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(54) Title: CLINICAL ACCEPTANCE TOOL

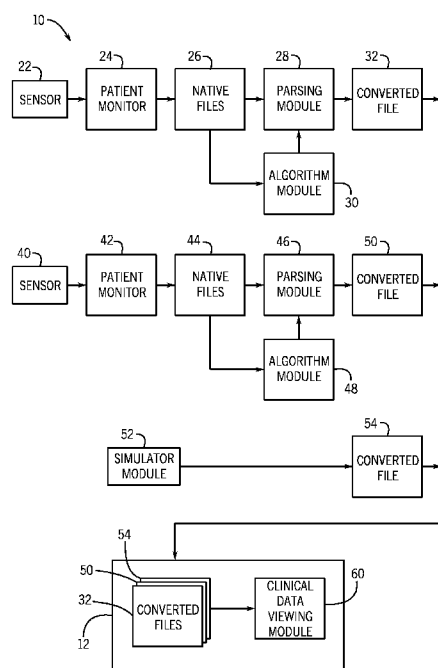


FIG. 2

(57) Abstract: Provided herein are methods and apparatuses for facilitating clinical acceptance of patient monitoring features. These methods may be used in conjunction with a computer that includes software for viewing the type of display associated with the monitoring feature. The clinical acceptance systems as provided herein may display a new or experimental monitoring feature along with a benchmark feature that a clinician is familiar with. In certain embodiments, the viewing tool may be isolated from the calculation tools so that the computer may include stored files that are in a format ready for display.



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CLINICAL ACCEPTANCE TOOL

BACKGROUND

5 The present disclosure relates generally to medical monitors and, more particularly, to a user interface that presents medical monitor information for user review.

 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
10 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.

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

 Monitoring devices are often configured as dedicated monitoring units (e.g., a stand-alone pulse oximetry monitor) or a general purpose computer with integral processing circuitry for receiving measurements from medical devices and converting these
25 measurements into medical information that is meaningful to a clinician. Accordingly, such devices typically include hardware and software capability for processing the data and supporting the graphical user interface that displays the data. The relationship between the received data and the displayed data may be complex. For example, raw data may be collected by a sensor and sent to the monitoring device to be amplified, filtered, digitized,
30 calibrated, compared with empirical data, graphed, and/or otherwise processed. This processed data may then be converted to a metric or indicator for display that a clinician may correlate to a clinical condition. In a particular example, in a photoplethysmography

system, an optical sensor may collect data from a photodetector and subject the data to a series of manipulations to convert the received photoplethysmography signal into one or more numerical indicators related to a patient's oxygen saturation or heart rate. The photoplethysmography data may also be graphed over time to provide information about ongoing trends. Accordingly, rather than displaying raw data, which may be difficult to interpret, the monitoring devices may present medical parameter data using graphical images or numerical indicators, which may be more user-friendly.

As clinicians have become more accustomed to having access to data from medical monitoring devices, their comfort with and ability to use the data provided by these devices has grown. Accordingly, these devices have achieved widespread clinical acceptance. However, at the same time, the capabilities of medical devices have also grown. For example, newer monitoring devices may be capable of presenting additional information related to the measured parameters or may be connected to different types of sensors that provide information about new parameters. As additional indicators and information are added to existing monitoring capabilities, clinical acceptance of these tools may be limited by a clinician's ability to understand and interpret the displayed data that is related to these indicators and/or information.

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 is an example of a user interface for a clinical acceptance system in accordance with embodiments;

FIG. 2 is a block diagram of a clinical acceptance system in accordance with embodiments;

FIG. 3 is a flowchart depicting a method of converting monitor data in accordance with embodiments;

FIG. 4 depicts an example of clinical acceptance display featuring an experimental parameter output and a benchmark parameter output; and

FIG. 5 depicts an example of a clinical acceptance system display including
5 additional review features.

DETAILED DESCRIPTION

One or more embodiments of the present techniques 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
10 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
15 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.

Provided herein are systems and methods for viewing clinical monitoring data for
20 a physiological parameter. The systems as provided may facilitate clinical acceptance of new or different features available for a medical monitor. These systems may be used in conjunction with a viewing tool for end users of the medical monitor. As medical devices become increasingly sophisticated and incorporate additional monitoring features, it is desirable to have methods of training and presenting information for the
25 healthcare professionals who will take advantage of the features of the device, such as information related to new capabilities of the device with which the user may be unfamiliar. In particular, the systems as provided herein facilitate understanding of the features of the medical monitor by presenting these features in graphical user interfaces that mimic or simulate the device when in use. Such systems may be incorporated into
30 general purpose computers that may be used as training tools. In certain embodiments, these computers may be isolated from, i.e., may lack, the algorithms or processing circuitry of the medical device itself. In this manner, the training tool may be operated with lower processing power, because the clinical data for display is provided in a format

that does not require conversion from raw sensor data to the clinical information typically presented by the monitor. Further, the systems may be distributed to end users for training purposes without concern for inappropriate use of or modification of the data processing algorithms.

5

The clinical acceptance tools provided herein may display medical monitoring information based on collected data from one or more sensors. This data may be stored with or accessed by the clinical acceptance tool in a format that is ready for display with minimal additional processing. Further, the data may be associated with a particular window of time. In certain embodiments, an experimental algorithm or monitoring feature may be provided as part of the displayed data on the clinical acceptance tool. Such experimental features may also be displayed with a benchmark parameter or data set that a clinician may be more familiar with to demonstrate how the new feature may be used. In such embodiments, the experimental data and the benchmark data are representative of a single patient over a particular period of time. Accordingly, when the experimental data is displayed with the benchmark data by the clinical acceptance tool, the end user may directly compare the experiment feature with its clinical benchmark. In other embodiments, the data accessed by the clinical acceptance tool may be empirical data or simulated data. In particular, simulated data may be used to create training scenarios for the benefit of the end user.

As noted, caregivers or other end users may use the clinical acceptance tool to become more familiar with a new indicator or parameter. In addition, the clinical acceptance tool may be used in lieu of or in conjunction with passive instruction techniques, such video demonstrations, textual based instruction, and demonstrations. Further, the clinical acceptance tool may be used to gather feedback on particular features of the monitoring data and/or its associated graphical user interface. Accordingly, in particular embodiments, the clinical acceptance tool may be used during an experimental phase for a new parameter. Rather than developing more complex training materials that may become outdated as the product changes, the clinical training tool may be a relatively rapid and low-cost solution for introducing new features in development.

With the foregoing in mind, **FIG. 1** is an illustration of an end user interface for the clinical acceptance system **10**, which may be implemented via a general purpose computer **12**. The clinical acceptance system **10** is capable of generating an output that represents an output of a patient monitor. However, this output may be isolated from the monitor itself and displayed on a general purpose computer. In this manner, the system **10** provides a user-friendly monitor display that may be used for training or collecting user feedback. Such embodiments may be particularly advantageous for the display of clinical monitoring data associated with new or upgraded monitoring features. Rather than training materials that incorporate a static screenshot or dummy training mode, the clinical acceptance system **10** provides a more realistic context for the displayed data. Accordingly, the clinical acceptance system **10** includes a display **14** and user inputs **16**, which may include a mouse, track pad, keyboard, touch screen, etc. The clinical acceptance system **10** may provide a simulator user, such as a caregiver, student, doctor, nurse, or medical technician, with graphical outputs **20**. As will be discussed in more detail below, the graphical outputs **20** may include various graphical user interfaces representative of the medical device that is being simulated. In addition, the acceptance system **10** may be used with any suitable computer capable of displaying monitoring data. Such computers may include personal computers, off-the-shelf computers, multi-purpose computers, laptops, desktop computers, notebooks, handheld device, mobile communication devices, or any suitable computing device. In other embodiments, the system **10** may be part of a modified medical device, such as a pulse oximetry monitor. In such embodiments, the system **10** may be accessible via an experimental or demo setting of medical device and may provide information related to proposed monitoring upgrades, e.g., new parameters.

FIG. 2 is a block diagram of an example of a clinical acceptance system **10**. It should be understood that, in certain embodiments, the system **10** may include all or some of the depicted components in any suitable arrangement. To generate an output that may be viewed and interpreted by the user, the system **10** may incorporate data collected from a medical sensor, e.g., sensor **22**. For example, the sensor **22** is applied to a patient for monitoring and provides an output to a patient monitor **24**, which is stored on the monitor in a native file format **26**, which may be accessed and provided to the system **10** for further processing. In other embodiments, the sensor data may be provided

to the system 10 in real time. The native file 26 from the patient monitor 24 includes raw data, e.g., absorption data, that is associated with a particular patient for a particular time frame. In certain embodiments, the time information is embedded in the native file 26 itself. In other embodiments, time information may be provided from a separate input, e.g., a clock associated with the monitor 24 or a user input. Further, the native file 26 may be raw data or preprocessed data.

The native file 26 is accessed by a parsing module 28, which is capable of reading the file format provided by the monitor and applying additional information, such as time information, and an algorithm module 30. The algorithm module is capable of processing the native file 26 to generate an output that is representative of an output that may be displayed on the monitor 24. For example, in a particular embodiment, the native file 26 may include absorption information. The absorption information is processed and correlated to a physiological parameter such as oxygen saturation. In particular embodiments, the physiological parameter may be a numerical output, e.g., a saturation index, or may be a graph or plot of numerical outputs over a period of time, e.g., a trend. The output of the algorithm module 30 is passed to the parsing module 28 to generate a converted file 32 that is capable of being displayed by the user interface computer 12. The converted file 32 may be accessed or stored by the computer 12 in isolation from its algorithm logic. In embodiments in which the output of the algorithm module 30 is a new or experimental monitoring feature, the computer 12 or software including the converted file 32 and a viewing tool may be distributed to the end user without the end user having access to any experimental algorithms. In particular, such an arrangement allows the end user to become familiar with a new user interface, e.g., a new parameter, while the algorithm itself is being tested and developed. In this manner, clinical acceptance for a new feature may progress more rapidly because the end user may be generally familiar with the displayed output even before the algorithm is finalized.

For embodiments in which a new monitoring feature replaces the functionality of a clinically familiar parameter or augments the information provided by such a parameter, it may be advantageous to include the familiar parameter in the displayed output of the clinical acceptance system 10. For example, the clinically familiar parameter may serve as a benchmark to facilitate understanding of how information from

the experimental parameter may be applied. In certain embodiments, the system 10 may be capable of accessing data from additional sensors, e.g., sensor 40, that provide information related to the clinically familiar parameter. These sensors are operatively connected to either the monitor 24 or other dedicated monitors, e.g., patient monitor 42.

5 A native file 44 representative of the sensor 40 may be parsed via parsing module 46 and processed by algorithm module 48 to provide a converted file 50 output for display. As noted, the sensor 22 may have different functionality than the sensor 40. Accordingly, it is contemplated that the algorithm module 48 may have different processing steps than the algorithm module 30. For example, the sensor 22 may be a photoplethysmography

10 sensor and the sensor 40 may be a carbon dioxide sensor capable of determining an end tidal carbon dioxide during a ventilation cycle.

To provide meaningful feedback to the end user, the sensor 40 may be applied to the same patient and the same time as the sensor 22. In this manner, the outputs of these

15 sensors may be directly compared. Accordingly, native file 44 may be from the same patient over an overlapping time frame as the native file 26. Where multiple native files from multiple patients are converted by the system 10, native files that are associated with one another (e.g., same patient) may be marked as such or otherwise bundled together in a single file. Further, because the sensors 22 and 40 may be of different

20 types, these native files may be in entirely different formats, with different sampling rates and time windows. In such embodiments, one or both of the native files 26 and 44 may be resampled at the same rate by the parsing modules 28 and 46 prior to processing. The rate of resampling may be dictated by the lowest sampling rate between the native files 26 and 44. However, in certain embodiments, when the sampling rates are divergent, a

25 lower sampling rate may be artificially increased by extrapolating sampling points. In addition, one or both of the native files 26 and 44 may be cropped to approximately the same time window. This may be accomplished using time information from the monitors 24 and 42.

30 As an alternative to accessing native files, the data may include simulated data. The system 10 may include a simulator module 52 that may allow a user to experience clinical conditions that may be relatively exaggerated for training purposes. For

example, a simulated data set may include respiration rate values that may be physiologically unlikely for an actual patient but that may be useful for showing the difference between an experimental parameter and a benchmark parameter. In one embodiment, the experimental parameter and the benchmark parameter may have high correlation across many patient types. In other embodiments, the experimental parameter may be more appropriate for certain types of patients or may be less prone to artifacts in conditions in which a benchmark parameter is less robust. The output of the simulator module 52 may be a converted file 54 that is in a format that is easily displayed. Alternatively, the simulator module 52 may generate data that is similar in format to a native file 26 or 50. In such embodiments, the system 10 may pass the output of the simulator module 52 to appropriate parsing and algorithm modules for further processing.

The system 10 includes an end user interface 12 on which the converted files may be displayed. Depending on the file format of these files, the computer 12 also includes a compatible clinical data viewing module 60. As depicted in FIG. 2, in addition to the end user interface, e.g., computer 12, the clinical acceptance system 10 may also include, among other things, the display 14, user inputs 16, one or more processors, a memory, non-volatile storage, and stored input files. While the computer 12 may be a separable component of the system 10, the depicted components and modules may be arranged in any suitable configuration. The various functional blocks shown in FIG. 2 may include hardware elements (including circuitry), software elements (including computer code stored on a computer-readable medium) or a combination of both hardware and software elements. Further, FIG. 2 is only one example of a particular implementation and is merely intended to illustrate the types of components that may be present in the system. In one implementation, the system 10 may be developed and implemented using open source tools. Such a system may be developed as a web-based application, allowing distributed access or use of the application. For example, such an implementation may be developed using one or more of Java, Java server pages (JSP), structured query language (SQL), extensible markup language (XML), XML user interface language (XUL) and/or scalable vector graphics (SVG) technologies. In an alternate implementation, the system 10 may include instructions that may be executed by an

associated processor, and stored on a non-volatile storage media, such as a CD-ROM or hard drive.

The converted files (e.g., files **32**, **50**, or **54**) may comprise various forms including: a text file, a binary file, an ASCII file, a formatted text file, an image file, a
5 MATLAB file, or any suitable form for display. The converted files may be stored on a non-volatile storage media associated with the computer **12**, or may be downloaded from an outside source through a network connection. In some embodiments, the system **10** may intake the converted files through an import screen. In alternative embodiments, the system **10** may select a file from a plurality of stored files based upon a user selection of
10 physiological conditions, e.g. conditions listed in the import screen of the system **10**. For example, the user may desire to view monitoring data associated with the conditions of severe sleep apnea. The user may select "sleep apnea" from the list of physiological conditions, and the system **10** will import either a simulated or patient data file corresponding to that condition.

15

An example of a simulation method **70** is illustrated in the flowchart depicted in **FIG. 3**. The method **70** may be performed as an automated procedure by a system, such as a system **10**. In addition, certain steps of the method may be performed by a processor, or a processor-based device that may be part of the system **10** and that
20 includes instructions for implementing certain steps of the method **70**. The simulation method **70** begins at block **72** when the system **10** receives input related from a medical monitor, e.g., monitor **24**, in the form of a raw sensor data. In alternative embodiments, the data provided by the medical monitor may be in the form of preprocessed or simulated data.

25

At block **74**, the system **10** applies appropriate processing instructions to the data to generate an output that is representative of the output of the monitor. These algorithms may be identical to the algorithms typically used by the monitor itself or may be modified or altered in some way. Based at least in part upon the native files (e.g., the
30 sensor data), the algorithm module may calculate the parameter of interest using various algorithms. In one embodiment, the algorithms may incorporate instructions such as those employed by the Nellcor™ N-600x™ pulse oximetry monitor. These algorithms

may also employ certain coefficients, which may be stored in a memory or other suitable computer-readable storage medium and accessed and operated according to processor instructions. In one embodiment, the algorithm module includes an experimental algorithm. Experimental algorithms may include algorithms that have not been approved
5 by a regulatory agency, algorithms that are in a beta testing mode, algorithms for new or modified parameters, or next generation algorithms.

At block **76** the system parses the output of the experimental algorithm module into a desired file format that includes time information. In addition, in block **78**, the
10 system receives benchmark data. Benchmark data may refer to data from a sensor and monitor that correlates to a clinically familiar physiological parameter. For example, a benchmark parameter may be a standard of care, part of an approved medical monitoring system, or a parameter for comparison. In certain embodiments, the benchmark
15 parameter may be a current generation parameter while the experimental parameter is a next generation parameter. The benchmark sensor data may be collected from or representative of the same patient during an overlapping time window. The benchmark data may be processed according to an appropriate algorithm module at block **80** and
parsed into a converted file format with associated time data at block **82**. These
converted files may be read to an appropriate computer, e.g., computer **12**, or other
20 device for eventual viewing by an end user at step **84**.

In particular, the system **10** may facilitate understanding and clinical acceptance of a new clinical monitoring parameter. To that end, the system **10** may provide one or more display screens **20** that are representative of the data that will be displayed on a
25 patient monitor. In addition, this data may be displayed along with training or supplemental data. **FIGS. 4-5** illustrate different types of displays that may be used with the system **10**. While the illustrated embodiments relate to respiration rate, it should be understood that the present techniques may be used in conjunction with other parameters. For example, the medical parameters of interest may include oxygen saturation, blood or
30 tissue constituent concentration, hemodynamic parameters, cardiac parameters, or respiratory parameters. Depicted is a dual window view that includes an upper window **98**. In the depicted embodiment, the parameter of interest, a respiration trend calculated based on a plethysmographic waveform signal, is displayed in trend view in plot **100**.

The plot **100** includes an indication of breaths per minute (BrPM) on the Y-axis over time on the x-axis. Also displayed is a plot **102** of an oxygen saturation trend over the same time window as the respiration rate trend. The plots may be labeled as appropriate, e.g., with text **104**. Numeric indicators **106**, **108**, and **110** for respiration rate, oxygen saturation, and pulse rate are also provided. In the depicted embodiment, the oxygen saturation plot **102** and the oxygen saturation indicator **108** and pulse rate indicator **110** are generally familiar to an experienced caregiver while the respiration rate plot **100** and the respiration rate indicator **106** are new features. Accordingly, the display **98** may be used to familiarize an end user with the relative positioning of the new parameter, respiration rate, and the types of data provided to convey information about the parameter (e.g., a trend plot and a numeric indicator). Such training is beneficial because clinicians tend to rely on quick glances at display screens and are accustomed to finding certain parameters in certain locations.

While the respiration rate plot **100** is displayed concurrently with an oxygen saturation plot **102**, oxygen saturation is not typically regarded as a benchmark parameter for respiration rate. That is, as shown, the oxygen saturation trend remains relatively stable while the respiration rate varies. While these parameters are related (e.g., decreased respiration rate may be correlated to lower oxygen saturation), they do not exhibit close correlation. One method of determining respiration rate is evaluating a patient's end tidal carbon dioxide concentration via capnography. In capnography, a carbon dioxide sensor monitors the partial pressure of carbon dioxide in the respiratory gases. By monitoring the carbon dioxide changes during the breath cycle, the number of breaths per minute may be determined. An end-tidal carbon dioxide plot **112** is shown in lower window **114**. The end-tidal carbon dioxide plot **112** may serve as a benchmark for the respiration rate as calculated via the pleth waveform. Accordingly, a clinician may note that the end-tidal carbon dioxide plot **112** correlates closely to the respiration rate plot **100** above for the same patient over the same time frame. In certain embodiments, the system **10** may display a correlation metric or indicator for the experimental parameter and the benchmark parameter. Also shown, for reference, is the waveform signal **116** for the end-tidal carbon dioxide plot. Additional information may be displayed in sidebar **118** and may include time-stamped events, including patient movement or drug administration, events that may introduce noise, such as suctioning of

a tracheal tube 112, and any alarms or specific conditions (e.g., clinical conditions or patient conditions) designated by the monitor, which may be shown as flags 120. The windows 98 and 114 may be labeled, e.g., labels 122 and 124) to indicate which window includes the experimental parameter of interest versus the benchmark parameter. In
5 certain embodiments, the lower window 114 may be closed and removed from view if the clinician has reviewed its contents.

FIG. 5 illustrates an additional display output 20 that provides additional graphical windows that may supplement the experimental parameter information. Such
10 displays may include a file information window 130, a waveform window 132 that includes the pleth signal 136 from which the respiration rate was calculated, a playback window 134 that includes a respiration rate plot 138 with playback controls 140. In the depicted embodiment, the healthcare professional may alter the playback rate of the simulation. For example, the user may pause the simulation or replay a portion of the
15 simulation with either the same or different alarm configuration settings. Further, the file information window 130 may allow the user to select a different file from a different patient or simulated data set.

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
20 will be described in detail herein. However, it should be understood that the disclosure is not intended to be limited to the particular forms disclosed. Rather, the disclosure is to 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 computer, comprising:
 - 5 a processor configured to display medical device data, wherein the processor is configured to execute instructions for:
 - accessing a first stored data set representative an output of a first algorithm for converting information collected by a first medical sensor to a first trend of a physiological parameter;
 - 10 accessing a second stored data set representative an output of a second algorithm for converting information collected by a second medical sensor to a second trend of the physiological parameter, wherein the first stored data set and the second stored data set represent a single patient over a time period, and wherein the first medical sensor and the second medical sensor are different from one another; and
 - 15 displaying the first trend and the second trend of the physiological parameter over the time period simultaneously.
2. The computer of claim 1, wherein the computer does not execute the first algorithm or the second algorithm.
- 20 3. The computer of claim 1, wherein the first medical sensor comprises a pulse oximetry sensor.
4. The computer of claim 1, wherein the physiological parameter comprises a
25 respiration rate.
5. The computer of claim 1, wherein the second medical sensor comprises a carbon dioxide sensor.
- 30 6. The computer of claim 1, wherein the output of the first algorithm comprises a respiratory trend based on a plethysmographic waveform.

7. The computer of claim 1, wherein the output of the second algorithm comprises an end-tidal carbon dioxide.
8. The computer of claim 1, wherein the first algorithm comprises an experimental
5 algorithm and wherein the second algorithm comprises a benchmark algorithm.
9. The computer of claim 1, wherein the first algorithm comprises an experimental algorithm and wherein the second algorithm comprises a benchmark algorithm.
- 10 10. The computer of claim 1, wherein the first data set or the second data set comprises a simulated data set.
11. A system, comprising:
a processor configured to execute instructions for:
15 receiving a first data set from a medical monitor or simulated data representative of the first data set, wherein the first data set comprises data from a patient over a predetermined time period;
determining a physiological parameter based on the data or the simulated data using a first algorithm;
20 receiving a second data set from a second monitor or simulated data representative of the second data set, wherein the second data set comprises data from the patient over the predetermined time period;
determining the physiological parameter based on the second data set;
generating a first output comprising the physiological parameter determined
25 based on the first data set and a second output comprising the physiological parameter determined based on the second data set; and
providing the first output and the second output to a computer capable of displaying the first output and the second output, wherein the computer does not include instructions for executing the first algorithm or the second algorithm.
30
12. The system of claim 11, wherein the physiological parameter comprises respiration rate.

13. The system of claim 11, wherein the physiological parameter comprises a respiratory rate trend.
14. The system of claim 11, wherein the first data set comprises data collected by a photoplethysmography sensor.
15. The system of claim 14, wherein the photoplethysmography sensor comprises a pulse oximetry sensor.
16. The system of claim 11, wherein the second data set comprises data collected by a carbon dioxide sensor.
17. The system of claim 11, wherein the second algorithm determines the physiological parameter based on an end-tidal carbon dioxide concentration.
18. The system of claim 11, comprising resampling the first data set and the second data set at substantially the same sampling rate.
19. A computer, comprising:
- a processor configured to display medical device data, wherein the processor is configured to execute instructions for:
- accessing a first stored data set representative an output of a first algorithm for converting information collected by a first medical sensor to a first trend of a physiological parameter, wherein the first stored data set comprises time stamp information corresponding with patient events;
- accessing a second stored data set representative an output of a second algorithm for converting information collected by a second medical sensor to a second trend of the physiological parameter, wherein the first stored data set comprises time stamp information corresponding with patient events, and wherein the first stored data set and the second stored data set represent a single patient over a time period; and
- displaying the first trend and the second trend at a time point in the period of time that corresponds to a patient event.

20. The computer of claim 19, wherein the patient event comprises a suction event, a clinical condition, an alarm event, or a patient movement event.

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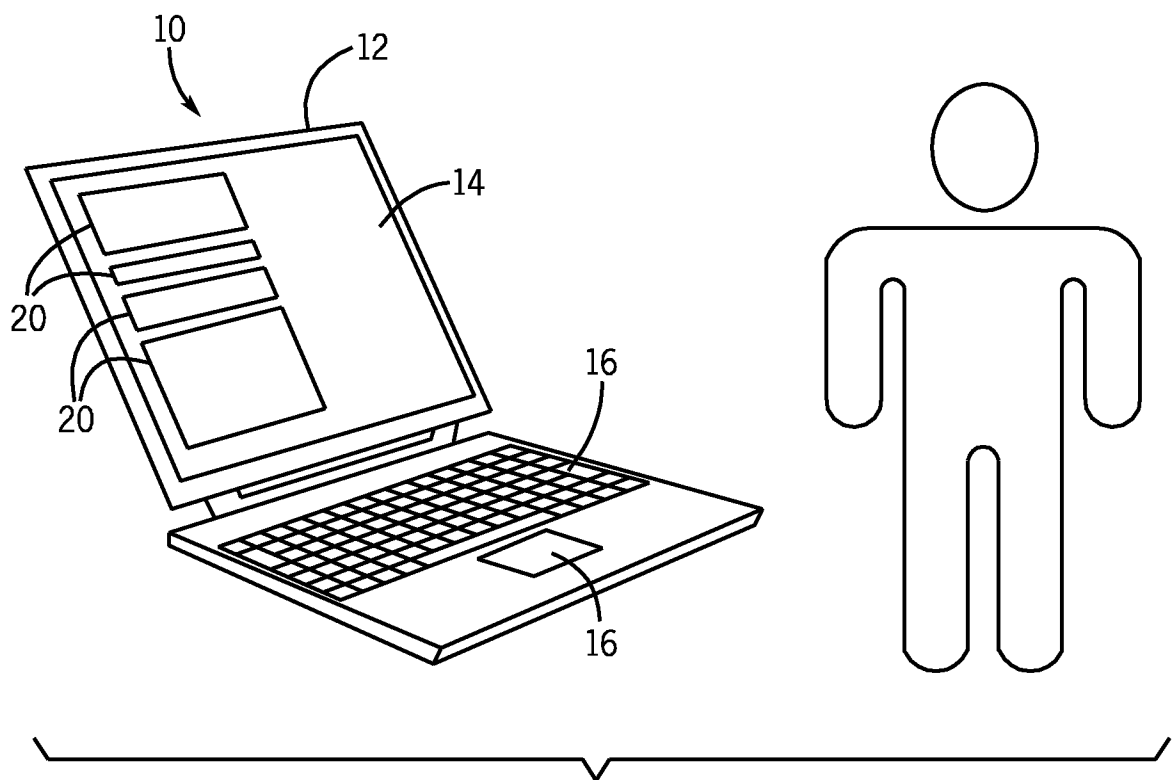


FIG. 1

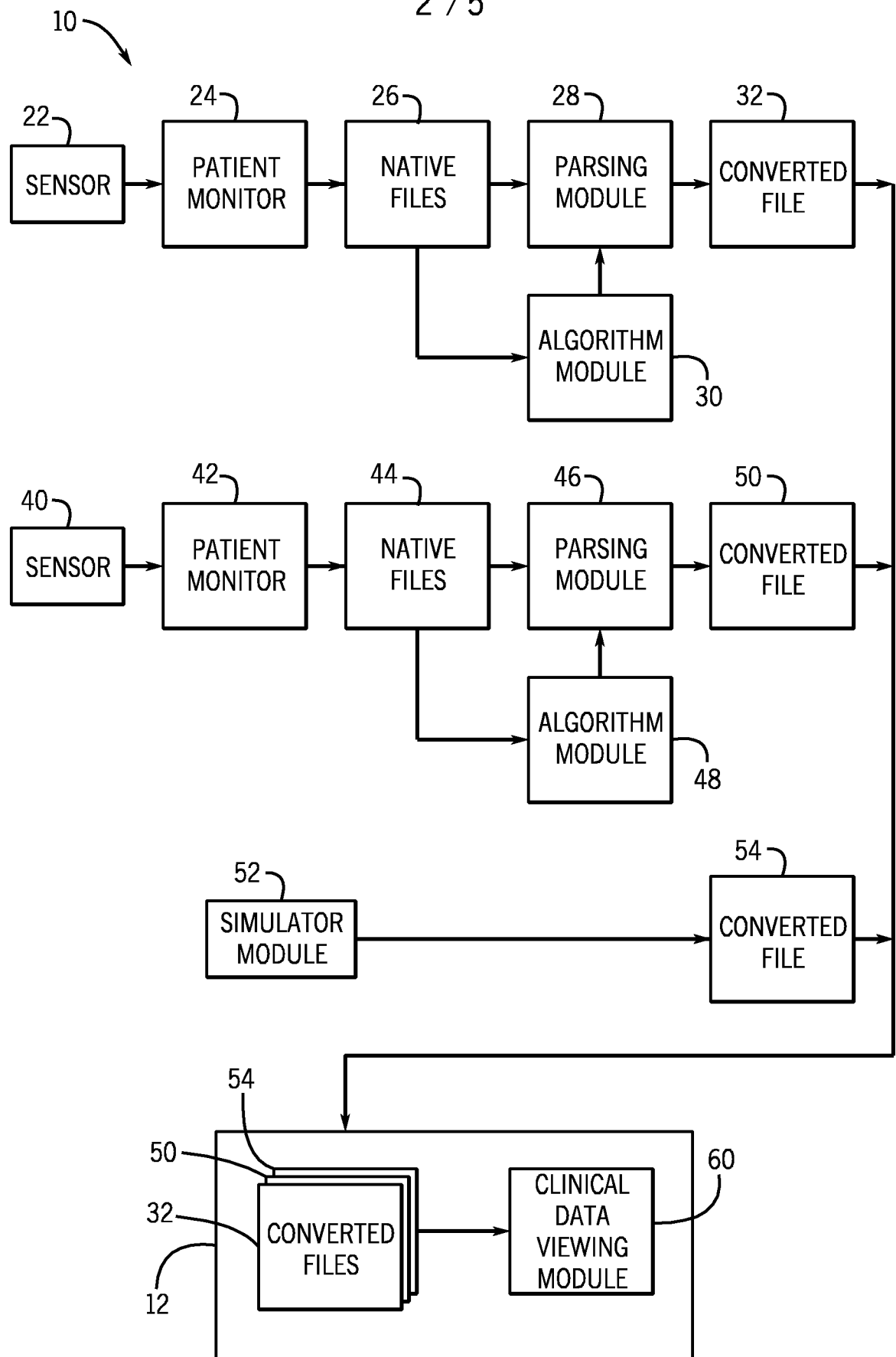


FIG. 2

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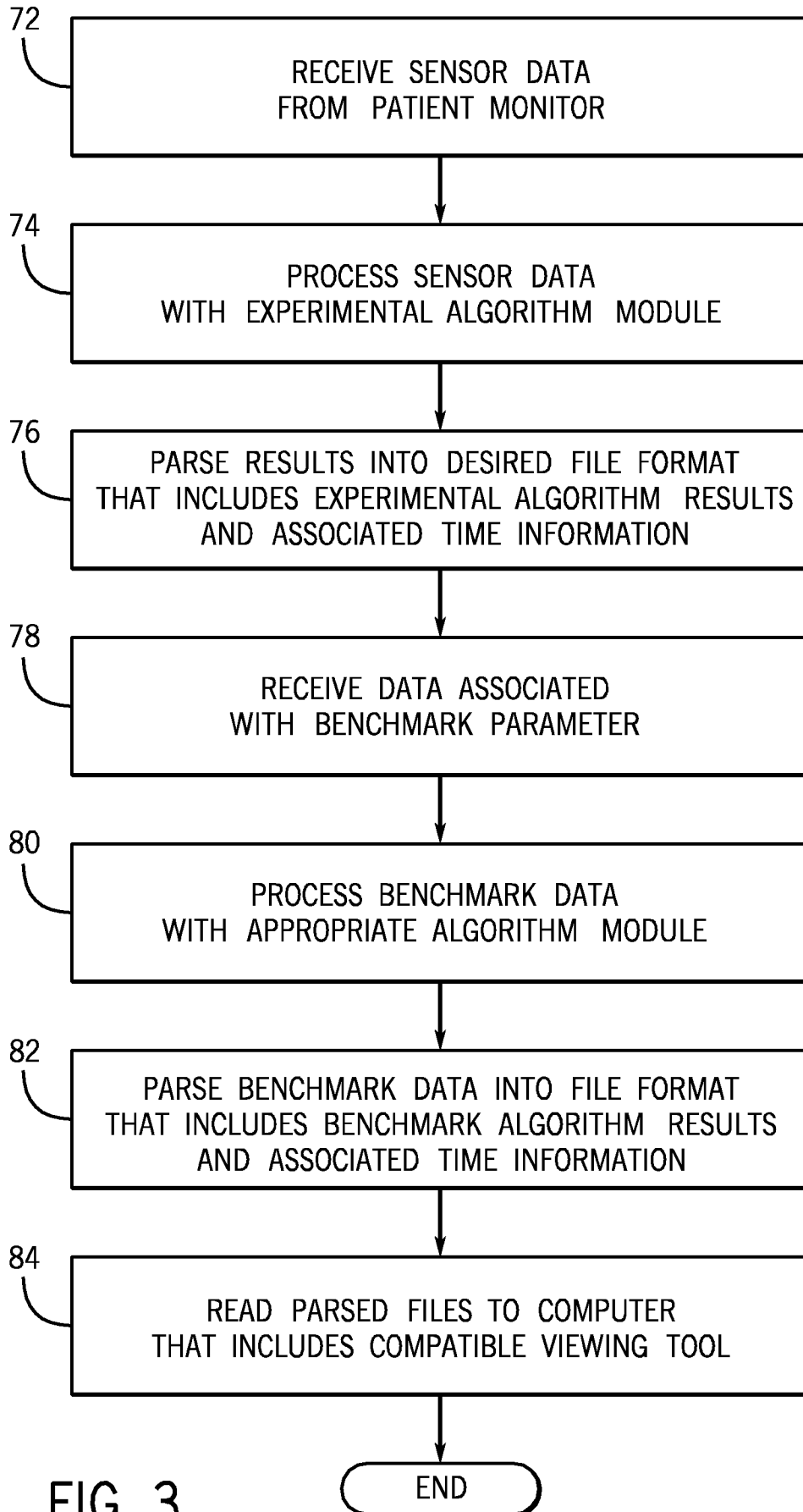


FIG. 3

4 / 5

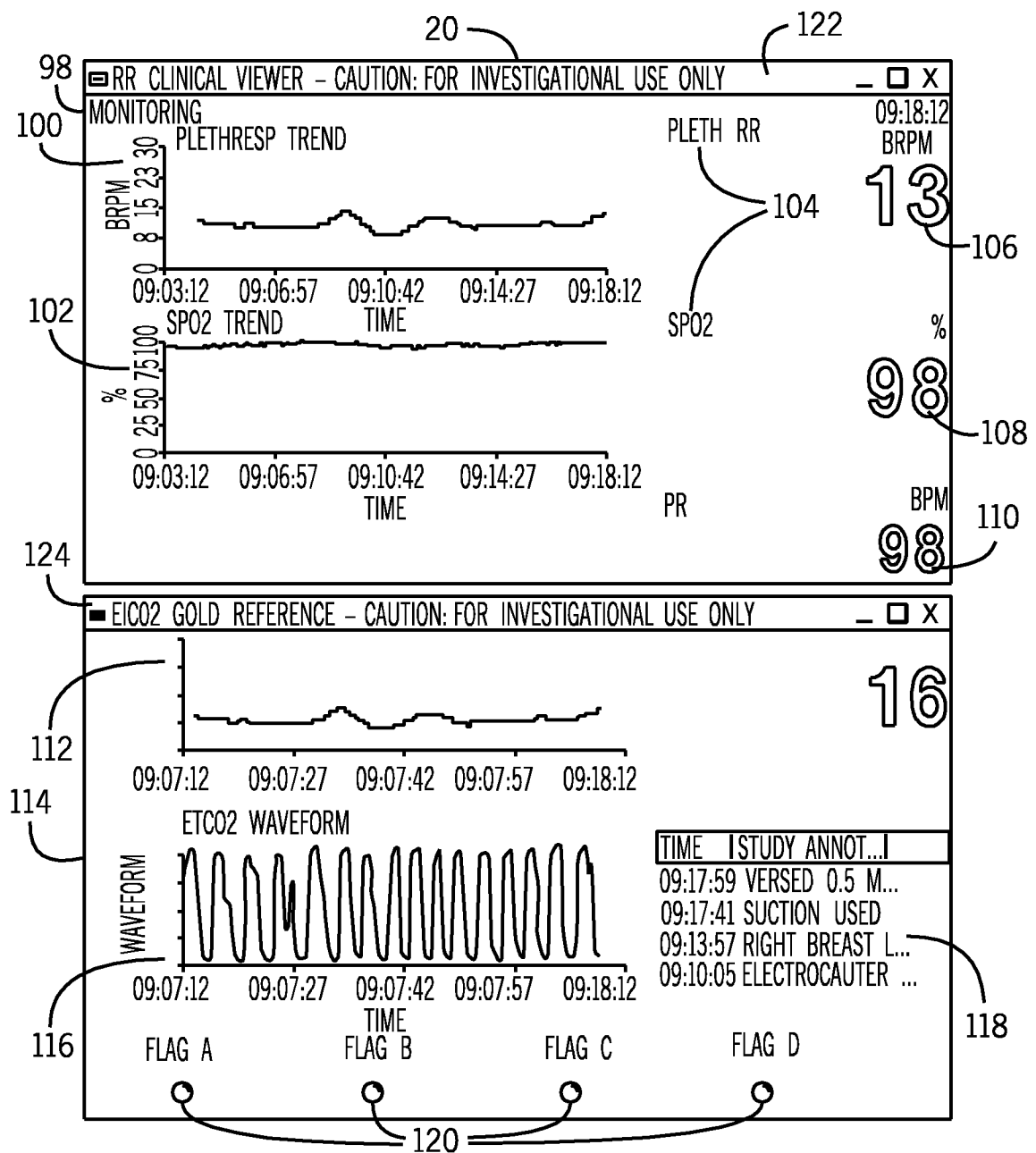


FIG. 4

5 / 5

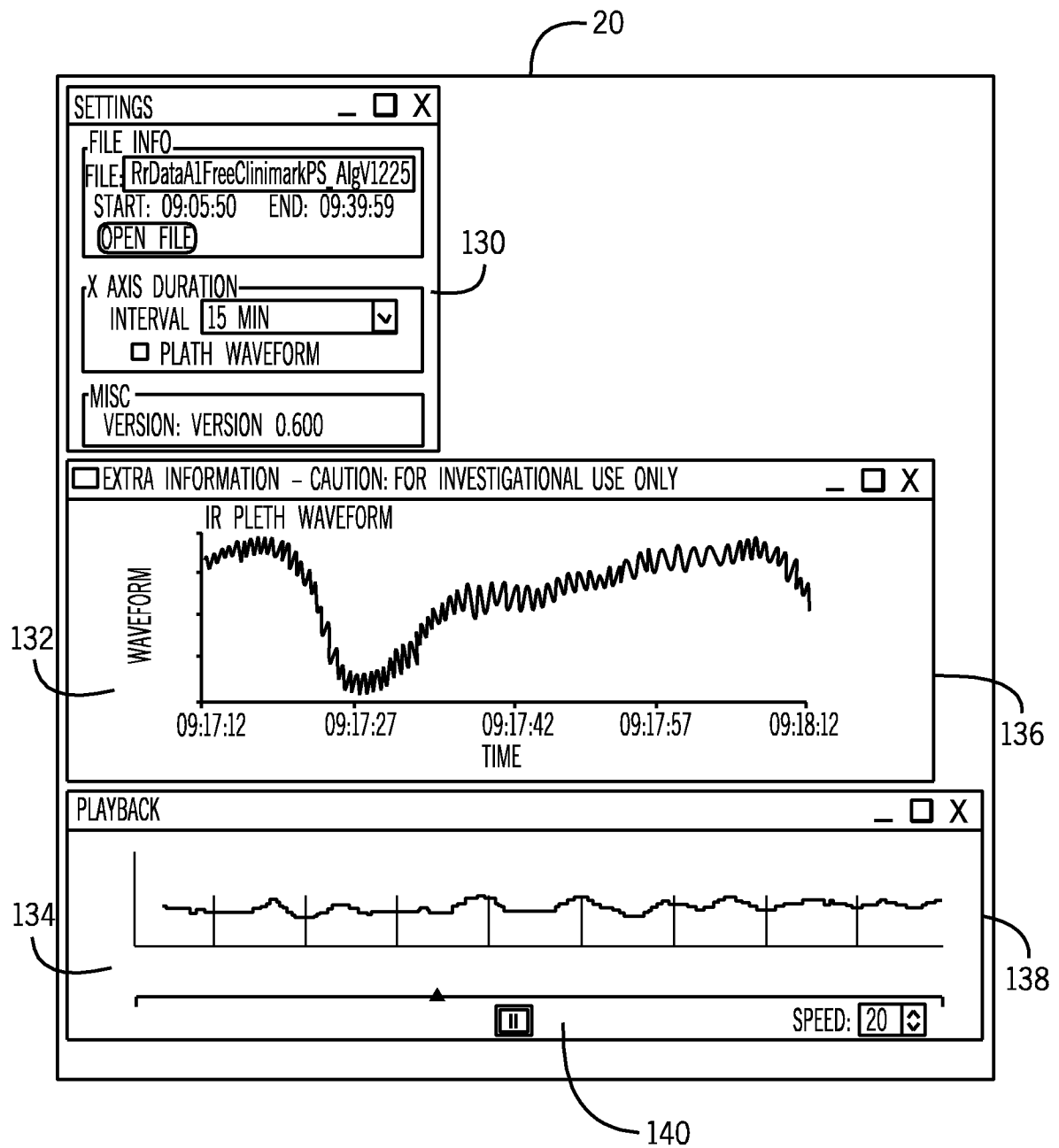


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/040087

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F19/00
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)
G06F

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)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/091088 A1 (KIANI MASSI E [US]) 17 April 2008 (2008-04-17) paragraph [0014] - paragraph [0035] figures 2A,2B,3 -----	1-20
A	WO 2010/102069 A2 (MASIMO CORP [US]; KIANI MASSI JOE E [US]; MUHSIN BILAL [US]; SAMPATH A) 10 September 2010 (2010-09-10) paragraph [0006] - paragraph [0019] -----	10,11
A	US 2011/105854 A1 (KIANI MASSI JOE E [US] ET AL) 5 May 2011 (2011-05-05) paragraph [0008] - paragraph [0011] -----	1,11,19
A	WO 99/62399 A1 (MASIMO CORP [US]) 9 December 1999 (1999-12-09) abstract; figure 1 -----	1,11,19



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

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"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

31 August 2012

Date of mailing of the international search report

21/09/2012

Name and mailing address of the ISA/

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Authorized officer

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/040087

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