Anspruch 17, wobei das wahrscheinlichkeitstheoretische Netzwerk ein Bayesianisches Netzwerk ist.

19. Verfahren gemäß Anspruch 17, wobei das wahrscheinlichkeitstheoretische Netzwerk ein prognostizierendes Netzwerk ist.

40 20. Verfahren gemäß einem der Ansprüche 17 bis 19, weiterhin umfassend Ändern der Wahrscheinlichkeit in dem wahrscheinlichkeitstheoretischen Netzwerk in Antwort auf die Anweisung, um die Meldung zu unterdrücken.

45 21. Verfahren gemäß einem der Ansprüche 13 bis 20, weiterhin umfassend:

Aussenden einer Anweisung, um den Alarm zu unterdrücken.

22. Verfahren gemäß einem der Ansprüche 13 bis 21, weiterhin umfassend:

50 Ermitteln einer zweiten Meldung auf Basis von zumindest einem dritten empfangenen Signal und unter der Vermutung, dass die Meldung nicht bezeichnend für den Zustand des Patienten ist.

23. Verfahren gemäß einem der Ansprüche 13 bis 22, weiterhin umfassend:

55 Empfangen einer Anweisung, um die Unterdrückung der spezifischen Meldung abubrechen;

Empfangen eines zweiten Signals, welches einen zweiten Wert des physiologischen Parameters wiedergibt, wobei der Wert einen Alarm in Verbindung mit dem physiologischen Parameter ausgelöst hat;

Ermitteln der besonderen Meldung auf Basis von zumindest dem empfangenen zweiten Signal; und

Wiedergabe der spezifischen Meldung an den Bediener.

24. Verfahren gemäß Anspruch 10, wobei der nochmalige Untersuchungsschritt umfasst:

nochmaliges Untersuchen der Meldung zumindest auf Basis der Annahme, dass die spezielle Meldung nicht bezeichnend für den Zustand des Patienten ist.

5

## Revendications

1. Système de surveillance d'un patient, comprenant :

10

une pluralité de dispositifs de surveillance (10, 20, 30, 40), chacun de la pluralité de dispositifs de surveillance servant à surveiller des valeurs d'un ou de plusieurs paramètres physiologiques respectifs, dans le but de déterminer qu'une valeur d'un ou de plusieurs paramètres physiologiques respectifs viole un seuil d'alarme associé, et dans le but d'émettre une alarme indiquant que la valeur viole le seuil d'alarme associé ; un système de notification servant à recevoir un signal représentant la valeur, et un ou plusieurs signaux représentant d'autres valeurs surveillées, dans le but de déterminer une notification basée au moins sur le signal reçu et sur le un ou les plusieurs signaux, et dans le but de présenter la notification à un opérateur ; **caractérisé en ce que**

15

un dispositif d'entrée est adapté pour recevoir une instruction de supprimer une notification particulière,

20

dans lequel le système de notification est agencé de façon à re-déterminer une notification en réponse à une instruction de supprimer une notification.

2. Système selon la revendication 1, dans lequel le système de notification est agencé de façon à re-déterminer la notification en se basant au moins sur une supposition que la notification particulière n'indique pas l'état d'un patient.

25

3. Système selon la revendication 1 ou 2, dans lequel le système de notification est agencé de façon à émettre une instruction de supprimer l'alarme.

4. Système selon l'une quelconque des revendications 1 à 3, dans lequel le système est un système d'alarme médicale servant à traiter des informations provenant d'une pluralité de sources de surveillance d'un patient dans le but de générer un message d'alerte, le système comprenant :

30

une interface de communication servant à recevoir des valeurs de paramètres physiologiques d'un patient délivrées en sortie par une pluralité de dispositifs de surveillance de patient pour un patient particulier ; un module de prédiction servant à fournir des données représentant un état extrapolé du patient en se basant sur les valeurs de paramètres ; un dispositif de traitement de décision servant à appliquer une règle de décision au dit état extrapolé du patient dans le but d'identifier une condition d'alerte ; et un dispositif de génération d'alerte servant à générer une indication d'alerte en réponse à ladite condition d'alerte identifiée.

35

40

5. Système selon la revendication 4, dans lequel :

ledit module de prédiction utilise des informations de dossier de patient pour un patient particulier en extrapolant un état du patient.

45

6. Système selon l'une quelconque des revendications précédentes, comprenant par ailleurs une interface utilisateur comprenant :

50

une zone d'image affichée servant à présenter une notification basée au moins sur un signal représentant une valeur d'un paramètre physiologique, la valeur ayant déclenché une alarme associée au paramètre physiologique, et sur un deuxième signal représentant une valeur d'un deuxième paramètre physiologique.

7. Système selon la revendication 6, dans lequel l'interface utilisateur comprend par ailleurs :

55

une zone d'image affichée servant à présenter une probabilité associée à la notification présentée.

## EP 1 420 686 B1

8. Système selon la revendication 7, dans lequel l'interface utilisateur comprend par ailleurs :

une zone d'image affichée servant à présenter une deuxième notification et une deuxième probabilité associée à la deuxième notification.

5

9. Système selon la revendication 8, dans lequel la zone d'image affichée présente une deuxième notification basée au moins sur le signal reçu, sur le deuxième signal, et sur l'instruction de supprimer la notification particulière.

10

10. Système selon l'une quelconque des revendications précédentes, dans lequel le système de notification comprend un réseau probabiliste.

11. Système selon la revendication 10 dans lequel une probabilité dans le réseau probabiliste change en réponse à une instruction de supprimer une notification.

15

12. Système selon la revendication 10 ou 11 dans lequel le réseau probabiliste est un réseau bayésien ou un réseau prédictif.

13. Procédé servant à fournir une notification, comprenant les étapes consistant à :

20

recevoir un signal représentant une valeur d'un paramètre physiologique, la valeur ayant déclenché une alarme associée au paramètre physiologique ;

déterminer une notification en se basant au moins sur le signal reçu et sur un deuxième signal représentant une valeur d'un deuxième paramètre physiologique ;

présenter la notification à un opérateur;

25

recevoir une instruction de supprimer la notification ; et

re-déterminer la notification en réponse à l'instruction de supprimer la notification.

14. Procédé selon la revendication 13, comprenant par ailleurs l'étape consistant à :

30

déterminer une deuxième notification en se basant au moins sur le signal reçu.

15. Procédé selon la revendication 14, comprenant par ailleurs les étapes consistant à déterminer une probabilité associée à chacune de la notification et de la deuxième notification ; et

35

à présenter chacune de la notification et de la deuxième notification en conjonction avec une probabilité respective associée.

16. Procédé selon l'une quelconque des revendications 13 à 15, comprenant par ailleurs les étapes consistant à :

40

déterminer la notification en se basant au moins sur un troisième signal reçu ; et

déterminer que la notification ne doit pas être présentée en se basant sur l'instruction reçue.

17. Procédé selon l'une quelconque des revendications 13 à 16, dans lequel la notification est déterminée en utilisant un réseau probabiliste.

45

18. Procédé selon la revendication 17, dans lequel le réseau probabiliste est un réseau bayésien.

19. Procédé selon la revendication 17, dans lequel le réseau probabiliste est un réseau prédictif.

50

20. Procédé selon l'une quelconque des revendications 17 à 19, comprenant par ailleurs l'étape consistant à faire changer une probabilité à l'intérieur du réseau probabiliste en réponse à l'instruction de supprimer la notification.

21. Procédé selon l'une quelconque des revendications 13 à 20, comprenant par ailleurs l'étape consistant à :

55

émettre une instruction de supprimer la notification.

22. Procédé selon l'une quelconque des revendications 13 à 21, comprenant par ailleurs l'étape consistant à :

## EP 1 420 686 B1

déterminer une deuxième notification en se basant au moins sur un troisième signal reçu et sur une supposition que la notification n'indique pas l'état du patient.

5 **23.** Procédé selon l'une quelconque des revendications 13 à 22, comprenant par ailleurs les étapes consistant à :

recevoir une instruction de cesser de supprimer la notification particulière ;  
recevoir un deuxième signal représentant une deuxième valeur d'un paramètre physiologique, la valeur ayant déclenché une alarme associée au paramètre physiologique ;  
10 déterminer la notification particulière en se basant au moins sur le deuxième signal reçu ; et  
présenter la notification particulière à un opérateur.

**24.** Procédé selon la revendication 10, dans lequel l'étape de re-détermination comprend l'étape consistant à :

15 re-déterminer la notification en se basant au moins sur une supposition que la notification particulière n'indique pas l'état du patient.

20

25

30

35

40

45

50

55

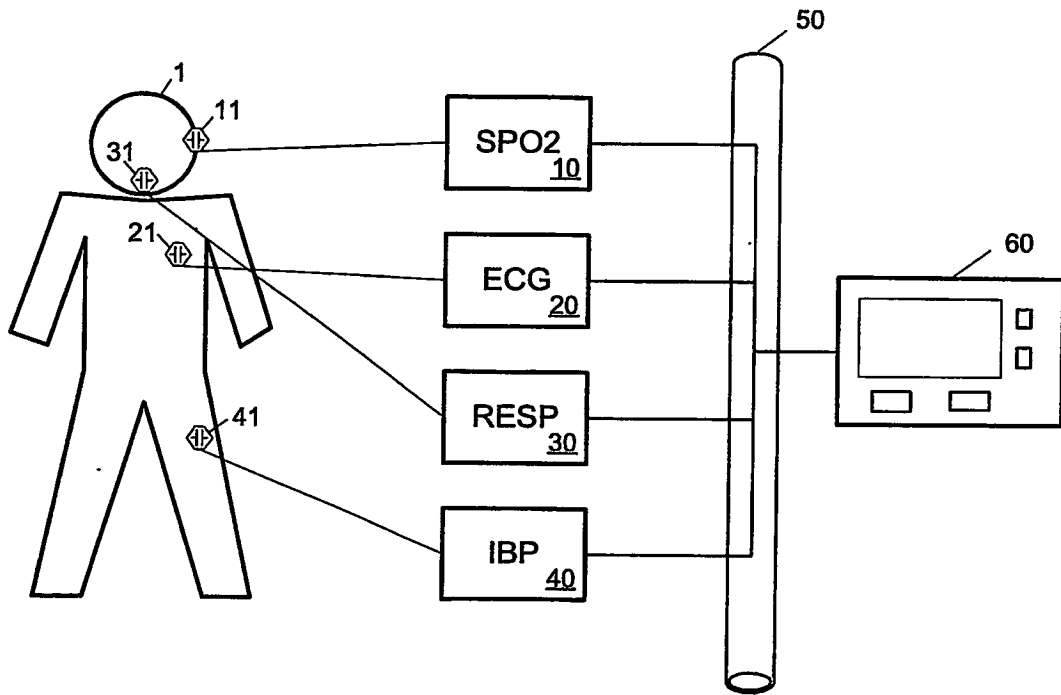


FIG. 1

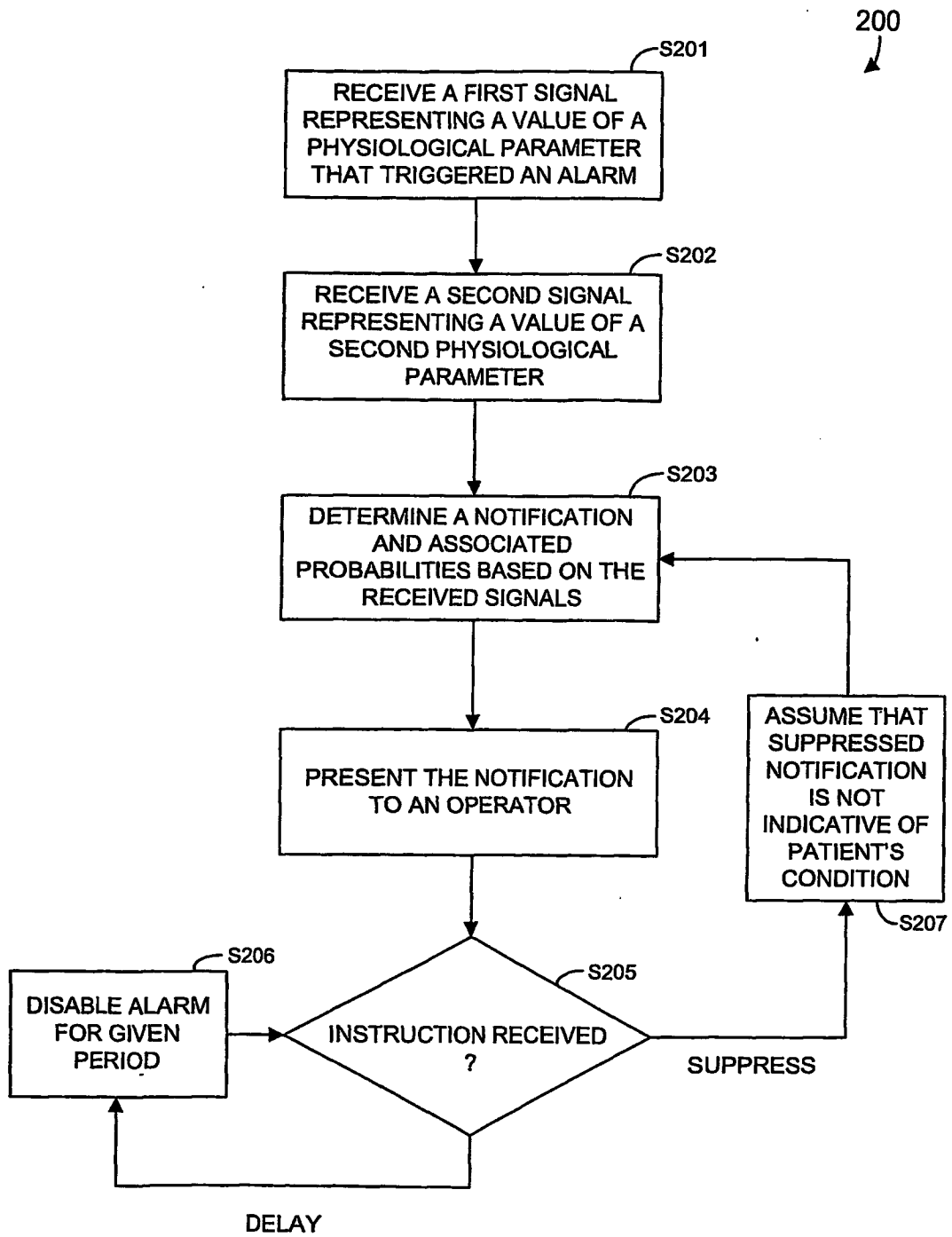


FIG. 2

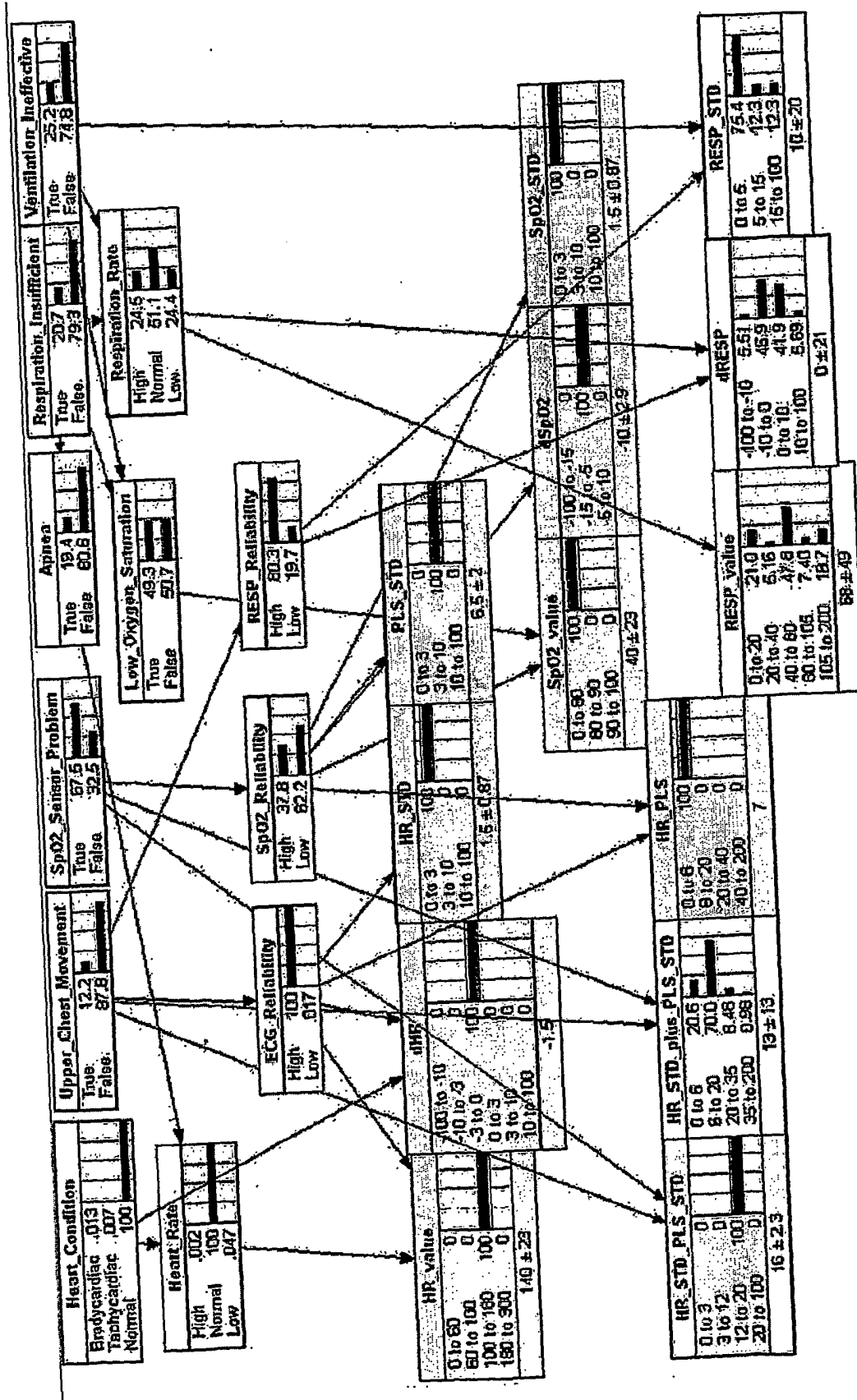


FIG. 3a

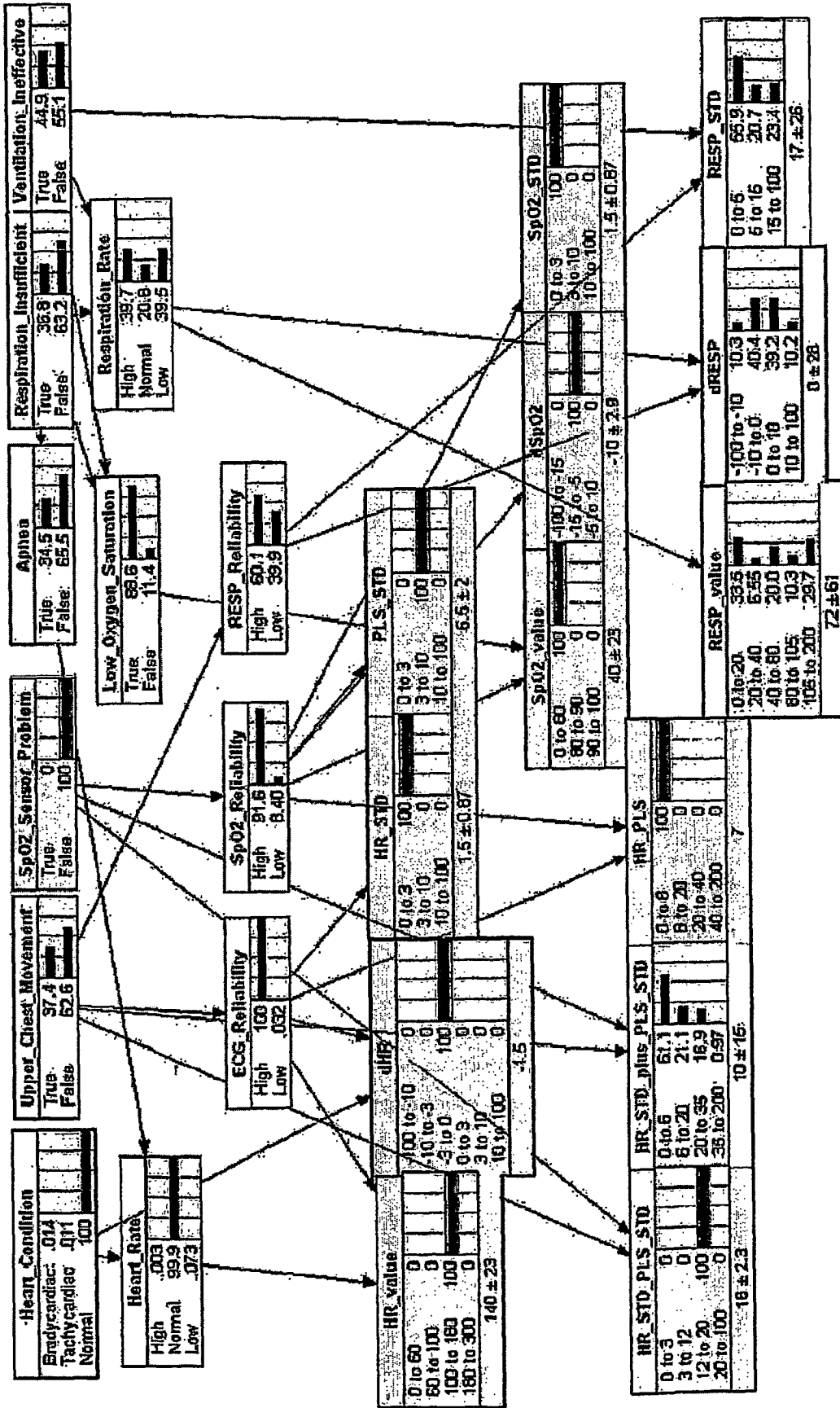


FIG. 3b

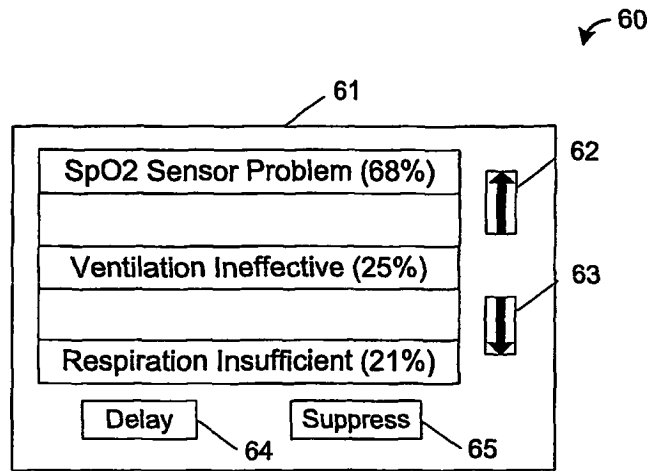


FIG. 4a

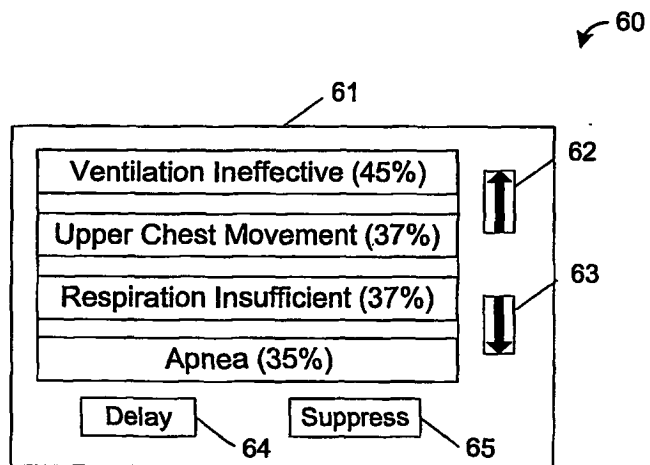


FIG. 4b

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- US 5819007 A [0005]

专利名称(译)	患者监控和报警处理系统和用户界面		
公开(公告)号	<a href="#">EP1420686B1</a>	公开(公告)日	2008-07-02
申请号	EP2002759415	申请日	2002-08-21
[标]申请(专利权)人(译)	美国西门子医疗解决公司		
申请(专利权)人(译)	西门子医疗解决方案USA, INC.		
当前申请(专利权)人(译)	德尔格医疗系统公司.		
[标]发明人	SANTOSO NUGROHO IWAN HUANG JOHNNIE W KELLY CLIFFORD MARK		
发明人	SANTOSO, NUGROHO, IWAN HUANG, JOHNNIE, W. KELLY, CLIFFORD, MARK		
IPC分类号	A61B5/00 A61B5/0205 A61B5/0215 A61B5/0402 A61B5/08 A61B5/145 A61G12/00		
CPC分类号	A61B5/0002 A61B5/0205 A61B5/0215 A61B5/0402 A61B5/1455 A61B2560/0271 G16H40/63 G16H50/20 Y10S128/92 Y10S706/924		
优先权	60/316605 2001-08-31 US 10/223311 2002-08-19 US		
其他公开文献	EP1420686A2		
外部链接	<a href="#">Espacenet</a>		

摘要(译)

本发明的一些实施例提供了一种监视患者的系统。在一些方面，从监测设备接收表示生理参数的值的信号。接收的值是使监视设备触发与心理参数相关联的警报的值。基于接收的信号和表示第二生理参数的值的第二信号确定通知。然后将通知呈现给操作员

		Heart_Condition		
		Bradycardiac	Tachycardiac	Normal
ECG_Kenabmt	High	n(dHR,-5,2)	n(dHR,5,2)	n(dHR,0,1)
	Low	n(dHR,-5,15)	n(dHR,5,15)	n(dHR,0,20)