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(54) **METHOD AND APPARATUS FOR DISPLAYING A HEART RATE SIGNAL**

VERFAHREN UND GERÄT ZUR ANZEIGE EINES HERZFREQUENZSIGNALS

PROCEDE ET APPAREIL D'AFFICHAGE D'UN SIGNAL DE RYTHME CARDIAQUE

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(73) Proprietor: **LMS Medical Systems, Ltd.**
**Montreal, Quebec H4A 3S5 (CA)**

(72) Inventors:
- **HAMILTON, Emily, F.**
  **Verdun, Quebec H3E 1K8 (CA)**
- **GLAUDE, Michael, C.**
  **Anjou, Quebec H1M 1V4 (CA)**
- **MACIESZCZAK, Maciej**
  **Kanata, Ontario K2M 2V3 (CA)**
- **WARRICK, Philip, A.**
  **Montreal, Quebec H3X 2K9 (CA)**

(74) Representative: **Kohn, Philippe**
**Cabinet Philippe Kohn,**
**30, rue Hoche**
**93500 Pantin (FR)**



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## Description

### FIELD OF THE INVENTION

**[0001]** The present invention relates generally to electronic heart rate monitoring and, more particularly; to a method and apparatus for displaying heart rate signals and heart rate signal characteristics. This invention is particularly application in the fields of heart rate monitoring and fetal heart rate monitoring.

### BACKGROUND OF THE INVENTION

**[0002]** A commonly used method to evaluate patient well-being is analysis of the heart rate by using electronic heart monitors. These monitors measure the heart rate of the patient and produce a paper print out of the tracing over time. Alternatively, the tracings over the most recent period of time are displayed on video screen displays. In the case where the patient is a fetus in-utero, an electronic fetal monitor is used. These monitors measure both the fetal heart rate and the mother's uterine contraction pattern and provide either in the form of a paper print out or in the form of a display on a display screen the tracings associated to the fetal heart rate and the mother's uterine contraction pattern. The clinical staff use visual methods to study the tracings and from this deduce the degree of patient well being. Abnormal patterns can lead to interventions such as more diagnostic tests, drug treatment or surgical intervention.

**[0003]** A deficiency with the above-described heart monitors is that they do not provide suitable functionality for allowing the clinical staff to easily assess a heart rate signal. In many cases, the heart information is not communicated effectively and intuitively, which sometimes results in a potentially harmful heart rate condition to remain undetected by the clinical staff.

**[0004]** A prior art device is disclosed in "A portable monitor for fetal heart rate and uterine contraction", IEEE Engineering in medicine and biology magazine, IEEE inc. New York, US November 1997. ISSN 0739-5175, vol. 16, NR.6, Pg. 80-84.

**[0005]** In the context of the above, there is a need in the industry to provide a method and device for displaying heart rate information that alleviates at least in part problems associated with the existing methods and devices.

### SUMMARY OF THE INVENTION

**[0006]** In accordance with a first broad aspect, the invention provides a computer readable storage medium storing a program element suitable for execution by a CPU where the program element implements a graphical user interface module for displaying fetal heart rate information. The graphical user interface module displays, in a first viewing window, a first tracing indicative of a heart rate signal. The graphical user interface module also displays a control allowing a user to select a portion of the first tracing in the first viewing window. The graphical user interface module also displays, in a second viewing window displayed simultaneously with the first viewing window, a second tracing which is a zoomed in view of the selected portion of the first tracing.

**[0007]** An advantage of the present invention is that it allows a user to view simultaneously compressed view of a heart rate trace and an expanded view, or zoomed-in view, of a selected portion of the compressed view. This allows the clinical staff to more easily assess a heart rate signal over the shortened period of time, shown in the second viewing window, while taking into account heart rate information observable over the lengthier period of time shown in the first viewing window.

**[0008]** In a specific implementation, the control includes a selection box having a transparent portion. The selection box is superposed upon the first viewing window such that a portion of the first tracing is viewable through the transparent portion of the selection box. The portion of the first tracing viewable through the transparent portion of the selection box corresponds to the selected portion of the first tracing displayed in the second viewing window.

**[0009]** Advantageously, the transparent portion of the selection box superposed on the view window allows a health care practitioner to readily view where the zoomed-in view displayed in the second viewing window is located with respect to the first tracing displayed in the first viewing window.

**[0010]** In accordance with a specific implementation, the control allows the user to displace the selection box along an axis associated with the first tracing in the first viewing window to select a portion of the first tracing in the first viewing window. The first tracing is indicative of a heart rate signal over a first time segment and the second tracing is indicative of a heart rate signal over a second time segment, where each of the first time segment and the second time segment have respective durations. The selection box includes handles allowing a user to modify the size of the selection box to select the duration of the second time segment.

**[0011]** In a non-limiting implementation, the duration of the first time segment is generally significantly longer that the duration of the second time segment. The first and segment time segments may have any suitable duration for providing the health care practitioners with information regarding heart rate. Generally, the first time segment will be on a scale of quarter hours, half hours or hours, while the second time segment will be on a scale of minutes. In a specific example, the length of a nurse's shift is taken into account when setting the duration of the first time segment. In a first specific implementation, the first time segment has a duration of fours hours. In as second specific implementation, the first time segment has a duration of eight hours. In a third specific implementation, the first time segment has a du-

ration of twelve hours. In a fourth specific implementation, the first time segment has a duration of sixteen hours. The duration of the second time segment is typically of a sufficient duration to provide to the clinical staff some detailed meaningful information which is reflective of the condition of the patent. In a first specific implementation, the second time segment has a duration of about 10 minutes. In a second specific implementation, the second time segment has a duration of about 20 minutes. In a third specific implementation, the second time segment has a duration which is a multiple of 10 minutes. In a preferred specific non-limiting implementation, the first time segment has a duration of eight hours and the second time segment has a duration of about 10 minutes.

**[0012]** The control allows the user to displace the selection box and to modify the size of the selection box by using an input device such as a mouse, keyboard, pointing device, speech recognition unit and touch sensitive screen amongst others. Modifying the size of the selection box allows modifying the duration of the second time segment.

**[0013]** In a non-limiting implementation, the heart rate signal is a fetal heart rate signal. The graphical user interface module is adapted for displaying in a third display window a third tracing indicative of a uterine contraction pattern. The third tracing is indicative of a uterine contraction pattern during the second time segment. Optionally, the graphical user interface module is adapted for displaying in another display window including information indicative of fetal heart rate features. The fetal heart rate features may be displayed in a number of various ways including in textual and graphical formats.

**[0014]** In accordance with another broad aspect, the invention provides an apparatus for implementing a user interface for displaying heart rate information of the type described above.

**[0015]** In accordance with another broad aspect, the invention provides a method for displaying heart rate information. A heart rate signal is received and a first tracing indicative of the heart rate signal is displayed in a first viewing window. A control is provided allowing a user to select a portion of the first tracing in the first viewing window. In a second viewing window displayed simultaneously with the first viewing window, a second tracing is displayed where the second tracing is a zoomed in view of the selected portion of the first tracing. In a specific implementation, the control includes a selection box having a transparent portion. The selection box is superposed upon the first viewing window such that a portion of the first tracing is viewable through the transparent portion of the selection box. The portion of the first tracing viewable through the transparent portion of the selection box corresponds to the selected portion of the first tracing displayed in the second viewing window.

**[0016]** In accordance with another broad aspect, the invention provides an apparatus for displaying heart rate information in accordance with the above-described method.

**[0017]** In accordance with yet another broad aspect, the invention provides a computer readable medium including a program element suitable for execution by a computing apparatus for displaying heart rate information in accordance with the above described method.

**[0018]** In accordance with another broad aspect, the invention provides a fetal monitoring system. The system includes a sensor for receiving a signal indicative of a fetal heart rate. The system also includes an apparatus for implementing a user interface for displaying fetal heart rate information where the apparatus includes an input, a processing unit and an output. The input is for receiving the fetal heart rate signal from the sensor. The processing unit implements a graphical user interface module for displaying heart rate information. The graphical user interface module displays, in a first viewing window, a first tracing indicative of the fetal heart rate signal received at the input. The graphical user interface module also displays a control allowing a user to select a portion of the first tracing in the first viewing window. In a second viewing window displayed simultaneously with the first viewing window, a second tracing which is a zoomed in view of the selected portion of the first tracing is displayed. The output is for releasing a signal for causing a display unit to display the graphical user interface module. The system also includes a display unit coupled to the output of the apparatus. The display unit is responsive to the signal to display the graphical user interface module.

**[0019]** In accordance with yet another broad aspect, the invention provides a server system implementing a graphical user interface module for displaying heart rate information. The server system stores a program element for execution by a CPU. The program element includes a plurality of program element components. A first program element component is for receiving a heart rate signal. A second program element component is for processing the heart rate signal to display, in a first viewing window, a first tracing indicative of the heart rate signal. A third program element component is for displaying a control allowing a user to select a portion of the first tracing in the first viewing window. A fourth program element component is for displaying, in a second viewing window displayed simultaneously with the first viewing window, a second tracing which is a zoomed in view of the selected portion of the first tracing.

**[0020]** In accordance with yet another broad aspect, the invention provides a client-server system for implementing a graphical user interface module for displaying heart rate information. The system includes a client system and a server system operative to exchange messages with one another over a data network. The client-server system includes a first program element component executed on the server system for receiving a heart rate signal. The client-server system also includes a second program element component executed on the server system for sending messages to the client sys-

tem for causing the latter to display in a first viewing window, a first tracing indicative of the heart rate signal. The client-server system also includes a third program element component executed on the server system for sending messages to the client system for causing the latter to display a control allowing a user to select a portion of the first tracing in the first viewing window. The client-server system also includes a fourth program element component executed on the server system for receiving a message from the client system indicative of a selected portion of the first tracing in the first viewing window. The client-server system also includes a fifth program element component executed on the server system for sending messages to the client system for causing the client system to display, in a second viewing window displayed simultaneously with the first viewing window, a second tracing which is a zoomed in view of the selected portion of the first tracing.

**[0021]** In a specific implementation, the client-server system includes a plurality of client systems operative to exchange messages with the server system over a data network. The data network may be of any suitable network configuration including Intranets and the Internet.

**[0022]** In accordance with another broad aspect, the invention provides an apparatus for implementing a user interface for displaying heart rate information. The apparatus includes means for receiving a heart rate signal, means for implementing a graphical user interface module for displaying heart rate information and means for releasing a signal for causing a display unit to display the graphical user interface module. The graphical user interface module displays, in a first viewing window, a first tracing indicative of the heart rate signal. The graphical user interface displays a control allowing a user to select a portion of the first tracing in the first viewing window. The graphical user interface also displays, in a second viewing window displayed simultaneously with the first viewing window, a second tracing which is a zoomed in view of the selected portion of the first tracing.

**[0023]** These and other aspects and features of the present invention will now become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0024]** In the accompanying drawings:

Fig. 1 shows a high-level functional block diagram of a system for providing heart rate information in accordance with a specific example of implementation of the present invention;

Fig. 2 shows a specific example of implementation of a graphical user interface implemented by the system shown in figure 1 for providing heart rate information in accordance with a non-limiting example of implementation of the invention;

Fig. 3 shows a simplified block diagram of a selection box part of a control allowing a user to select a portion of the first tracing in the first viewing window in accordance with a non-limiting example of implementation of the invention;

Fig. 4 shows a simplified block diagram of a control allowing a user to , select a portion of the first tracing in the first viewing window in accordance with a non-limiting example of implementation of the invention;

Fig. 5 is a functional block diagram of a fetal monitoring system for providing fetal heart rate information in accordance with a specific example of implementation of the present invention;

Fig. 6a shows a specific example of implementation of a graphical user interface implemented by the system shown in figure 5 for providing fetal heart rate information in accordance with a non-limiting example of implementation of the invention;

Fig. 6b shows a specific non-limiting preferred implementation of a graphical user interface implemented by the system shown in figure 5 for providing fetal heart rate information in accordance with a second non-limiting example of implementation of the invention;

Fig. 7 is a block diagram of an apparatus for providing heart rate information in accordance with a specific example of implementation of the present invention;

Fig. 8 is a high level conceptual block diagram of a program element for implementing a graphical user interface of the type shown in either one of figures 2, 6a and 6b in accordance with a specific example of implementation of the present invention;

Fig. 9 shows a functional block diagram of a client-server system for providing heart rate information in accordance in accordance with an alternative specific non-limiting example of implementation of the present invention.

**[0025]** Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

## DETAILED DESCRIPTION

**[0026]** With reference to Fig. 1, there is shown a configuration of a heart rate monitoring system 150 comprising a heart rate sensor 110, a user input device 118, an apparatus 100 implementing a user interface for displaying heart rate information and a display unit 114.

**[0027]** The user input device 118 is for receiving data from a user of the system. The user input device 118 includes any one or a combination of the following: keyboard, pointing device, touch sensitive surface or speech recognition unit.

**[0028]** The heart rate sensor 110 samples a heart rate at a certain pre-determined frequency to generate a signal indicative of the heart rate. Heart rate sensors are well known in the art to which this invention pertains and any suitable sensor for detecting a heart rate may be used without detracting from the spirit of the invention and as such will not be described further here.

**[0029]** The display unit 114 is coupled to the apparatus 100 and receives a signal causing the display unit 114 to display a graphical user interface module implemented by apparatus 100. The display unit 114 may be in the form of a display screen, a printer or any other suitable device for conveying to the physician or other health care professional the data indicative of heart rate signal. In a non-limiting implementation, the display unit 114 includes a display monitor to display the graphical user interface. The display unit 114 may also include a printer device for providing a paper print out of the graphical user interface implemented by apparatus 100.

**[0030]** The apparatus 100 includes a first input 102, a second input 116, a processing unit 106 and an output 108. The first input 102 is for receiving a heart rate signal from the heart rate sensor 110. The second input 116 is for receiving data from a user through input device 118. The processing unit 106 implements a graphical user interface module for displaying heart rate information. The output 108 is for releasing a signal for causing display unit 114 to display the graphical user interface module implemented by processing unit 106. The graphical user interface module implemented by apparatus 100 is described in greater detail herein below.

**[0031]** With reference to figure 2, a specific example of a graphical user interface module 200 is shown including a first viewing window 204, a second viewing window 202 and a control 208.

**[0032]** In the first viewing window 204, a first tracing indicative of the heart rate signal is displayed. In the second viewing window 202, which is displayed simultaneously with the first viewing window 204, a second tracing 210, which is a zoomed in view of a selected portion of the first tracing, is displayed.

**[0033]** The first tracing is indicative of the heart rate signal over a first time segment 214 and the second tracing is indicative of the heart rate signal over a second time segment 210. The duration of the first time segment 214 is longer that the duration of the second time segment 210. The first time segment 214 and segment time segment 210 may have any suitable duration for providing the health care practitioners with information regarding heart rate. Generally, the first time segment 214 will be on a scale of quarter hours, half hours or hours, while the second time segment 210 will be on a scale of minutes.

**[0034]** In a specific example, the length of a nurse's shift is taken into account when setting the duration of the first time segment. In a first specific implementation, the first time segment has a duration of fours hours. In as second specific implementation, the first time segment has a duration of eight hours. In a third specific implementation, the first time segment has a duration of twelve hours. In a fourth specific implementation, the first time segment has a duration of sixteen hours.

**[0035]** The duration of the second time segment is typically of a sufficient length to provide to the clinical staff some meaningful information which is reflective of the condition of the patent. In a first specific implementation, the second time segment has a duration of about 10 minutes. In a second specific implementation, the second time segment has a duration of about 20 minutes. In a third specific implementation, the second time segment has a duration which is a multiple of 10 minutes. In a preferred specific non-limiting implementation, the first time segment has a duration of eight hours and the second time segment has a duration of about 10 minutes. In the example shown in figure 2, the first time segment 214 has a duration of four (4) hours and the second time segment 210 has a duration of three minutes.

**[0036]** Generally, the first tracing will show the heart rate tracing over the most recent time segment, however, it will be readily appreciated that the first tracing may shown a time period prior to the most recent time segment without detracting from the spirit of the invention. In addition, the duration of the first time segment 214 may be a configurable parameter such as to allow the system administrator or, alternatively, the user to select the duration of the first time segment 214 to be displayed in the first viewing window 204. Such functionality may be provided to the user through buttons, text boxes, handles or other suitable means on the user interface. The user may provide his selection through the user input device 118 which may be any one or a combination of the following: keyboard, pointing device, touch sensitive surface or speech recognition unit.

**[0037]** Optionally, shown in figure 2, in the second viewing window 202, tracings extending beyond the second time segments 210 are also displayed. In the figure, a tracing over time segment 212 extending about 3:30 minutes prior to the beginning of the second time segment 210 and a tracing over time segment 213 extending about 3:30 minutes subsequent to the end of the second time segment 210 are displayed in the second viewing window 202. It is to be understood that omitting to display tracings prior to and subsequent to the second time segment 210 does not detract from the spirit of the invention.

**[0038]** The control 208 allows a user to select the portion of the first tracing in the first viewing window 204 for display in the second viewing window 202. The control 208 may provide the user with a prompt to select the portion of the first tracing. The prompting can be active or passive. In the case of a passive prompting the user is presented with a control where information can be entered through the user input device 118 (shown in figure 1). The active prompting includes, in addition to just presenting the control 208 where the information can be

entered, the performance of some other action positively urging the user to supply the information. One example is to present a dialog box with a message to draw the attention of the user, playing an audible message, among many others. The user supplies the selected portion of the first tracing in the first viewing window 204 for display in the second viewing window 202 through the user input device 118.

**[0039]** The control 208 may be of any suitable form for allowing the user to select a portion of the first tracing.

**[0040]** In a specific example of implementation, the control 208 includes a selection box 216 for allowing the user to selection the portion of the first tracing. The selection box 216 is superposed upon the first viewing window 204. The selection box 216 is shown in greater detail in figure 3 of the drawings. In the example shown in figure 3, the selection box 216 has a transparent portion 302. The selection box 216 is superposed upon the first viewing window 204 (shown in figure 2) such that a portion 310 of the first tracing is viewable through the transparent portion 302 of the selection box 216. The portion 310 of the first tracing viewable through the transparent portion 302 of the selection box 216 corresponds to the selected portion of the first tracing displayed in the second viewing window 202 (shown in figure 2).

**[0041]** The selection box 216 can be displaced along the axis of the first tracing in the first viewing window 204 to select a desired portion of the first tracing by modifying the portion of the first tracing viewable through the transparent portion 302 of the selection box 216.

**[0042]** Optionally, the user can modify the size of the selection box 216 to select the duration of the second time segment. In this variant, the size of the transparent portion 302 changes to display various durations of the portion of the first tracing. In a non-limiting implementation, the selection box 216 includes handles 304 allowing a user to modify the size of the selection box 216 by using user input device 118 to "stretch" or "compress" the size of the selection box 216 in a desired direction.

**[0043]** The user can displace the selection box 216 through the user input device 118. Many different manners of displacing the selection box to the desired location in the first viewing window may be used.

**[0044]** Optionally, the control 208 also includes one or more input facilitators 218 for allowing the user to displace and/or modify the size of the selection box 216. These are shown in greater detail in figure 4 of the drawings.

**[0045]** Advantageously, these input facilitators allow positioning the selection box 216 over the first viewing window 204 with greater accuracy than by manipulating the selection box 216 directly through the use of a pointing device for example.

**[0046]** Input facilitators 218 in the form of editable text boxes 402, are provided allowing the user to input via user input device 118 the beginning time and end time of the desired selection the portion of the first tracing to be displayed in the second viewing window. When the user modifies the content of the editable text boxes 402, the position and potentially the size of the selection box 216 is modified in a corresponding fashion. Similarly, when the selection box 216 is displaced or its size is modified, the beginning time and end time appearing in the editable text boxes 402 is adjusted to correspond to the position of the selection box 216 in the first display window 204.

**[0047]** Optionally, in a first example, time increment controls 404 406 408 410 are provided for displacing the selection box in the first viewing window. The increment control 406 displaces the selection box 216 to the left in increments of a first size while increment control 404 displaces the selection box to the left in increments of a second size. Similarly, the increment control 408 displaces the selection box to the right in increments of a first size while increment control 410 displaces the selection box to the right in increments of a second size. The increments of the second size are longer that the increments of the first size.

**[0048]** In a second example, time increment controls 412 414 are provided for modifying the size of the selection box 216. The increment controls 412 414 modify the size of the selection box 216 and therefore the degree of zooming applied to the first tracing in the first viewing window. The "zoom-in" button 412 decreases the size of the selection box 216 such that a shorter portion of the tracing appearing the first viewing window 202 is displayed in the second viewing window 204. The "zoom-out" button 414 increases the size of the selection box 216 such that a longer portion of the tracing appearing the first viewing window 202 is displayed in the second viewing window 204.

**[0049]** In will be readily apparent to the person skilled in the art, in light of the above description, that other forms of input facilitators 218 may be used without detracting from the spirit of the invention.

**[0050]** In a preferred non-limiting implementation, the second tracing is displayed such that the aspect ratio of the vertical axis (fetal heart rate value) and the horizontal axis (time) is preserved.

**[0051]** Advantageously, this allows users to quickly assess the heart rate information displayed in second window 202 without being misled by unfamiliar or changing degrees of compression or stretching of either axis. Typically, the aspect ratio is established by the institution in which the heart rate monitor is used. In a non-limiting implementation, American and International standards for heart rate displays may be used. Maintaining the aspect ratio is also particularly advantageous where the tracings are displayed on a paper printout. In such cases, the scaling of the vertical axis (fetal heart rate value) and the horizontal axis (time) is limited to a number of fixed values to facilitate the assessment of the heart rate information printed on the paper print out. The x-axis is typically in scales of 1, 2 or 3 cm per minute

**[0052]** In a preferred non-limiting implementation,

certain input facilitators 218 of control 208 may have reduced functionality such as to limit the number of possible scales that can be displayed. For instance the input facilitators 218 in the form of editable text boxes 402 may allow the user to input via user input device 118 the beginning time or end time of the desired selection the portion of the first tracing. The unspecified beginning time or end time is automatically set by the system to preserve the desired aspect ratio. Similarly, the selection box 216 may be adapted to adopt only preselected dimensions to preserve the desired aspect ratio.

**[0053]** In the preferred implementation the moveable window selects a 10-minute segment of the tracing which is displayed in a fashion in the second segment so that the standard North American aspect ratio is maintained. In this standard, on paper the y-axis displays the heart rate in beats per minute (bpm) where the lower limit on the graph is 30bpm and the upper limits is 240bpm. The scale of the y-axis is 1 cm = 30bpm. The x-axis measures time on a scale where 1 cm=20 seconds.

**[0054]** Alternatively, the size of the second viewing window may be modified according to the selection portion of the first tracing in the first viewing window 204 such as such as to preserve the desired aspect ratio.

***Fetal heart rate monitoring system***

**[0055]** In accordance with an alternative embodiment, described with reference to figure 5 of the drawings, there is shown a configuration of a fetal heart rate monitoring system 550 comprising a fetal heart rate sensor 510, a uterine activity sensor 511, a user input device 518, an apparatus 500 implementing a user interface for displaying fetal heart rate information and a display unit 514.

**[0056]** The user input device 518 is analogous to user input device 118 (shown in figure 1) and is for receiving data from a user of the system. The user input device 518 includes any one or a combination of the following: keyboard, pointing device, touch sensitive surface or speech recognition unit.

**[0057]** The fetal heart rate sensor 510 is for detecting a fetal heart rate of a fetus in-utero, also referred to as a fetus in the womb. The fetal heart rate sensor 510 samples the fetal heart rate at a certain pre-determined frequency to generate the signal indicative of the fetal heart rate. Fetal heart rate sensors are well known in the art to which this invention pertains and any suitable sensor for detecting a fetal heart rate may be used without detracting from the spirit of the invention and as such will not be described further here.

**[0058]** In a non-limiting implementation, the fetal monitoring system 550 includes a sensor 511 for monitoring uterine activity (TOCO). The sensor samples the contraction pattern at a certain pre-determined frequency to generate the signal indicative of uterine activity. Sensors for monitoring uterine activity are well known in the art to which this invention pertains and any suitable sensor may be used without detracting from the spirit of the invention and as such will not be described further here.

**[0059]** Optionally, the fetal monitoring system 550 may include other sensors (not shown) for measuring labour progress and the fetus' tolerance to labour. Such sensors may include for example:

- a sensor for measuring the maternal oxygen saturation
- a sensor for measuring the foetal oxygen saturation
- a sensor for measuring maternal blood pressure

**[0060]** In a non-limiting example of implementation, the sensors for measuring the oxygen saturation emit and absorb infrared light of 2 different wavelengths. The light of these two wavelengths is absorbed differently by oxygenated and deoxygenated hemoglobin. By calculating the ratio of emitted to absorbed lights, the percentage of hemoglobin which is carrying oxygen can be determined. Because of the different specific chemical structure of fetal and adult hemoglobin, different pairs of wavelengths are used in the sensors for determining oxygen saturation of the mother and for the fetus. Suitable sensors other than the ones described above may be used without detracting from the spirit of the invention.

**[0061]** The display unit 514 is coupled to the apparatus 500 and receives a signal causing the display unit 514 to display a graphical user interface module implemented by apparatus 500. The display unit 514 may be in the form of a display screen, a printer or any other suitable device for conveying to the physician or other health care professional the data indicative of heart rate signal. In a non-limiting implementation, the display unit 514 includes a display monitor to display the graphical user interface.

**[0062]** The display unit may also include a printer device for providing a paper print out of the graphical user interface implemented by apparatus 500.

**[0063]** The apparatus 500 includes a first input 502, a second input 516, a processing unit 506 and an output 508. The first input 502 is for receiving a fetal heart rate signal from the fetal heart rate sensor 510 and the uterine activity signal from the uterine activity sensor 511. The second input 516 is for receiving data from a user through input device 518. The processing unit 506 processes the foetal heart rate signal received at input 502 and implements a graphical user interface module for displaying fetal heart rate information. Optionally, the processing unit 506 processes the uterine activity signal received at input 502 and the graphical user interface module also displays uterine activity information. The output 508 is for releasing a signal for causing display unit 514 to display the graphical user interface module implemented by processing unit 506. The graphical user interface module implemented by apparatus 500 is described in greater detail herein below.

**[0064]** With reference to figures 6a and 6b, a specific example of a graphical user interface module 600 is shown including a first viewing window 606, a second viewing window 602, a third viewing window 604 and a control 608.

**[0065]** In the first viewing window 606, a first tracing indicative of the fetal heart rate signal is displayed. In the second viewing window 602, which is displayed simultaneously with the first viewing window 606, a second tracing, which is a zoomed in view of a selected portion of the first tracing, is displayed. The control 608 may be of any suitable form for allowing the user to select a portion of the first tracing. The first viewing window 606, the second viewing window 602 and the control 608 are analogous to the first viewing window 204, the second viewing window 202 and the control 208 described in connection with figure 2 of the drawings and essentially have similar functionality. Similarly, in a specific example, the control 608 includes a selection box 616 and input facilitators 618 analogous to selection box 216 and input facilitators 218 described in connection with figure 2.

**[0066]** In the third viewing window 604, which is displayed simultaneously with the first viewing window 606 and the second viewing window 602, a third tracing indicative of a uterine contraction pattern is displayed. The third tracing is indicative of a uterine contraction pattern, also referred to as TOCO tracing, during the same time segment as the second tracing in the second viewing window 602.

**[0067]** When the user through the control 608 selects a portion of the first tracing for display in the second viewing window 602, the corresponding segment of the uterine contraction pattern is displayed in the third viewing window 604.

**[0068]** Optionally, the graphical user interface module 600 also displays in a fourth viewing window (not shown) a fourth tracing indicative of a uterine contraction, during the same time segment as the first tracing in the first viewing window 606. The fourth viewing window may be displayed simultaneously with the other windows 602 604 606 on the display screen or may be made available upon request by the user by providing functionality to the user to show or hide the fourth viewing window.

**[0069]** As yet another option, the graphical user interface module 600 also displays information indicative of fetal heart rate features 614. Such information may be depicted in textual format, graphical format or any other suitable format for allowing the health care professionals to readily have access to the information.

**[0070]** As yet another option, where the fetal monitoring system 550 includes other sensors for measuring labour progress and the fetus' tolerance to labour, additional viewing windows showing tracings of the other measurements may also be provided by the graphical user interface module 600. Such tracings may be shown during the same time segment as the second tracing in the second viewing window 602 as well as during the same time segment as the first tracing in the first viewing window 606. The additional viewing windows may be displayed simultaneously with the other windows on the display screen or may be made available upon request by the user by providing functionality to the user to show or hide the additional viewing windows. In a non-limiting implementation, the tracings associated to the measure of the maternal oxygen saturation, the measure of foetal oxygen saturation and the measure of maternal blood pressure are shown in the first viewing window 606 and the second viewing window 602. Distinct display colours may be used to differentiate between the different tracings.

**[0071]** As yet another option, identifiers 650 652 (shown in figure 6b) denoting accelerations and decelerations in the fetal heart rate are displayed in the second viewing window 602. In figure 6b, the identifiers 650 652 are in the form of tabs denoting the location of the accelerations and decelerations. Other identifiers may be used without detracting from the spirit of the invention. Advantageously, these identifiers allow the clinical team to quickly identify the presence and location of acceleration and deceleration events. In a non-limiting implementation, the user is enabled to select one of the identifiers 650 652 to obtain details regarding the selected acceleration or deceleration event. Such information may include for example duration, area, and amplitude, minimum and maximum value, and the time delay from an associated contraction. The user may provide his selection through the user-input device 118, which may be any one or a combination of the following: keyboard, pointing device, touch sensitive surface or speech recognition unit. In the example depicted in figure 6b, the user selects a desired acceleration/deceleration by using a pointing device or touch sensitive screen to select a tab associated to the desired acceleration/deceleration.

***Specific Physical Implementation***

**[0072]** Those skilled in the art should appreciate that in some embodiments of the invention, all or part of the functionality previously described herein with respect to the apparatus implementing a user interface for displaying heart rate information may be implemented as pre-programmed hardware or firmware elements (e.g., application specific integrated circuits (ASICs), electrically erasable programmable read-only memories (EEPROMs), etc.), or other related components.

**[0073]** In other embodiments of the invention, all or part of the functionality previously described herein with respect to the apparatus for implementing a graphical user interface module for displaying heart rate information may be implemented as software consisting of a series of instructions for execution by a computing unit. The series of instructions could be stored on a medium which is fixed, tangible and readable directly by the computing unit, (e.g., removable diskette, CD-ROM, ROM,

PROM, EPROM or fixed disk), or the instructions could be stored remotely but transmittable to the computing unit via a modem or other interface device (e.g., a communications adapter) connected to a network over a transmission medium. The transmission medium may be either a tangible medium (e.g., optical or analog communications lines) or a medium implemented using wireless techniques (e.g., microwave, infrared or other transmission schemes).

**[0074]** The apparatus implementing a user interface for displaying heart rate information may be configured as a computing unit of the type depicted in figure 7, including a processing unit 702 and a memory 704 connected by a communication bus 708. The memory 704 includes data 710 and program instructions 706. The processing unit 702 is adapted to process the data 710 and the program instructions 706 in order to implement the functional blocks described in the specification and depicted in the drawings. In a non-limiting implementation, the program instructions 706 implement the functionality of either one of processing unit 106 or 506 described above. The computing unit 702 may also comprise a number of interfaces 712 714 716 for receiving or sending data elements to external devices. For example, interface 712 is used for receiving data streams indicative of a heart rate signal and interface 714 is used for receiving a control signal from the user indicating the selected portion of the heart rate tracing to be displayed in the second viewing window. When the apparatus is used in the context of a fetal heart rate monitor, an interface for receiving a signal indicative of uterine activity (not shown) may also be provided. Interface 716 is for releasing a signal causing a display unit to display the user interface generated by the program instructions 706.

**[0075]** It will be appreciated that the system for implementing a user interface for displaying heart rate information may also be of a distributed nature where the heart rate signal is collected at one location by a heart rate sensor and transmitted over a network to a server unit implementing the graphical user interface. The server unit may then transmit a signal for causing a display unit to display the graphical user interface. The display unit may be located in the same location as the heart rate sensor, in the same location as the server unit or in yet another location. Figure 9 illustrates a network-based client-server system 900 for displaying heart rate information. The client-server system 900 includes a plurality of client systems 912 914 916 918 connected to a server system 910 through network 920. The communication links 950 between the client systems 912 914 916 918 and the server system 910 can be metallic conductors, optical fibers or wireless, without departing from the spirit of the invention. The network 920 may be any suitable network including but not limited to a global public network such as the Intranet, a private network and a wireless network. The server 910 may be adapted to process and issue signals to display multiple heart rate signals originating from multiple sensors 926 928 concurrently using suitable methods known in the computer related arts.

**[0076]** The server system 910 includes a program element 960 for execution by a CPU. Program element 960 implements similar functionality as program instructions 706 (shown in figure 7) and includes the necessary networking functionality to allow the server system 910 to communicate with the client systems 912 914 916 918 over network 920. In a non-limiting implementation, program element 960 includes a number of program element components, each program element components implementing a respective portion of the functionality of the user interface for displaying heart rate information. Figure 8 shows a non-limiting example of the architecture of program element 960 at the server system. As shown, the program element 960 includes five program element components:

1. the first program element component 800 is executed on server system 910 and is for receiving a heart rate signal;
2. the second program element component 802 is executed on server system 910 and is for sending messages to a client system, say client system 914, for causing client system 914 to display, in a first viewing window, a first tracing indicative of the heart rate signal;
3. the third program element component 804 is executed on server system 910 and is for sending messages to client system 914 for causing client system 914 to display a control allowing a user to select a portion of the first tracing in the first viewing window;
4. the fourth program element component 806 is executed on server system 910 and is for receiving a message from client system 914 indicative of a selected portion of the first tracing in the first viewing window;
5. the fifth program element component 808 is executed on server system 910 and is for sending messages to client system 914 for causing client system 914 to display, in a second viewing window displayed simultaneously with the first viewing window, a second tracing which is a zoomed in view of the selected portion of the first tracing.

**[0077]** Those skilled in the art should further appreciate that the program instructions 706 and 960 may be written in a number of programming languages for use with many computer architectures or operating systems. For example, some embodiments may be implemented in a procedural programming language (e.g., "C") or an object oriented programming language (e.g., "C++" or "JAVA").

**[0078]** Although the present invention has been described in considerable detail with reference to certain preferred embodiments thereof, variations and refine-

ments are possible without departing from the invention. Therefore, the scope of the invention should be limited only by the appended claims.

## Claims

1. A method for displaying fetal heart rate information, said method comprising:

   a) receiving a fetal heart rate signal;
   b) causing a first tracing to be displayed in a first viewing window, the first tracing being indicative of the fetal heart rate signal over a first time segment;
   c) providing a control allowing a user to select a portion of the first tracing in the first viewing window;
   d) causing a second tracing to be displayed in a second viewing window simultaneously with the first viewing window, the second tracing being a zoomed in view of the selected portion of the first tracing and being indicative of the fetal heart rate signal over a second time segment.

2. A method as defined in claim 1, wherein said control includes a selection box.

3. A method as defined in claim 2, wherein said selection box includes a transparent portion, said selection box being superposed upon said first viewing window.

4. A method as defined in claim 3, wherein said control allows the user to displace the selection box along an axis associated with the first tracing in the first viewing window to select a portion of the first tracing in the first viewing Window.

5. A method as defined in claim 3, wherein each of the first time segment and the second time segment has respective a duration, said selection box including handles allowing a user to modify the size of the selection box to select the duration of the second time segment.

6. A method as defined in either one of claims 4 and 5, wherein said control allows the user to displace the selection box by using an input device selected from the set consisting of a mouse, keyboard, pointing device, speech recognition unit and touch sensitive screen.

7. A method as defined in claim 3, wherein said method comprises causing a third tracing indicative of a uterine contraction pattern to be displayed in a third display window.

8. A method as defined in claim 7, wherein the third tracing is indicative of a uterine contraction pattern during the second time segment.

9. A method as defined in claim 3, wherein said method comprises causing information indicative of fetal heart rate features to be displayed in a third display window.

10. A method as defined in claim 9, wherein the information indicative of fetal heart rate features is displayed in textual format.

11. A method as defined in claim 3, wherein in the second viewing window, identifiers denoting feature events in the second tracing are displayed.

12. A method as defined claim 11, wherein the feature events include accelerations and decelerations of the fetal heart rate.

13. A method as defined in claim 1, wherein the first time segment has a duration of at least about one hour.

14. A method as defined in claim 13, wherein the second time segment has a duration of at least about one minute.

15. A method as defined in claim 14, wherein the first time segment has a duration of about four hours.

16. A method as defined in claim 14, wherein the first time segment has a duration of about eight hours.

17. A method as defined in claim 14, wherein the first time segment has a duration of about twelve hours.

18. A method as defined in claim 3, wherein said method comprises causing a third tracing indicative of maternal oxygen saturation levels to be displayed in a third display window.

19. A method as defined in claim 3, wherein said method comprises causing a third tracing indicative of fetal oxygen saturation levels to be displayed in a third display window.

20. A method as defined in claim 3, wherein said method comprises causing a third tracing indicative of maternal blood pressure levels to be displayed in a third display window.

21. An apparatus for displaying fetal heart rate information, said apparatus comprising an input for receiving a fetal heart rate signal and a processing unit in communication with said input, said processing unit being adapted for implementing the method de-

scribed in either one of claims 1 to 20.

**22.** A computer readable storage medium storing a program element suitable for execution by a CPU, said program element implementing the method for displaying fetal heart rate information described in either one of claims 1 to 20.

**23.** A fetal monitoring system comprising:

a) a sensor for receiving a heart rate signal indicative of a fetal heart rate;
b) an apparatus for displaying fetal heart rate information, said apparatus comprising an input for receiving the fetal heart rate signal and a processing unit in communication with said input, said processing unit being adapted for implementing the method described in either one of claims 1 to 20,
c) a display unit coupled to said apparatus.

**24.** A server system storing a program element for execution by a CPU, said program element implementing the method for displaying fetal heart rate information described in either one of claims 1 to 20.

**25.** A client-server system for implementing a graphical user interface module for displaying heart rate information, said client-server system comprising a client system and a server system, said client system and said server system operative to exchange messages over a data network, said server system storing a program element for execution by a CPU, said program element comprising:

a) first program element component executed on said server system for receiving a heart rate signal;
b) a second program element component executed on said server system for sending messages to said client system for causing said client system to display in a first viewing window, a first tracing indicative of the heart rate signal over a first time segment;
c) a third program element component executed on said server system for sending messages to said client system for causing said client system to display a control allowing a user to select a portion of the first tracing in the first viewing window;
d) a fourth program element component executed on said server system for receiving a message from said client system indicative of a selected portion of the first tracing in the first viewing window;
e) a fifth program element component executed on said server system for sending messages to said client system for causing said client system to display, in a second viewing window displayed simultaneously with the first viewing window, a second tracing which is a zoomed in view of the selected portion of the first tracing, said second tracing indicative of the heart rate signal over a second time segment.

**26.** A client-server system as defined in claim 25, wherein the data network is the Internet.

**27.** A client-server system as defined in claim 25, wherein said control includes a selection box.

**28.** A client-server system as defined in claim 27, wherein said selection box includes a transparent portion, said selection box being superposed upon said first viewing window.

**29.** A client-server system as defined in claim 28, wherein said control allows the user to displace the selection box along an axis associated with the first tracing in the first viewing window to select a portion of the first tracing in the first viewing window.

**30.** A client-server system as defined in claim 28, wherein each of the first time segment and the second time segment has a respective duration, said selection box including handles allowing a user to modify the size of the selection box to select the duration of the second time segment.

**31.** A client-server system as defined in claim 29, wherein said control allows the user to displace the selection box by using an input device selected from the set consisting of a mouse, keyboard, pointing device, speech recognition unit and touch sensitive screen.

**32.** A client-server system as defined in claim 30, wherein the control allows the user to modify the size of the selection box by using an input device selected from the set consisting of a mouse, keyboard, pointing device, speech recognition unit and touch sensitive screen.

**33.** A client-server system as described in claim 25, wherein the heart rate signal is a fetal heart rate signal.

**34.** A client-server system as defined in claim 33, wherein said graphical user interface module is adapted for displaying in a third display window a third tracing indicative of a uterine contraction pattern.

**35.** A client-server system as defined in claim 34, wherein the third tracing is indicative of a uterine contraction pattern during the second time seg-

ment.

**36.** A client-server system as defined in claim 33, wherein said graphical user interface module is adapted for displaying in a third display window including information indicative of fetal heart rate features.

**37.** A client-server system as defined in claim 33, wherein said graphical user interface module is adapted for displaying in a third display window including information indicative of maternal oxygen saturation levels.

**38.** A client-server system as defined in claim 33, wherein said graphical user interface module is adapted for displaying in a third display window including information of fetal oxygen saturation levels.

**39.** A client-server system as defined in claim 33, wherein said graphical user interface module is adapted for displaying in a third display window including information indicative of maternal blood pressure levels.

**Patentansprüche**

**1.** Verfahren zum Anzeigen von fötaler Herzfrequenzinformation, welches umfasst:

a) Empfangen eines fötalen Herzfrequenzsignals;
b) Veranlassen der Anzeige einer ersten Spur in einem ersten Sichtfenster, wobei die erste Spur das fötale Herzfrequenzsignal über ein erstes Zeitsegment darstellt;
c) Bereitstellen einer Steuerung, die es einem Benutzer ermöglicht, einen Abschnitt der ersten Spur in dem ersten Sichtfenster auszuwählen;
d) Veranlassen der Anzeige einer zweiten Spur in einem zweiten Sichtfenster gleichzeitig mit dem ersten Sichtfenster, wobei die zweite Spur eine gespreizte Ansicht des ausgewählten Abschnitts der ersten Spur ist und das fötale Herzfrequenzsignal über ein zweites Zeitsegment darstellt.

**2.** Verfahren nach Anspruch 1, bei dem die Steuerung einen Auswahlkasten umfasst.

**3.** Verfahren nach Anspruch 2, bei dem der Auswahlkasten einen transparenten Abschnitt umfasst und der Auswahlkasten dem ersten Sichtfenster überlagert ist.

**4.** Verfahren nach Anspruch 3, bei dem die Steuerung es dem Benutzer ermöglicht, den Auswahlkasten entlang einer der ersten Spur in dem ersten Sichtfenster zugeordneten Achse zu verschieben, um einen Abschnitt der ersten Spur in dem ersten Sichtfenster auszuwählen.

**5.** Verfahren nach Anspruch 3, bei dem das erste Zeitsegment und das zweite Zeitsegment jeweils eine Dauer haben und der Auswahlkasten Griffe aufweist, die es einem Benutzer ermöglichen, die Größe des Auswahlkastens zu verändern, um die Dauer des zweiten Zeitsegments auszuwählen.

**6.** Verfahren nach einem der Ansprüche 4 und 5, bei dem die Steuerung es dem Benutzer ermöglicht, den Auswahlkasten durch Verwendung einer Eingabevorrichtung zu verschieben, die ausgewählt ist aus der Menge bestehend aus Maus, Tastatur, Zeigevorrichtung, Spracherkennungseinheit und berührungsempfindlichem Schirm.

**7.** Verfahren nach Anspruch 3, bei dem das Verfahren das Veranlassen der Anzeige einer dritten Spur, die ein Uterus-Kontraktionsmuster darstellt, in einem dritten Anzeigefenster umfasst.

**8.** Verfahren nach Anspruch 7, bei dem die dritte Spur ein Uterus-Kontraktionsmuster während des zweiten Zeitsegments darstellt.

**9.** Verfahren nach Anspruch 3, bei dem das Verfahren das Veranlassen der Anzeige von Merkmale der fötalen Herzfrequenz darstellender Information in einem dritten Anzeigefenster umfasst.

**10.** Verfahren nach Anspruch 9, bei dem die die Merkmale der fötalen Herzfrequenz darstellende Information im Textformat angezeigt wird.

**11.** Verfahren nach Anspruch 3, bei dem in dem zweiten Sichtfenster Identifikatoren angezeigt werden, die Merkmalereignisse in der zweiten Spur bezeichnen.

**12.** Verfahren nach Anspruch 11, bei dem die Merkmalereignisse Beschleunigungen und Verlangsamungen der fötalen Herzfrequenz umfassen.

**13.** Verfahren nach Anspruch 1, bei dem das erste Zeitsegment eine Dauer von wenigstens etwa einer Stunde hat.

**14.** Verfahren nach Anspruch 13, bei dem das zweite Zeitsegment eine Dauer von wenigstens etwa einer Minute hat.

**15.** Verfahren nach Anspruch 14, bei dem das erste

Zeitsegment eine Dauer von etwa vier Stunden hat.

**16.** Verfahren nach Anspruch 14, bei dem das erste Zeitsegment eine Dauer von etwa acht Stunden hat.

**17.** Verfahren nach Anspruch 14, bei dem das erste Zeitsegment eine Dauer von etwa 12 Stunden hat.

**18.** Verfahren nach Anspruch 3, bei dem das Verfahren das Veranlassen der Anzeige einer dritten Spur in einem dritten Anzeigefenster umfasst, welche mütterliche Sauerstoffsättigungspegel darstellt.

**19.** Verfahren nach Anspruch 3, bei dem das Verfahren das Veranlassen der Anzeige einer dritten Spur in einem dritten Anzeigefenster umfasst, die fötale Sauerstoffsättigungspegel darstellt.

**20.** Verfahren nach Anspruch 3, bei dem das Verfahren das Veranlassen der Anzeige einer dritten Spur in einem dritten Anzeigefenster umfasst, die mütterliche Blutdruckpegel darstellt.

**21.** Vorrichtung zum Anzeigen von fötaler Herzfrequenzinformation, wobei die Vorrichtung einen Eingang zum Empfangen eines fötalen Herzfrequenzsignals und eine Verarbeitungseinheit in Kommunikation mit dem Eingang hat, wobei die Verarbeitungseinheit eingerichtet ist, das Verfahren nach einem der Ansprüche 1 bis 20 zu implementieren.

**22.** Computerlesbares Speichermedium, das ein zur Ausführung durch eine CPU geeignetes Programmelement speichert, wobei das Programmelement das Verfahren zum Anzeigen von fötaler Herzfrequenzinformation nach einem der Ansprüche 1 bis 20 implementiert.

**23.** Fötus-Überwachungssystem mit:

a) einem Sensor zum Empfangen eines Herzfrequenzsignals, das eine fötale Herzfrequenz darstellt;
b) einer Vorrichtung zum Anzeigen von fötaler Herzfrequenzinformation, wobei die Vorrichtung einen Eingang zum Empfangen des fötalen Herzfrequenzsignals und eine mit dem Eingang kommunizierende Verarbeitungseinheit umfasst und die Verarbeitungseinheit eingerichtet ist, das Verfahren nach einem der Ansprüche 1 bis 20 zu implementieren;
c) einer an die Vorrichtung gekoppelten Anzeigeeinheit.

**24.** Serversystem, das ein Programmelement zum Ausführen durch eine CPU speichert, wobei das Programmelement das Verfahren zum Anzeigen von fötaler Herzfrequenzinformation nach einem der Ansprüche 1 bis 20 implementiert.

**25.** Client-Server-System zum Implementieren eines grafischen Benutzerschnittstellenmoduls zum Anzeigen von Herzfrequenzinformation, wobei das Client-Server-System ein Client-System und ein Server-System umfasst, wobei das Client-System und das Server-System betreibbar sind, um Nachrichten über ein Datennetz auszutauschen und das Server-System ein Programmelement zur Ausführung durch eine CPU speichert, wobei das Programmelement umfasst:

a) eine auf dem Server-System ausgeführte erste Programmelementkomponente zum Empfangen eines Herzfrequenzsignals;
b) eine auf dem Server-System ausgeführte zweite Programmelementkomponente zum Senden von Nachrichten an das Client-System, um das Client-System zu veranlassen, eine erste Spur, die das Herzfrequenzsignal über ein erstes Zeitsegment darstellt, in einem ersten Sichtfenster anzuzeigen;
c) eine dritte Programmelementkomponente, die auf dem Server-System ausgeführt wird, zum Senden von Nachrichten an das Client-System, um das Client-System zu veranlassen, eine Steuerung anzuzeigen, die es einem Benutzer ermöglicht, einen Abschnitt der ersten Spur in dem ersten Sichtfenster auszuwählen;
d) eine vierte Programmelementkomponente, die auf dem Server-System ausgeführt wird, zum Empfangen einer Nachricht von dem Client-System, die einen ausgewählten Abschnitt der ersten Spur in dem ersten Sichtfenster angibt;
e) eine fünfte auf dem Server-System ausgeführte Programmelementkomponente zum Senden von Nachrichten an das Client-System, um das Client-System zu veranlassen, in einem gleichzeitig mit dem ersten Sichtfenster angezeigten zweiten Sichtfenster eine zweite Spur anzuzeigen, die eine gespreizte Ansicht des ausgewählten Abschnitts der ersten Spur ist, wobei die zweite Spur ein Herzfrequenzsignal über ein zweites Zeitsegment darstellt.

**26.** Client-Server-System nach Anspruch 25, bei dem das Datennetz das Internet ist.

**27.** Client-Server-System nach Anspruch 25, bei dem die Steuerung eine Auswahlbox umfasst.

**28.** Client-Server-System nach Anspruch 27, bei dem die Auswahlbox einen transparenten Abschnitt umfasst und die Auswahlbox dem ersten Sichtfenster überlagert ist.

**29.** Client-Server-System nach Anspruch 28, bei dem die Steuerung es dem Benutzer ermöglicht, die Auswahlbox entlang einer der ersten Spur in dem ersten Sichtfenster zugeordneten Achse zu verschieben, um einen Abschnitt der ersten Spur in dem ersten Sichtfenster auszuwählen.

**30.** Client-Server-System nach Anspruch 28, bei dem das erste Zeitsegment und das zweite Segment jeweils eine Dauer haben und die Auswahlbox Handgriffe umfasst, die es einem Benutzer ermöglichen, die Größe der Auswahlbox zu verändern, um die Dauer des zweiten Zeitsegments auszuwählen.

**31.** Client-Server-System nach Anspruch 29, bei dem die Steuerung dem Benutzer ermöglicht, die Auswahlbox durch Verwendung einer Eingabevorrichtung zu verschieben, die ausgewählt ist aus der Menge bestehend aus Maus, Tastatur, Zeigervorrichtung, Spracherkennungseinheit und berührungsempfindlichem Schirm.

**32.** Client-Server-System nach Anspruch 30, bei dem die Steuerung es dem Benutzer ermöglicht, die Größe der Auswahlbox durch Verwendung einer Eingabevorrichtung zu verändern, die ausgewählt ist aus der Menge bestehend aus Maus, Tastatur, Zeigervorrichtung, Spracherkennungseinheit und berührungsempfindlichem Schirm.

**33.** Client-Server-System nach Anspruch 25, bei dem das Herzfrequenzsignal ein fötales Herzfrequenzsignal ist.

**34.** Client-Server-System nach Anspruch 33, bei dem das grafische Benutzerschnittstellenmodul eingerichtet ist, um in einem dritten Anzeigefenster eine dritte Spur anzuzeigen, die ein Uterus-Kontraktionsmuster darstellt.

**35.** Client-Server-System nach Anspruch 34, bei dem die dritte Spur ein Uterus-Kontraktionsmuster während des zweiten Zeitsegments darstellt.

**36.** Client-Server-System nach Anspruch 33, bei dem das grafische Benutzerschnittstellenmodul eingerichtet ist, um in einem dritten Anzeigefenster Informationen darzustellen, die fötale Herzfrequenzmerkmale darstellt.

**37.** Client-Server-System nach Anspruch 33, bei dem das grafische Benutzerschnittstellenmodul eingerichtet ist, um in einem dritten Anzeigefenster mütterliche Sauerstoffsättigungspegel darstellende Information anzuzeigen.

**38.** Client-Server-System nach Anspruch 33, bei dem das grafische Benutzerschnittstellenmodul eingerichtet ist, um in einem dritten Anzeigefenster Informationen über fötale Sauerstoffsättigungspegel anzuzeigen.

**39.** Ciient-Server-System nach Anspruch 33, bei dem das grafische Benutzerschnittstellenmodul eingerichtet ist, um in einem dritten Anzeigefenster Informationen über mütterliche Blutdruckpegel anzuzeigen.

**Revendications**

**1.** Procédé pour afficher des informations de rythme cardiaque foetal, ledit procédé consistant à :

a) recevoir un signal de rythme cardiaque foetal ;
b) provoquer l'affichage d'un premier tracé dans une première fenêtre de visualisation, le premier tracé étant représentatif du signal du rythme cardiaque foetal au cours d'un premier segment de temps ;
c) fournir une commande permettant à un utilisateur de sélectionner une portion du premier tracé dans la première fenêtre de visualisation ;
d) provoquer l'affichage d'un second tracé dans une seconde fenêtre de visualisation simultanément avec la première fenêtre de visualisation, le second tracé étant une vue zoomée de la portion sélectionnée du premier tracé et étant représentatif du rythme cardiaque foetal au cours d'un second segment de temps.

**2.** Procédé selon la revendication 1, **caractérisé en ce que** ladite commande comporte une boîte de sélection.

**3.** Procédé selon la revendication 2, **caractérisé en ce que** ladite boîte de sélection comporte une portion transparente, ladite boîte de sélection étant superposée à ladite première fenêtre de visualisation.

**4.** Procédé selon la revendication 3, **caractérisé en ce que** ladite commande permet à l'utilisateur de déplacer la boîte de sélection le long d'un axe associé avec le premier tracé dans la première fenêtre de visualisation pour visualiser une portion du premier tracer dans la première fenêtre de visualisation.

**5.** Procédé selon la revendication 3, **caractérisé en ce que** chacun des premier segment de temps et second segment de temps a une durée respective, ladite boîte de sélection comportant des poignées permettant à l'utilisateur de modifier la taille de la boîte de sélection pour sélectionner la durée du second segment de temps.

6. Procédé selon l'une des revendications 4 ou 5, **caractérisé en ce que** ladite commande permet à l'utilisateur de déplacer la boîte de sélection en utilisant un dispositif d'entrée sélectionné dans un ensemble comportant une souris, un clavier, un dispositif de pointage, une unité de reconnaissance de la parole, et un écran sensible au toucher.

7. Procédé selon la revendication 3, **caractérisé en ce que** ledit procédé consiste à provoquer l'affichage dans une troisième fenêtre de visualisation d'un troisième tracé représentatif du profil d'une contraction utérine.

8. Procédé selon la revendication 7, **caractérisé en ce que** le troisième tracé est représentatif du profil d'une contraction utérine durant le second segment de temps.

9. Procédé selon la revendication 3, **caractérisé en ce que** ledit procédé consiste à provoquer l'affichage dans une troisième fenêtre de visualisation d'une information représentative des caractéristiques du rythme cardiaque foetal.

10. Procédé selon la revendication 9, **caractérisé en ce que** l'information représentative des caractéristiques du rythme cardiaque foetal est affichée en format textuel.

11. Procédé selon la revendication 3, **caractérisé en ce que** des identifiants dénotant des évènements caractéristiques dans le second tracé sont affichées dans la seconde fenêtre de visualisation.

12. Procédé selon la revendication 11, **caractérisé en ce que** les évènements caractéristiques comportent des accélérations et des décélérations du rythme cardiaque foetal.

13. Procédé selon la revendication 1, **caractérisé en ce que** le premier segment de temps a une durée d'au moins environ une heure.

14. Procédé selon la revendication 13, **caractérisé en ce que** le second segment de temps a une durée d'au moins environ une minute.

15. Procédé selon la revendication 14, **caractérisé en ce que** le premier segment de temps a une durée d'environ quatre heures.

16. Procédé selon la revendication 14, **caractérisé en ce que** le premier segment de temps a une durée d'environ huit heures.

17. Procédé selon la revendication 14, **caractérisé en ce que** le premier segment de temps a une durée d'environ douze heures.

18. Procédé selon la revendication 3, **caractérisé en ce que** ledit procédé consiste à provoquer l'affichage dans une troisième fenêtre de visualisation d'un troisième tracé représentatif de niveaux de saturation en oxygène maternel.

19. Procédé selon la revendication 3, **caractérisé en ce que** ledit procédé consiste à afficher dans une troisième fenêtre de visualisation un troisième tracé représentatif de niveaux de saturation en oxygène foetal.

20. Procédé selon la revendication 3, **caractérisé en ce que** ledit procédé consiste à afficher dans une troisième fenêtre de visualisation un troisième tracé représentatif de niveaux de la pression sanguine maternelle.

21. Appareil pour l'affichage d'informations de rythme cardiaque foetal, ledit appareil comportant une entrée pour recevoir un signal de rythme cardiaque foetal et une unité de traitement communiquant avec ladite entrée, ladite unité de traitement étant adaptée pour implémenter le procédé décrit à l'une quelconque des revendications 1 à 20.

22. Média de stockage lisible par un ordinateur stockant un élément de programme convenable pour l'exécution par une unité centrale de traitement, ledit élément de programme implémentant le procédé pour l'affichage d'informations de rythme cardiaque foetal décrit à l'une quelconque des revendications 1 à 20.

23. Système de monitoring foetal comportant :

    a) un capteur pour recevoir un signal de rythme cardiaque représentatif d'un rythme cardiaque foetal ;
    b) un appareil pour afficher des informations de rythme cardiaque foetal, ledit appareil comportant une entrée pour recevoir le signal de rythme cardiaque foetal et une unité de traitement communiquant avec ladite entrée, ladite unité de traitement étant adaptée pour implémenter le procédé décrit à l'une quelconque des revendications 1 à 20 ;
    c) une unité d'affichage couplée audit appareil.

24. Système serveur stockant un élément de programme pour l'exécution par une unité centrale de traitement, ledit élément de programme implémentant le procédé pour afficher des informations de rythme cardiaque foetal décrit à l'une quelconque des revendications 1 à 20.

**25.** Système client-serveur pour implémenter un module d'interface graphique utilisateur pour afficher des informations de rythme cardiaque, ledit système client-serveur comportant un système client et un système serveur, ledit système client et ledit système serveur étant opérationnels pour échanger des messages à travers un réseau de données, ledit système stockant un élément de programme pour l'exécution par une unité centrale de traitement, ledit élément de programme comportant :

a) un premier composant d'élément de programme exécuté sur ledit système serveur pour recevoir un signal de rythme cardiaque ;
b) un deuxième composant d'élément de programme exécuté sur ledit système serveur pour envoyer des messages audit système client pour provoquer l'affichage par ledit système client, dans une première fenêtre de visualisation, d'un premier tracé représentatif du signal de rythme cardiaque au cours d'un premier segment de temps ;
c) un troisième composant d'élément de programme exécuté sur ledit système serveur pour envoyer des messages audit système client pour provoquer, par ledit système client, l'affichage d'une commande permettant à l'utilisateur de sélectionner une portion du premier tracé dans la première fenêtre de visualisation ;
d) un quatrième composant d'élément de programme exécuté sur ledit système serveur pour recevoir un message dudit système client représentatif d'une portion sélectionnée du premier tracé dans la première fenêtre de visualisation ;
e) un cinquième composant d'élément de programme exécuté sur ledit système serveur pour envoyer des messages audit système client pour provoquer, par ledit système client, l'affichage dans une seconde fenêtre de visualisation simultanément avec la première fenêtre de visualisation, d'un second tracé qui est une vue zoomée de la portion sélectionnée du premier tracé, ledit second tracé étant représentatif du signal de rythme cardiaque au cours d'un second segment de temps.

**26.** Système client-serveur selon la revendication 25, **caractérisé en ce que** le réseau de données est l'Internet.

**27.** Système client-serveur selon la revendication 25, **caractérisé en ce que** ladite commande comporte une boîte de sélection.

**28.** Système client-serveur selon la revendication 27, **caractérisé en ce que** ladite boîte de sélection comporte une portion transparente, ladite boîte de sélection étant superposée à ladite première fenêtre de visualisation.

**29.** Système client-serveur tel que défini à la revendication 28, **caractérisé en ce que** ladite commande permet à l'utilisateur de déplacer la boîte de sélection selon un axe associé avec le premier tracé dans la première fenêtre de visualisation pour sélectionner une portion du premier tracé dans la première fenêtre de visualisation.

**30.** Système client-serveur selon la revendication 28, **caractérisé en ce que** chacun des premier segment de temps et second segment de temps a une durée respective, ladite boîte de sélection comportant des poignées permettant à l'utilisateur de modifier la taille de la boîte de sélection pour sélectionner la durée du second segment de temps.

**31.** Système client-serveur selon la revendication 29, **caractérisé en ce que** ladite commande permet à l'utilisateur de déplacer la boîte de sélection en utilisant un dispositif d'entrée sélectionné dans un ensemble comportant une souris, un clavier, un dispositif de pointage, une unité de reconnaissance de la parole, et un écran sensible au toucher.

**32.** Système client-serveur tel que défini à la revendication 30, **caractérisé en ce que** la commande permet à l'utilisateur de modifier la dimension de la boîte de sélection en utilisant un dispositif d'entrée sélectionné dans un ensemble comportant une souris, un clavier, un dispositif de pointage, une unité de reconnaissance de la parole, et un écran sensible au toucher.

**33.** Système client-serveur selon la revendication 25, **caractérisé en ce que** le signal de rythme cardiaque est un signal de rythme cardiaque foetal.

**34.** Système client-serveur selon la revendication 33, **caractérisé en ce que** ledit module d'interface graphique utilisateur est adapté pour l'affichage, dans une troisième fenêtre de visualisation, d'un troisième tracé représentatif d'un profil de contraction utérine.

**35.** Système client-serveur selon la revendication 34, **caractérisé en ce que** le troisième tracé est représentatif du profil de contraction utérine durant le second segment de temps.

**36.** Système client-serveur selon la revendication 33, **caractérisé en ce que** ledit module d'interface graphique utilisateur est adapté pour afficher dans une troisième fenêtre de visualisation y compris des informations représentatives de caractéristiques du rythme cardiaque foetal.

**37.** Système client-serveur selon la revendication 33, **caractérisé en ce que** ledit module d'interface graphique utilisateur est adapté pour afficher dans une troisième fenêtre de visualisation y compris des informations représentatives de niveau de saturation en oxygène maternel.

**38.** Système client-serveur selon la revendication 33, **caractérisé en ce que** ledit module d'interface graphique utilisateur est adapté pour afficher dans une troisième fenêtre de visualisation y compris des informations de niveau de saturation en oxygène foetal.

**39.** Système client-serveur selon la revendication 33, **caractérisé en ce que** ledit module d'interface graphique utilisateur est adapté pour afficher dans une troisième fenêtre de visualisation y compris des informations représentatives de niveau de pression sanguine maternelle.

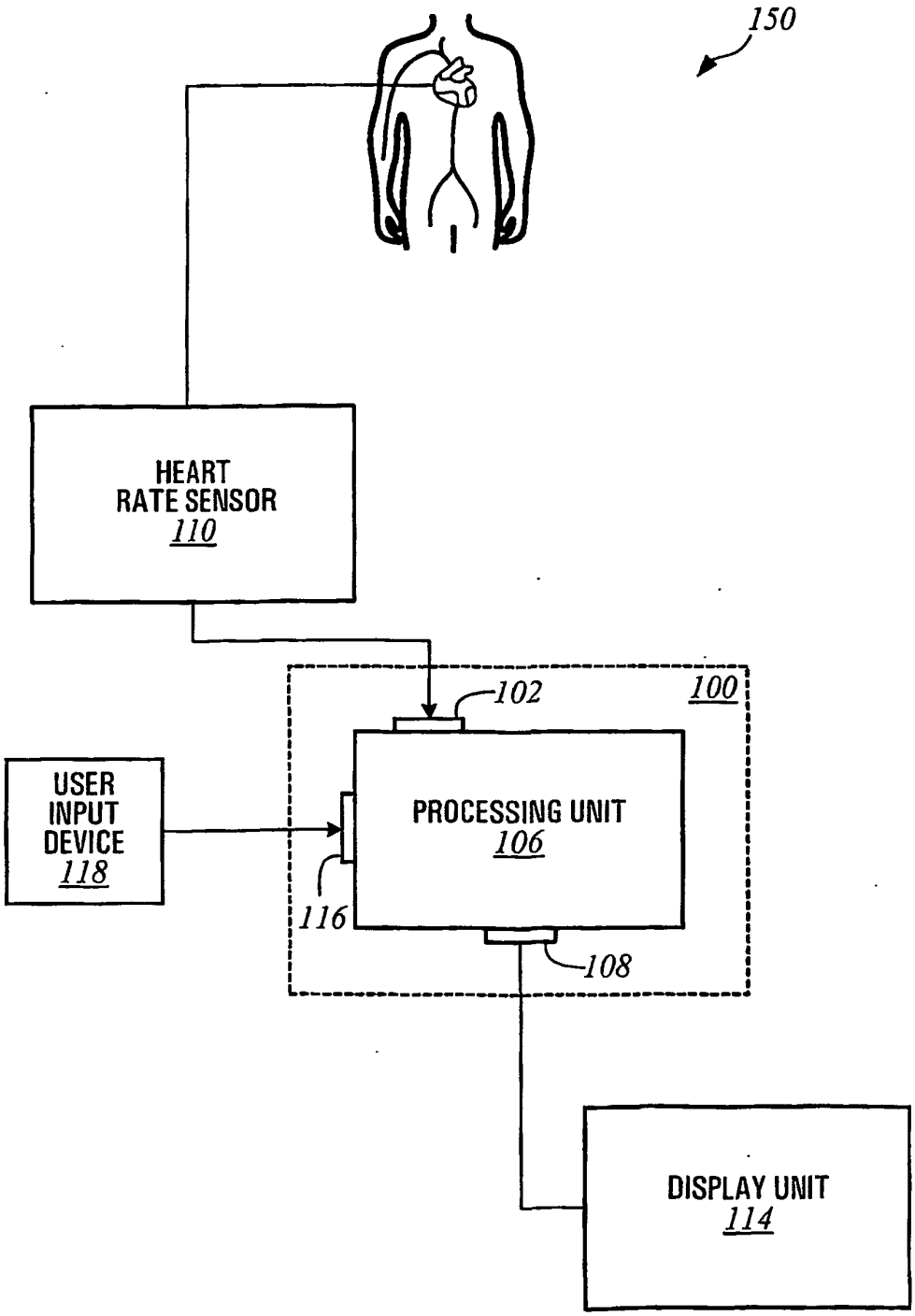
150
HEART
RATE SENSOR
110
100
102
USER
INPUT
DEVICE
118
PROCESSING UNIT
106
116
108
DISPLAY UNIT
114

FIG. 1

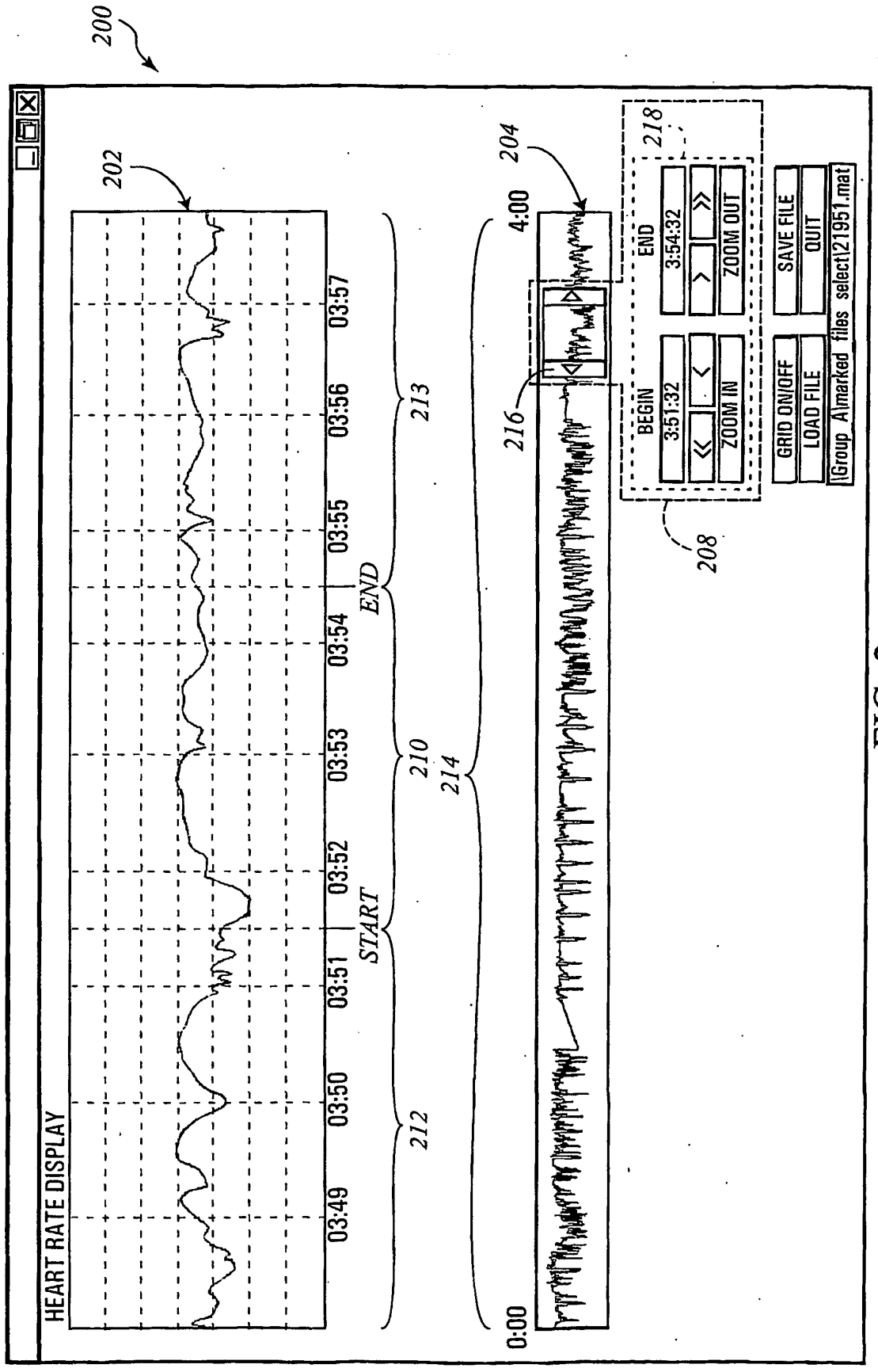
200
HEART RATE DISPLAY
202
03:49
03:50
03:51
03:52
03:53
03:54
03:55
03:56
03:57
START
END
212
210
213
214
204
4:00
0:00
216
208
218
BEGIN
3:51:32
END
3:54:32
ZOOM IN
ZOOM OUT
GRID ON/OFF
LOAD FILE
SAVE FILE
QUIT
Group A\marked files select\21951.mat

FIG. 2

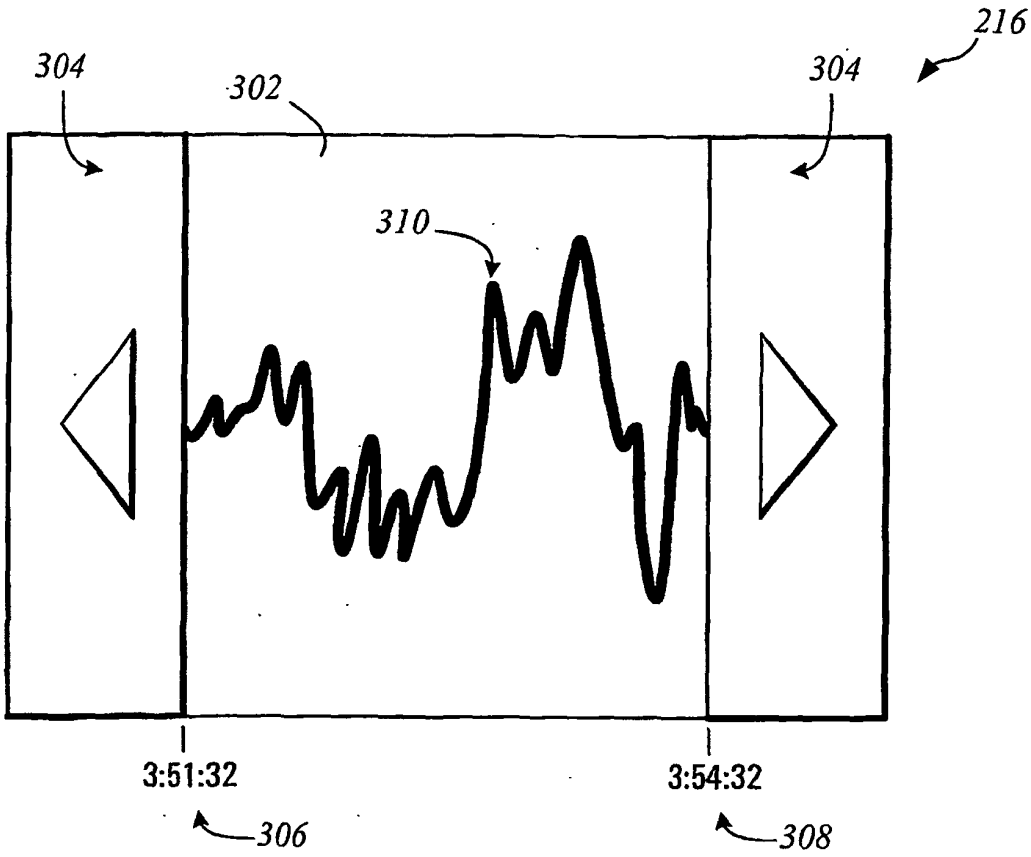
216
304
302
304
310
3:51:32
3:54:32
306
308

FIG. 3

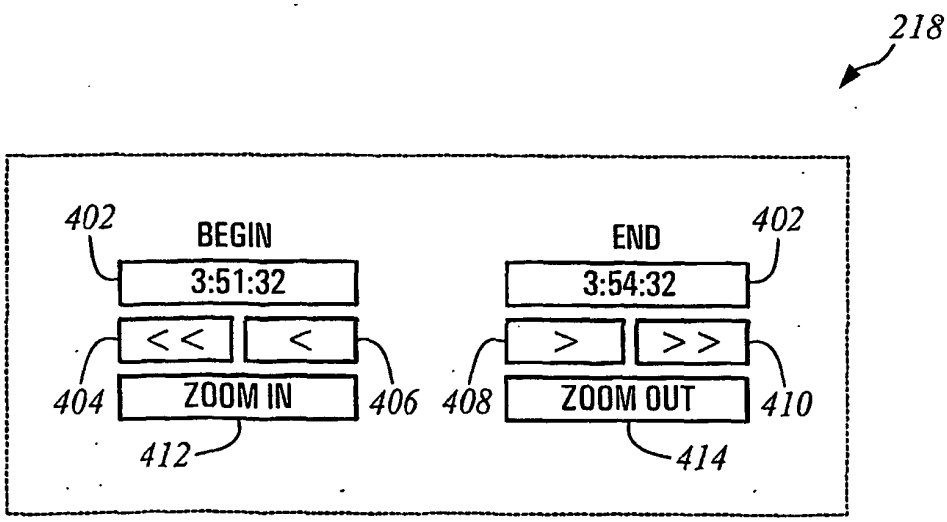
218
402
BEGIN
3:51:32
<<
<
404
ZOOM IN
406
412
402
END
3:54:32
>
>>
408
ZOOM OUT
410
414

FIG. 4

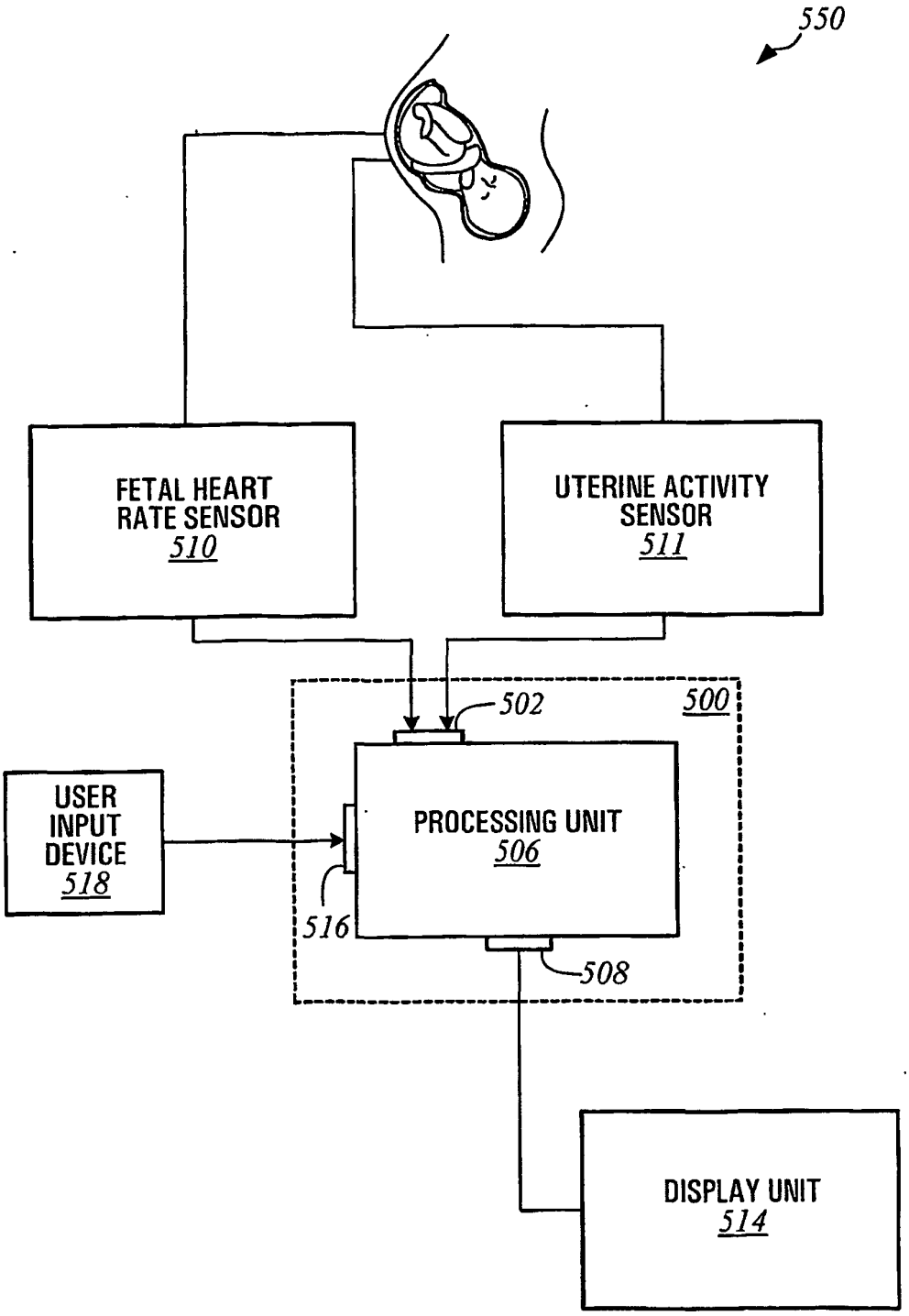
550
FETAL HEART RATE SENSOR 510
UTERINE ACTIVITY SENSOR 511
500
502
USER INPUT DEVICE 518
PROCESSING UNIT 506
516
508
DISPLAY UNIT 514

FIG. 5

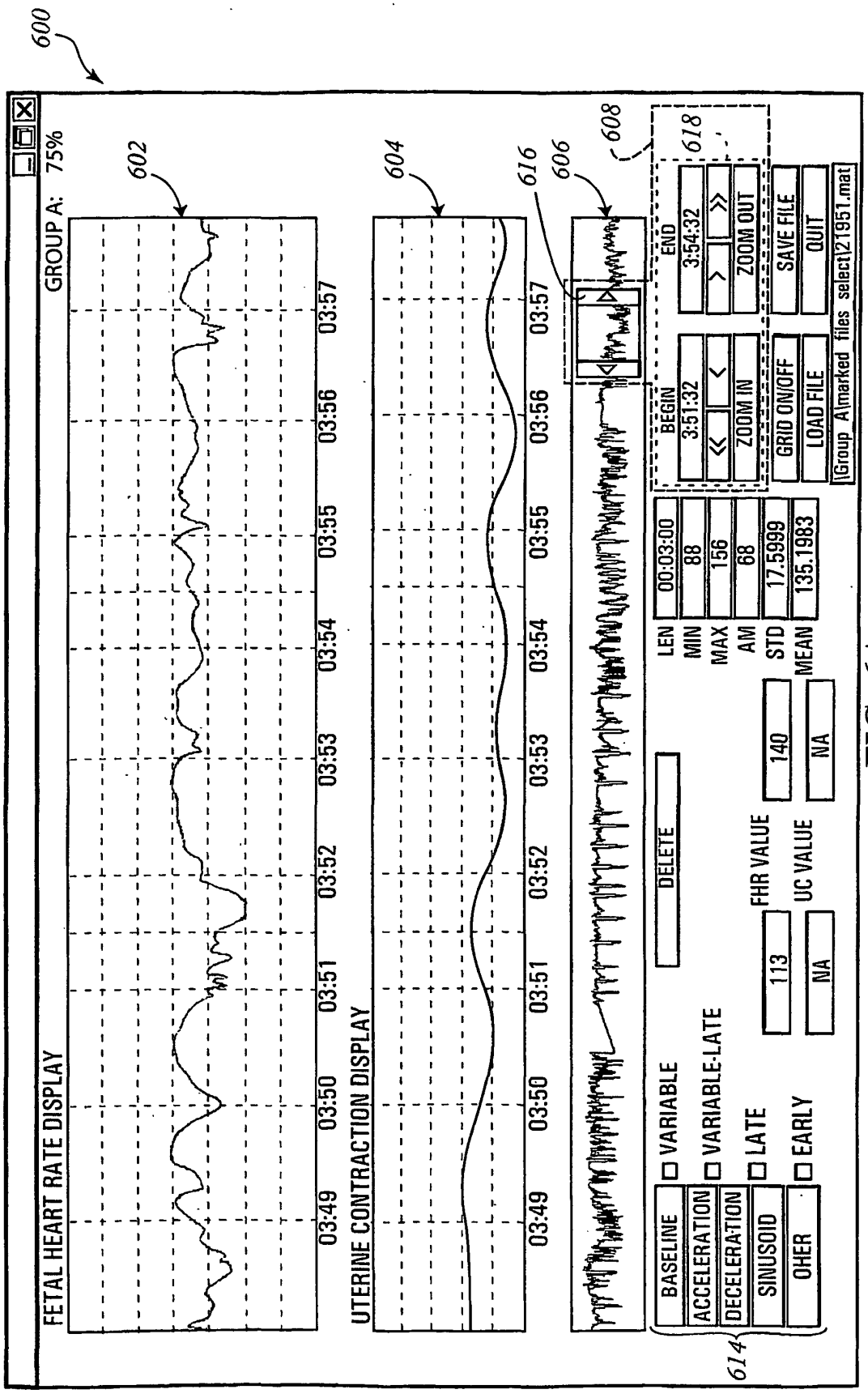
600
FETAL HEART RATE DISPLAY
GROUP A: 75%
602
604
606
608
616
618
03:49
03:50
03:51
03:52
03:53
03:54
03:55
03:56
03:57
UTERINE CONTRACTION DISPLAY
BASELINE
ACCELERATION
DECELERATION
SINUSOID
OHER
VARIABLE
VARIABLE-LATE
LATE
EARLY
DELETE
FHR VALUE
113
UC VALUE
NA
140
NA
LEN
MIN
MAX
AM
STD
MEAN
00:03:00
88
156
68
17.5999
135.1983
BEGIN
3:51:32
END
3:54:32
ZOOM IN
ZOOM OUT
GRID ON/OFF
SAVE FILE
LOAD FILE
QUIT
\Group_A\marked files select\21951.mat
614

FIG. 6A

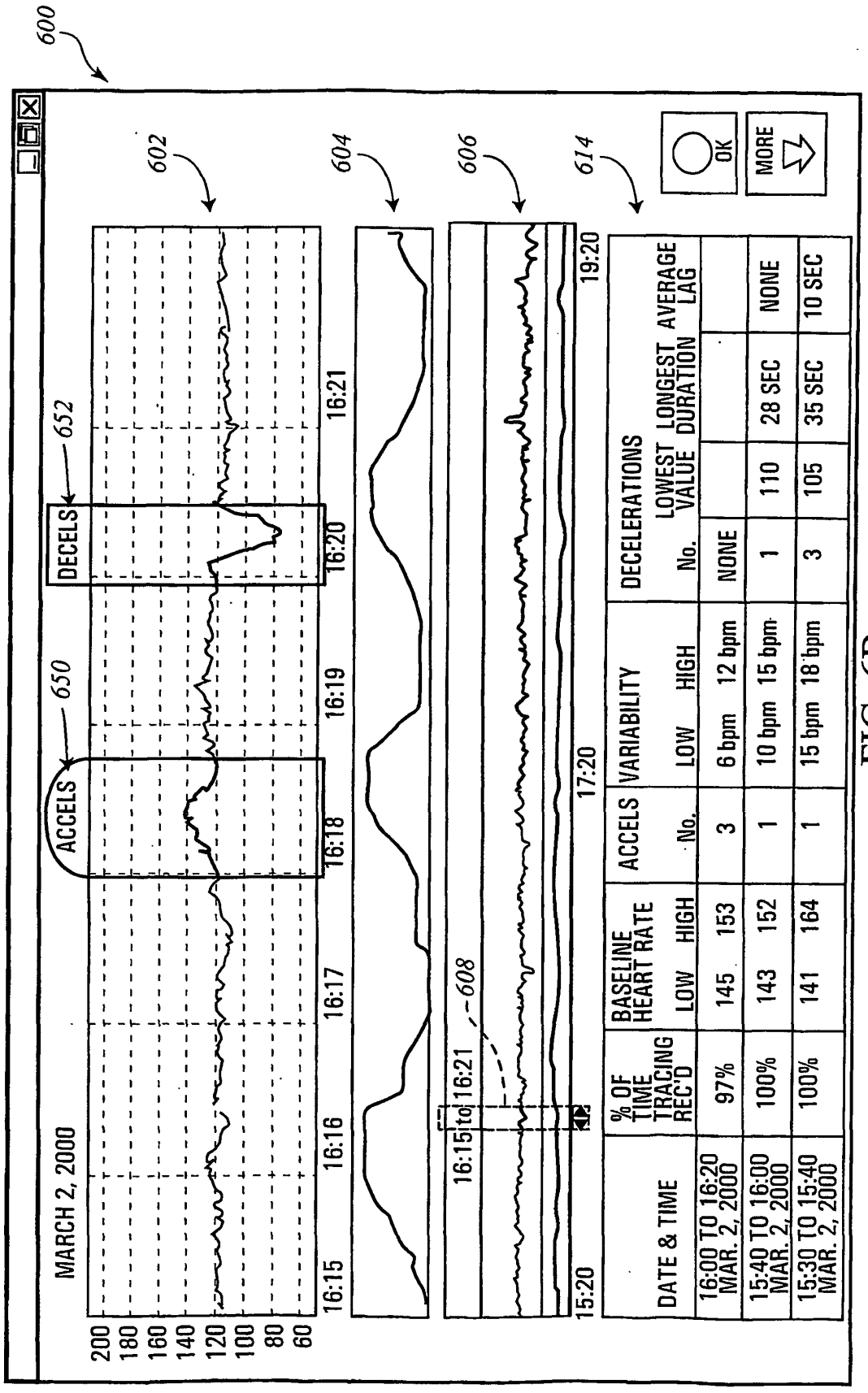
600
602
604
606
614
650
652
608
ACCELS
DECELS
MARCH 2, 2000
200
180
160
140
120
100
80
60
16:15
16:16
16:17
16:18
16:19
16:20
16:21
15:20
17:20
19:20
16:15 to 16:21
OK
MORE
DATE & TIME
% OF TIME TRACING REC'D
BASELINE HEART RATE LOW HIGH
ACCELS No.
VARIABILITY LOW HIGH
DECELERATIONS No.
LOWEST VALUE
LONGEST DURATION
AVERAGE LAG
16:00 TO 16:20 MAR. 2, 2000
97%
145 153
3
6 bpm 12 bpm
NONE
15:40 TO 16:00 MAR. 2, 2000
100%
143 152
1
10 bpm 15 bpm
1
110
28 SEC
NONE
15:30 TO 15:40 MAR. 2, 2000
100%
141 164
1
15 bpm 18 bpm
3
105
35 SEC
10 SEC

FIG. 6B

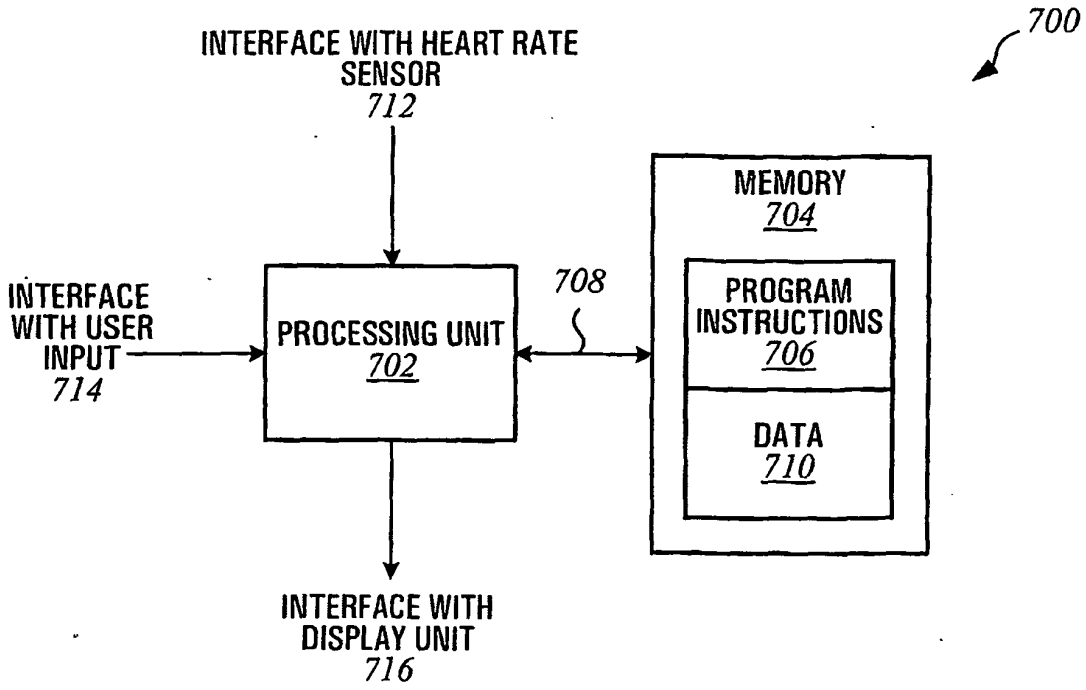
700
INTERFACE WITH HEART RATE SENSOR
712
MEMORY
704
PROGRAM INSTRUCTIONS
706
DATA
710
708
INTERFACE WITH USER INPUT
714
PROCESSING UNIT
702
INTERFACE WITH DISPLAY UNIT
716

FIG. 7

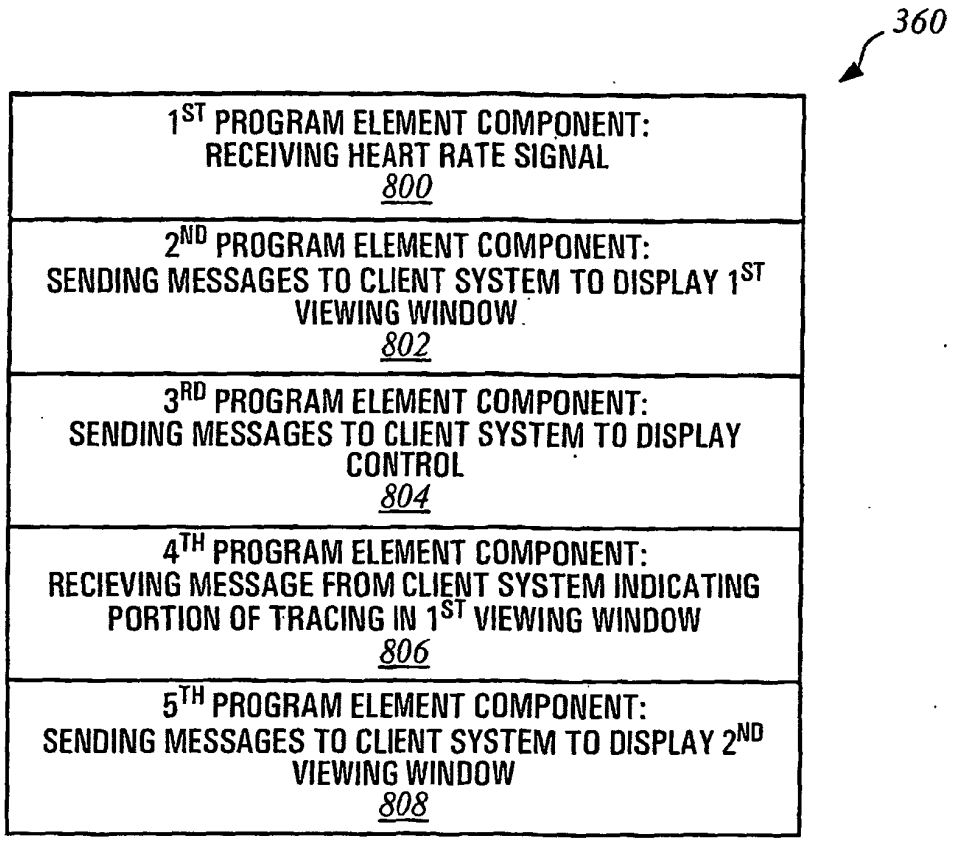
360
1ST PROGRAM ELEMENT COMPONENT:
RECEIVING HEART RATE SIGNAL
800
2ND PROGRAM ELEMENT COMPONENT:
SENDING MESSAGES TO CLIENT SYSTEM TO DISPLAY 1ST VIEWING WINDOW
802
3RD PROGRAM ELEMENT COMPONENT:
SENDING MESSAGES TO CLIENT SYSTEM TO DISPLAY CONTROL
804
4TH PROGRAM ELEMENT COMPONENT:
RECIEVING MESSAGE FROM CLIENT SYSTEM INDICATING PORTION OF TRACING IN 1ST VIEWING WINDOW
806
5TH PROGRAM ELEMENT COMPONENT:
SENDING MESSAGES TO CLIENT SYSTEM TO DISPLAY 2ND VIEWING WINDOW
808

FIG. 8

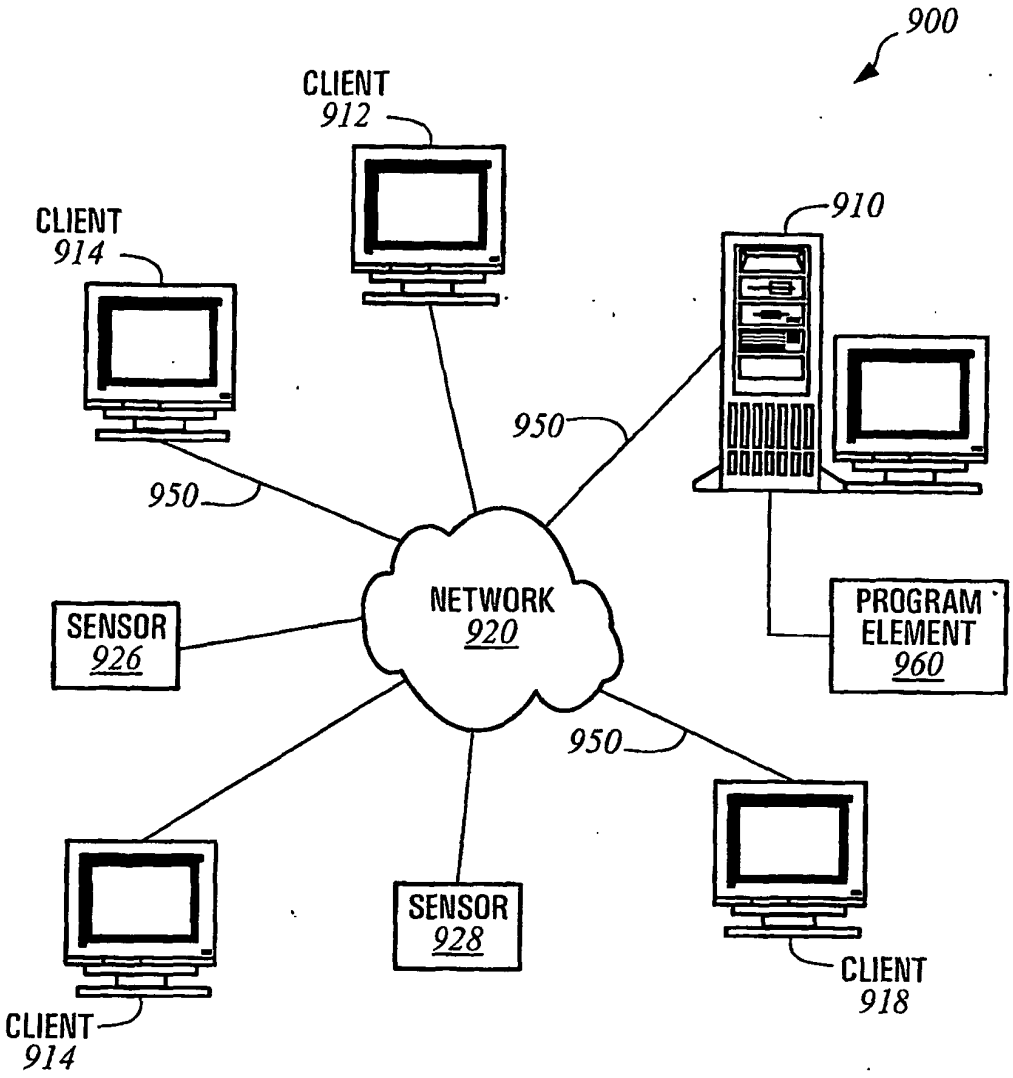
900
CLIENT
912
CLIENT
914
910
950
950
NETWORK
920
SENSOR
926
PROGRAM
ELEMENT
960
950
SENSOR
928
CLIENT
914
CLIENT
918

FIG. 9

| | | | |
|---|---|---|---|
| 专利名称(译) | 用于显示心率信号的方法和设备 | | |
| 公开(公告)号 | EP1505903B1 | 公开(公告)日 | 2005-12-28 |
| 申请号 | EP2003720046 | 申请日 | 2003-04-29 |
| [标]申请(专利权)人(译) | LMS医疗SYST | | |
| 申请(专利权)人(译) | LMS医疗系统，LTD. | | |
| 当前申请(专利权)人(译) | LMS医疗系统，LTD. | | |
| [标]发明人 | HAMILTON EMILY F<br>GLAUDE MICHAEL C<br>MACIESZCZAK MACIEJ<br>WARRICK PHILIP A | | |
| 发明人 | HAMILTON, EMILY, F.<br>GLAUDE, MICHAEL, C.<br>MACIESZCZAK, MACIEJ<br>WARRICK, PHILIP, A. | | |
| IPC分类号 | A61B5/00 A61B5/024 G06F3/048 | | |
| CPC分类号 | A61B5/024 A61B5/7445 A61B5/748 | | |
| 优先权 | 2384516 2002-05-03 CA<br>10/138303 2002-05-03 US | | |
| 其他公开文献 | EP1505903A2 | | |
| 外部链接 | Espacenet | | |


摘要(译)

提供了一种实现用于显示心率信息的图形用户界面的系统和装置。图形用户界面在第一观察窗口中显示指示心率信号的第一追踪。图形用户界面显示允许用户选择第一个跟踪的一部分的控件。在与第一观察窗口同时显示的第二观察窗口中，图形用户界面显示第二追踪，该第二追踪是第一追踪的所选部分的放大视图。在特定实现中，控件包括选择框，该选择框具有叠加在第一观察窗口上的透明部分。可通过透明部分看到的第一跟踪的部分对应于第二跟踪。该控件允许用户替换和修改选择框的大小以选择第一个跟踪的一部分。


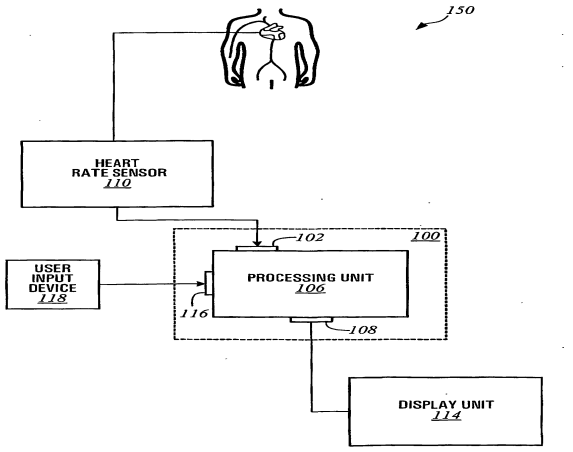


FIG. 1