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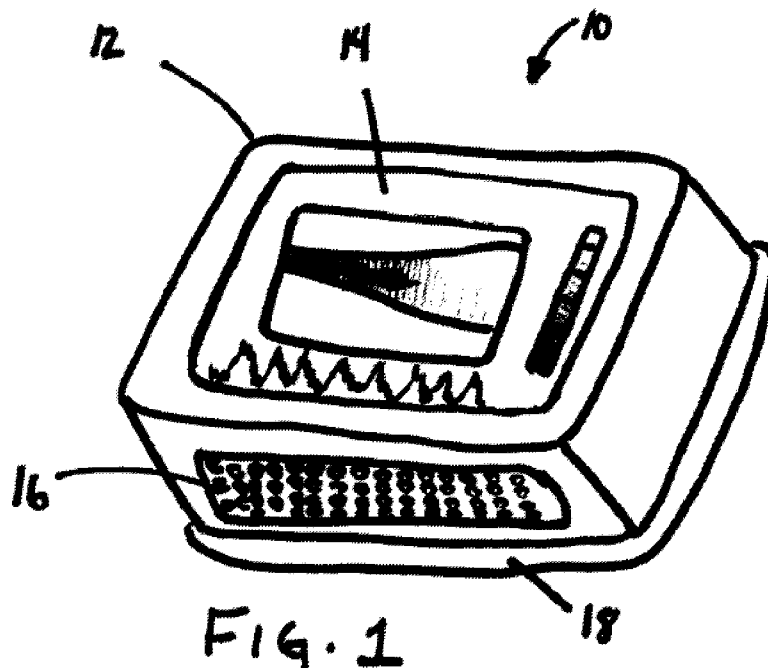
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(54) Title: PULSE DETECTOR



(57) Abstract: The present invention is directed to a small, portable ultrasound color Doppler device. The device can be applied and retained over a pulse point, such as the neck or foot, in order to detect and monitor pulse. The device is also configured to detect pulse strength, in some instances. For example, if the device is placed on the neck over the carotid pulse, it is capable of detecting carotid pulse, but also pulse strength. The device is hands-free after it is applied to the skin over the pulse point. Therefore, the device can be used to continuously assess pulse flow during CPR and after vascular surgery.

PULSE DETECTOR

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No.
5 61/905,478, filed November 18, 2013, which is incorporated by reference herein, in its
entirety.

FIELD OF THE INVENTION

[0002] The present invention relates generally to medical devices. More particularly, the
present invention relates to a device for detecting a pulse in a subject.

BACKGROUND OF THE INVENTION

10 [0003] It is very difficult to assess presence of pulse during a low-flow state of
cardiopulmonary resuscitation (CPR). During the low-flow state of CPR cardiac output and
pulmonary blood flow are approximately 25% of that during normal sinus rhythm. The goal
of effective CPR is to optimize coronary and cerebral perfusion and blood flow to critical
15 organs during the low-flow phase.

[0004] A challenge to providing quality CPR is trying to “feel” a pulse during CPR or after
vascular surgery, which is not reliable and is associated with interruptions in CPR. In the
current state of the art, one could monitor pulse during CPR and after vascular surgery with a
handheld Doppler device. However, such devices provide no visual representation of the
20 pulse, which could be problematic in environments that are noisy and chaotic. Additionally,
the Doppler devices currently on the market are hands on, and require a person at a CPR
event to use at least one hand to hold and operate the device.

[0005] Accordingly, there is a need in the art for a device for pulse detection having a visual feedback and hands-free operation.

SUMMARY OF THE INVENTION

[0006] The foregoing needs are met by the present invention which provides a device for
5 detection of pulse in a subject including a housing defining an interior space and having a wall surrounding the interior space. The device includes a Doppler device configured to detect the pulse of the subject and disposed within the interior space of the housing.

Additionally, the device includes an ultrasound color flow screen disposed on a face of the wall surrounding the interior space. The device also includes a speaker disposed on another
10 face of the wall surrounding the interior space and a gel pad disposed on a face of the wall surrounding the interior space such that the gel pad allows for sound communication between the Doppler device and the subject.

[0007] In accordance with an aspect of the present invention, the device for detection of pulse includes a first speaker and a second speaker disposed on opposite faces of the wall
15 surrounding the interior space. A user interface can also be included, as well as a processor. The device for detection of pulse in a subject can also include a touch screen configured for user input and integrated into the ultrasound color flow display.

[0008] In accordance with another aspect of the present invention, the device includes a non-transitory computer readable medium. The gel pad can include adhesive properties. The
20 gel pad further takes the form of a removable and replaceable gel pad. The housing is formed from a plastic. The ultrasound color flow display screen includes a display of a waveform representation of the subject's pulse. The non-transitory computer readable medium is programmed to display the waveform representation of the subject's pulse in unison with the ultrasound color flow display. The non-transitory computer readable medium is further

programmed to play a sound in unison with the subject's pulse. The sound can take the form of a beep or the sound of the subject's pulse. The ultrasound color flow display screen includes a display of duration of CPR, a visual display of the artery at the pulse point, a gradient scale for decoding blood flow through the artery at the pulse point. The device can include a user input for information about the subject. The device is configured to sit on a pulse point of the patient. The adhesive properties of the gel pad allow the device to be repositioned on the subject in order to isolate the pulse point.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The accompanying drawings provide visual representations, which will be used to more fully describe the representative embodiments disclosed herein and can be used by those skilled in the art to better understand them and their inherent advantages. In these drawings, like reference numerals identify corresponding elements and:

[0010] FIG. 1 illustrates a perspective view of a pulse detecting device according to an embodiment of the present invention.

[0011] FIG. 2 illustrates a perspective view of the pulse detecting device in a preferred placement on a neck of a subject, according to an embodiment of the present invention.

[0012] FIG. 3 illustrates a perspective view of a bottom side of the pulse detecting device, according to an embodiment of the present invention.

[0013] FIG. 4 illustrates a schematic diagram of a display for the pulse detecting device, according to an embodiment of the present invention.

[0014] FIG. 5 illustrates a flow diagram showing a method of use of the pulse detecting device, according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0015] The presently disclosed subject matter now will be described more fully hereinafter with reference to the accompanying Drawings, in which some, but not all

embodiments of the inventions are shown. Like numbers refer to like elements throughout. The presently disclosed subject matter may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Indeed, many
5 modifications and other embodiments of the presently disclosed subject matter set forth herein will come to mind to one skilled in the art to which the presently disclosed subject matter pertains, having the benefit of the teachings presented in the foregoing descriptions and the associated Drawings. Therefore, it is to be understood that the presently disclosed subject matter is not to be limited to the specific embodiments disclosed and that
10 modifications and other embodiments are intended to be included within the scope of the appended claims.

[0016] The present invention is directed to a small, portable ultrasound color Doppler device. The device can be applied and retained over a pulse point, such as the neck or foot, in order to detect and monitor pulse. The device is also configured to detect pulse strength, in
15 some instances. For example, if the device is placed on the neck over the carotid pulse, it is capable of detecting carotid pulse, but also pulse strength. The device is hands-free after it is applied to the skin over the pulse point. Therefore, the device can be used to continuously detect and assess pulse flow during CPR and after vascular surgery. The device can also be used to determine quality of CPR.

20 **[0017]** More particularly, the device for detecting pulse is a small rectangular device having an ultrasound color flow screen on one side and a gel containing pouch disposed on the opposite side. The other sides of the device can include speakers for broadcasting the Doppler sounds to the person(s) monitoring the device for detecting pulse. Once the device

for detecting pulse is applied onto the skin over a pulse point, such as the carotid or dorsalis pedis, it will provide a color-flow display on the screen and Doppler sound, simultaneously.

[0018] FIG. 1 illustrates a perspective view of a pulse detecting device according to an embodiment of the present invention. The pulse detecting device 10 includes an outer

5 housing 12. The outer housing 12 is shown having a generally rectangular shape, however this is merely by way of example, and the device could take any shape suitable. The housing 12 defines an opening for holding a display screen 14. The display screen 14 can show the user a variety of different metrics such as pulse rate, duration of CPR, visual display of the artery at the pulse point, a gradient scale for decoding blood flow through the artery at the
10 pulse point, or any other suitable metric known to or conceivable by one of skill in the art. In some embodiments of the invention the pulse detecting device can include a touch screen for inputting relevant information, such as patient data and purpose of use (i.e. CPR or monitoring post vascular surgery). In other embodiments the housing 12 can also define openings for buttons for uses such as to input information and to start or stop the device 10.

15 **[0019]** As illustrated in FIG. 1, the housing 12 also defines openings for at least one speaker 16 for playing the sounds detected by the ultrasound system disposed within the housing (not shown). Additionally, the device 10 includes a gel pad 18 disposed opposite the display screen 14. The gel pad 18 allows for transmission of the sound waves into the patient and detection of the sound waves bounced back to the device 10. The gel pad 18 can also
20 include adhesive properties in order to hold the device on the patient's pulse point. The gel pad can take any suitable form known to or conceivable by one of skill in the art.

[0020] The device 10 can also include a microprocessor or solid state drive disposed within the housing 12. The microprocessor or solid state drive is used to process the data provided

by the ultrasound device for display and transmission through the display screen 14 and the speaker 16. The microprocessor or solid state drive can also be programmed to utilize data such as patient data, CPR or post vascular surgery duration data, for instance, to display alerts or updates on the display.

5 [0021] FIG. 2 illustrates a perspective view of the pulse detecting device in a preferred placement on a neck of a subject, according to an embodiment of the present invention. The pulse detecting device 10 can be positioned on the neck 20 of the patient 22 over a pulse point, such that the device detects the carotid pulse. Alternately, the device 10 can be positioned over any other suitable pulse point, such as a wrist of the patient. The device 10
10 can be positioned in any suitable way that allows the CPR provider or a CPR assistant to view the display 14 and hear the feedback regarding the pulse of the patient. The device 10 can include a gel pad 18, which allows for transmission of the sound waves into the patient and detection of the soundwaves as bounced back from the patient to the device. The gel pad 18 can also include adhesive properties, such that the CPR administrator or assistant do not
15 have to continuously hold the device to the pulse point of the patient. The adhesive properties of the gel pad can also be such that the device 10 can be repositioned and re-adhered, if necessary to capture data from the pulse point.

[0022] FIG. 3 illustrates a perspective view of a bottom side of the pulse detecting device, according to an embodiment of the present invention. As illustrated in FIG. 3, the gel pad 18
20 is coupled to a bottom surface of the device 10. The gel pad 18 can be coupled to the device with an adhesive, or any other suitable means of coupling the gel pad 18 to the device. The gel pad 18 can also be removable and replaceable, such that the device can be used for more than one patient.

[0023] FIG. 4 illustrates a schematic diagram of a display for the pulse detecting device, according to an embodiment of the present invention. The display screen 14 can show the user a variety of different metrics such as pulse rate, duration of CPR, visual display of the artery at the pulse point, a gradient scale for decoding blood flow through the artery at the pulse point, or any other suitable metric known to or conceivable by one of skill in the art. In some embodiments of the invention the pulse detecting device can include a touch screen for inputting relevant information, such as patient data and purpose of use (i.e. CPR or monitoring post vascular surgery). As illustrated in FIG. 4, in one embodiment, the display can include a color Doppler view of blood flow 24, a waveform display of the pulse 26, and a color key 28 for interpreting the color Doppler view of blood flow 24.

[0024] FIG. 5 illustrates a flow diagram showing a method of use of the pulse detecting device, according to an embodiment of the present invention. A method 100 according to an embodiment of the present invention includes a step 102 of placement of the device over a pulse point of the patient. The method 100 includes a step 104 of monitoring the patient's pulse using the display of the device and also sound transmission provided by the device. The method 100 also includes a step 106 of administering CPR while continuing to monitor the patient pulse using the display and the sound transmission provided by the device.

[0025] It should be noted that any computer application associated with the execution of the present invention is programmed onto a non-transitory computer readable medium that can be read and executed by any of the computing devices mentioned in this application. The non-transitory computer readable medium can take any suitable form known to one of skill in the art. The non-transitory computer readable medium is understood to be any article of manufacture readable by a computer. Such non-transitory computer readable media includes, but is not limited to, magnetic media, such as floppy disk, flexible disk, hard, disk, reel-to-reel tape, cartridge tape, cassette tapes or cards, optical media such as CD-ROM, DVD, blu-

ray, writable compact discs, magneto-optical media in disc, tape, or card form, and paper media such as punch cards or paper tape. Alternately, the program for executing the method and algorithms of the present invention can reside on a remote server or other networked device. If it is necessary to transmit information from the device, all of the information is transmitted either wired or wirelessly over a network, via the internet, cellular telephone network, or any other suitable data transmission means known to or conceivable by one of skill in the art. The non-transitory computer readable medium can be programed onto a

[0026] The many features and advantages of the invention are apparent from the detailed specification, and thus, it is intended by the appended claims to cover all such features and advantages of the invention which fall within the true spirit and scope of the invention.

Further, since numerous modifications and variations will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed is:

1. A device for detection of pulse in a subject comprising:

a housing defining an interior space and having a wall surrounding the interior space;

a Doppler device configured to detect the pulse of the subject and disposed within the

5 interior space of the housing;

an ultrasound color flow display screen disposed on a face of the wall surrounding the interior space;

a speaker disposed on another face of the wall surrounding the interior space; and

a gel pad disposed on a face of the wall surrounding the interior space such that the

10 gel pad allows for sound communication between the Doppler device and the subject.

2. The device for detection of pulse in a subject of claim 1 further comprising a first

speaker and a second speaker disposed on opposite faces of the wall surrounding the interior space.

15

3. The device for detection of pulse in a subject of claim 1 further comprising a user interface.

4. The device for detection of pulse in a subject of claim 1 further comprising a

20 microprocessor.

5. The device for detection of pulse in a subject of claim 1 further comprising the ultrasound color flow display screen comprising a touch screen configured for user input.

6. The device for detection of pulse in a subject of claim 1 further comprising a non-transitory computer readable medium.

7. The device for detection of pulse in a subject of claim 1 wherein the gel pad further
5 comprises adhesive properties.

8. The device for detection of pulse in a subject of claim 1 wherein the gel pad further comprises a removable and replaceable gel pad.

9. The device for detection of pulse in a subject of claim 1 wherein the housing is
10 formed from a plastic.

10. The device for detection of pulse in a subject of claim 1 wherein the ultrasound color flow display screen includes a display of a waveform representation of the subject's pulse.

11. The device for detection of pulse in a subject of claim 10 further comprising a non-transitory computer readable medium being programmed to display the waveform
15 representation of the subject's pulse in unison with the ultrasound color flow display.

12. The device for detection of pulse in a subject of claim 6 wherein the non-transitory
20 computer readable medium is further programmed to play a sound in unison with the subject's pulse.

13. The device for detection of pulse in a subject of claim 12 wherein the sound
25 comprises a beep.

14. The device for detection of pulse in a subject of claim 12 wherein the sound comprises the sound of the subject's pulse.

15. The device for detection of pulse in a subject of claim 1 wherein the ultrasound color flow display screen comprises a display of duration of CPR.

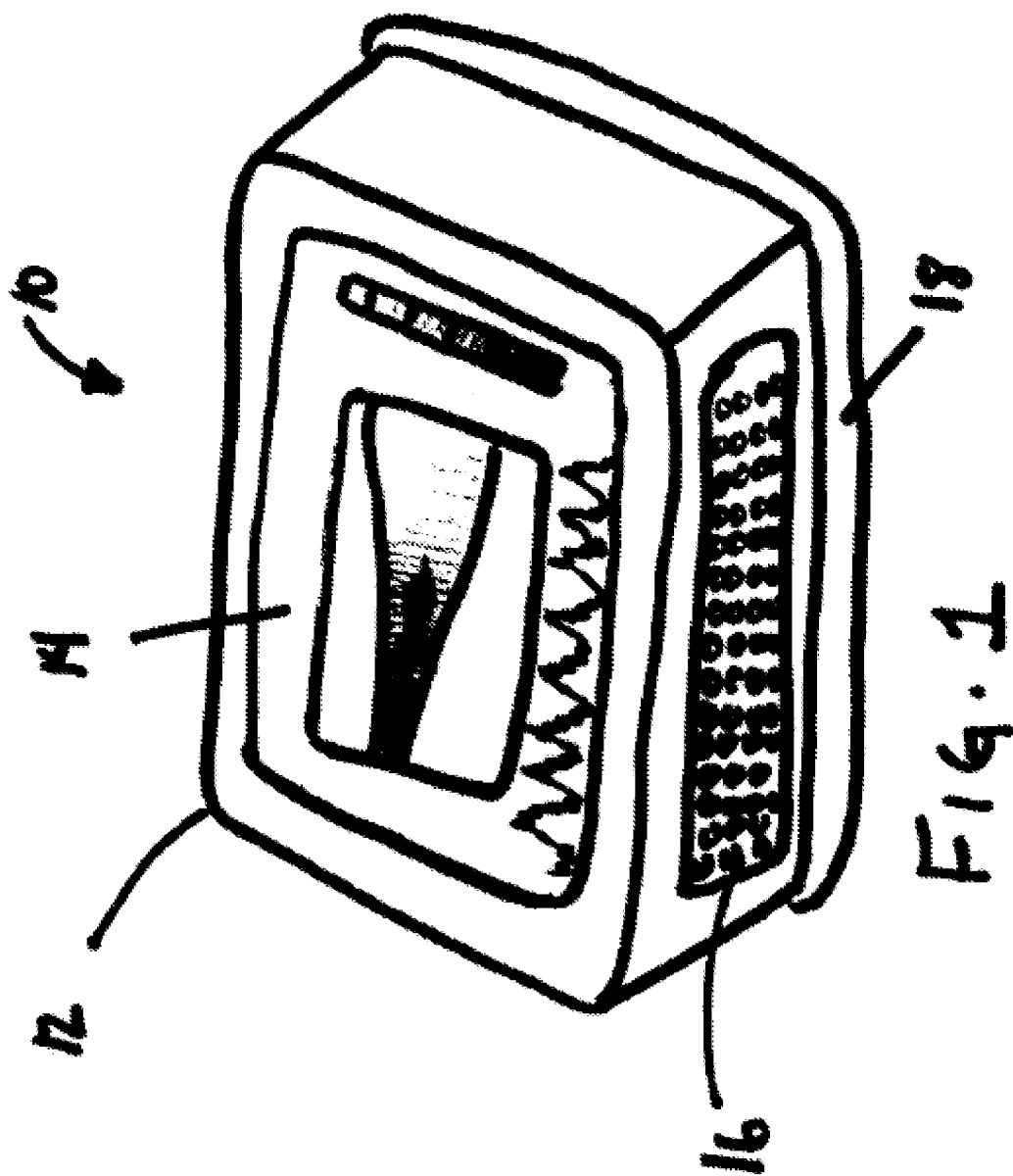
16. The device for detection of pulse in a subject of claim 1 wherein the ultrasound color flow display screen comprises a visual display of the artery at the pulse point.

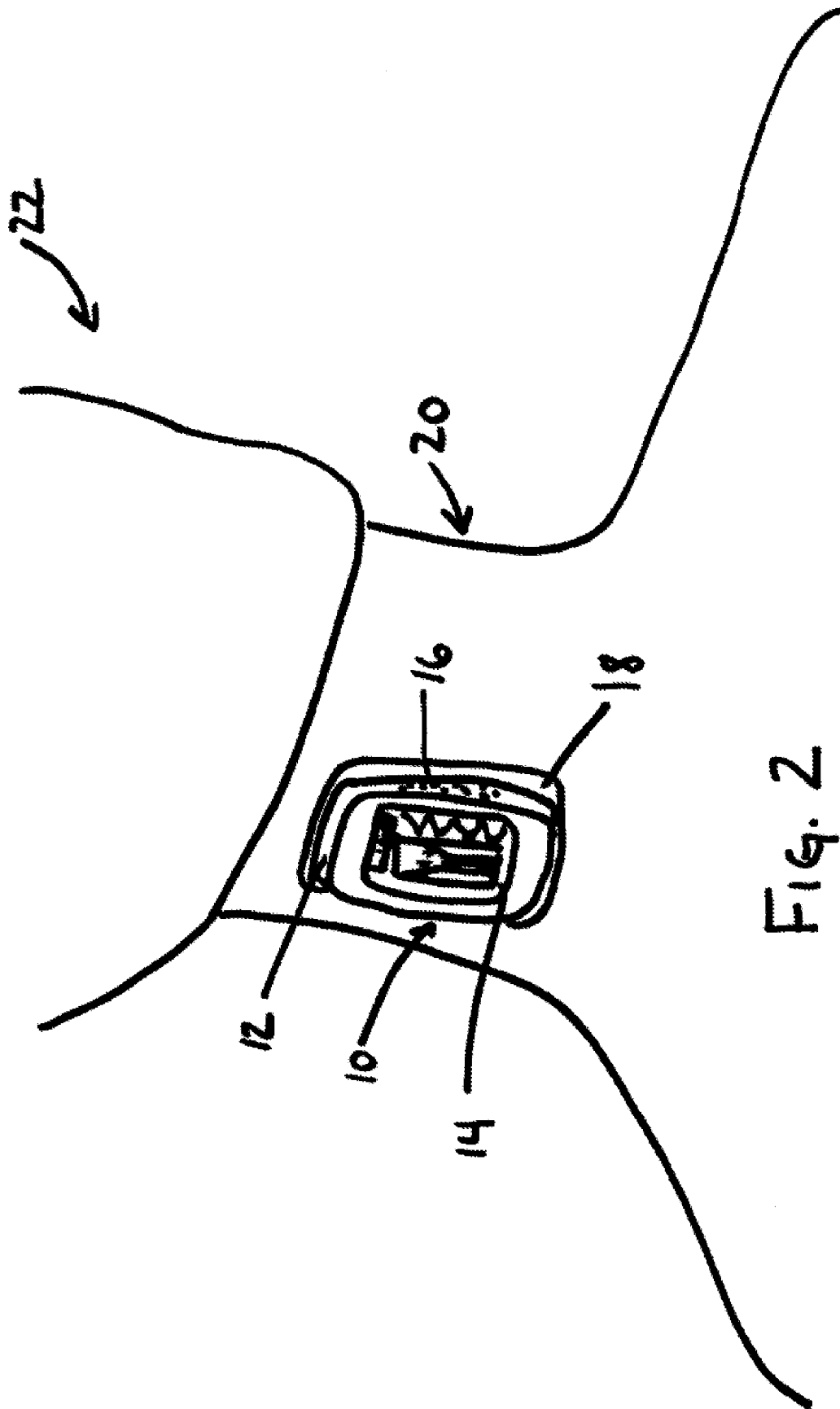
17. The device for detection of pulse in a subject of claim 1 wherein the ultrasound color flow display screen comprises a gradient scale for decoding blood flow through the artery at the pulse point.

18. The device for detection of pulse in a subject of claim 1 wherein the device includes a user input for information about the subject.

19. The device for detection of pulse in a subject of claim 1 further comprising the device being configured to sit on a pulse point of the patient.

20. The device for detection of pulse in a subject of claim 7 wherein the adhesive properties allow the device to be repositioned on the subject in order to isolate the pulse point.





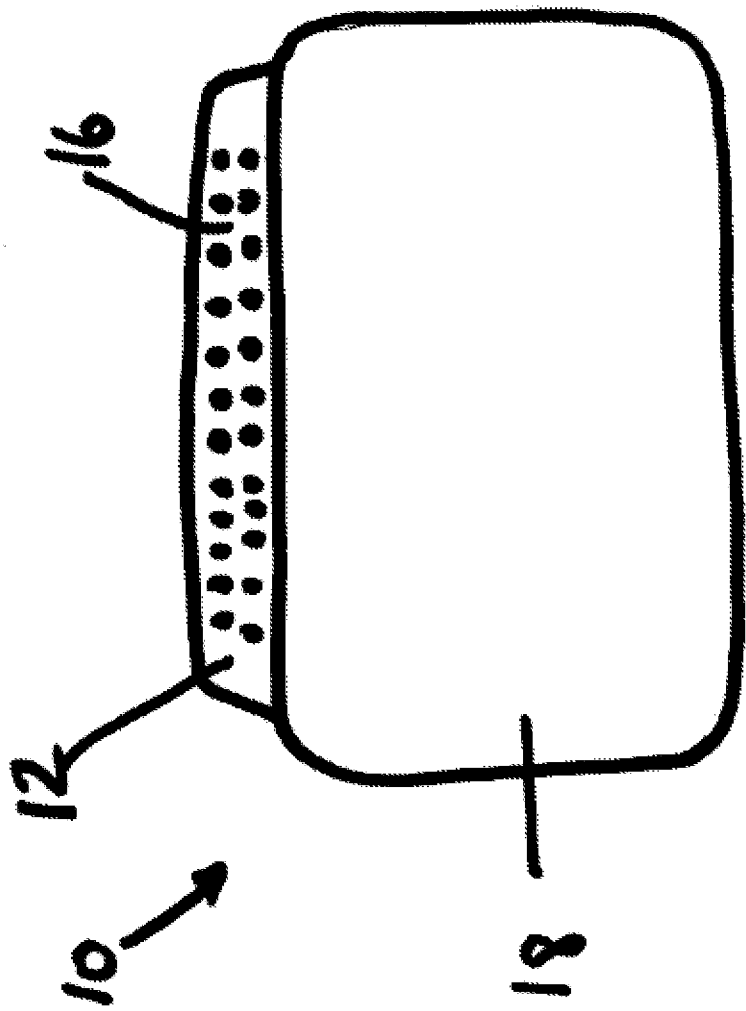
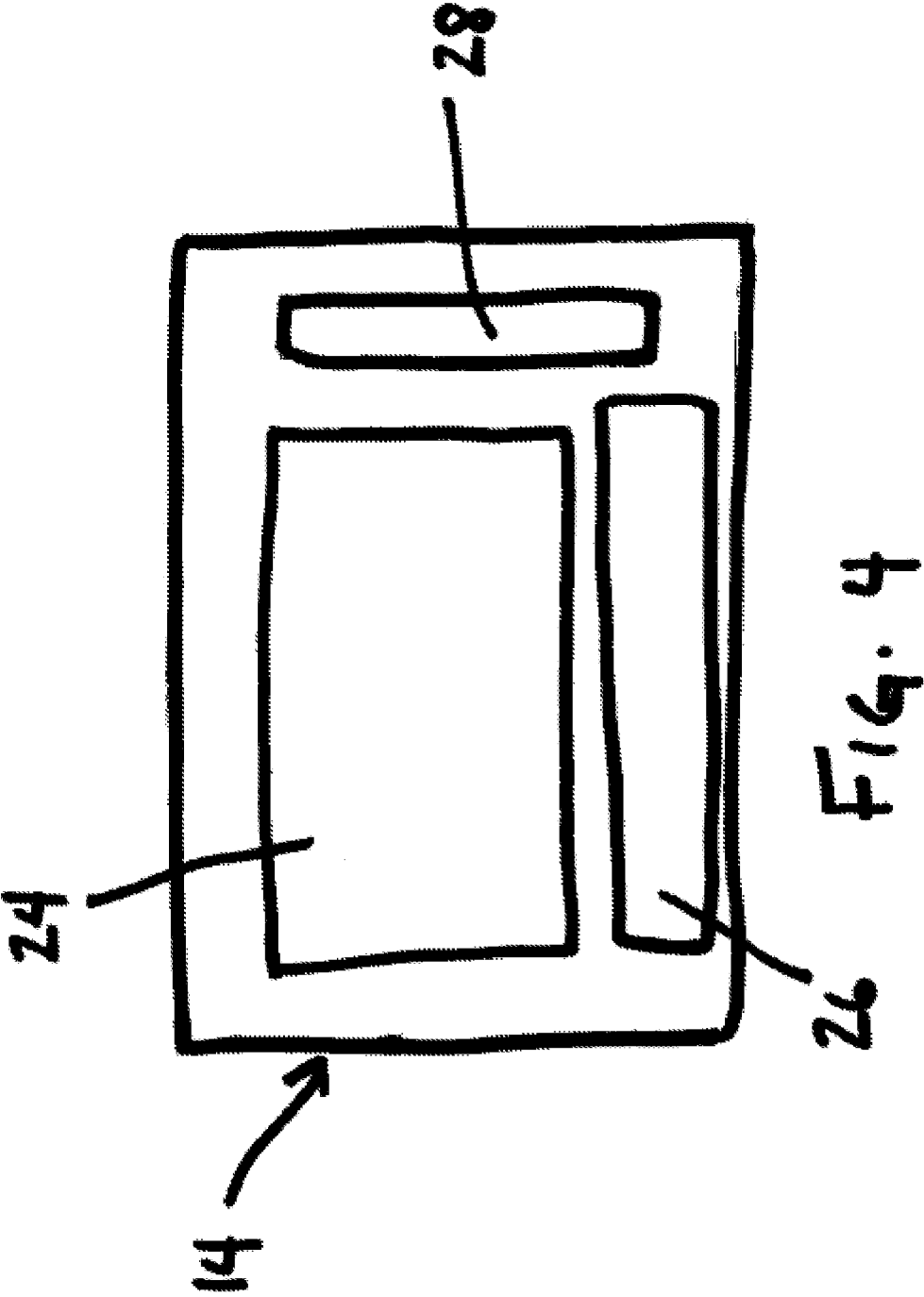
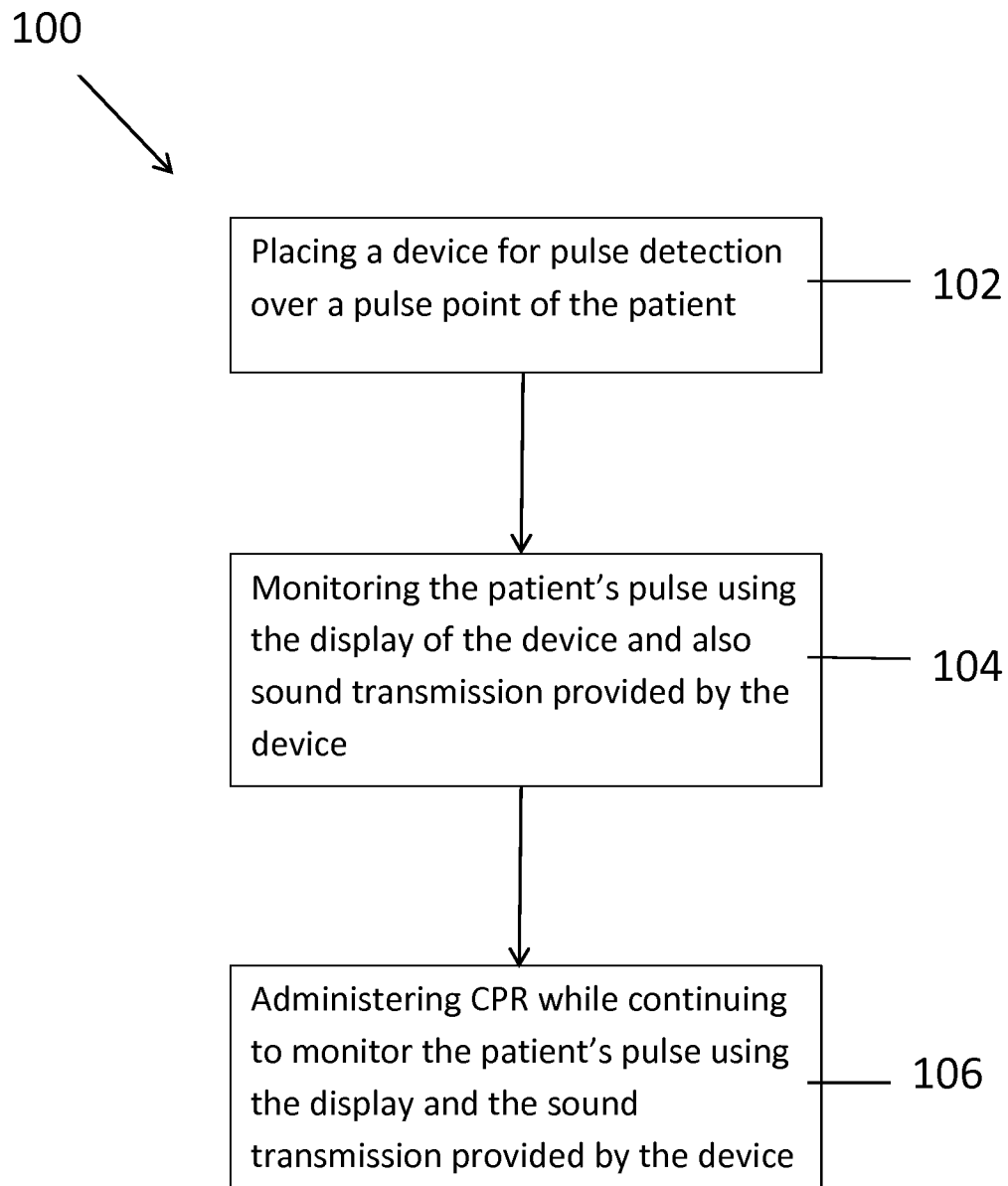


Fig. 3



**FIG. 5**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/066059**A. CLASSIFICATION OF SUBJECT MATTER****A61B 8/02(2006.01)i, A61N 1/38(2006.01)i, A61N 1/08(2006.01)i, A61H 31/00(2006.01)i**

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61B 8/02; A61B 5/05; A61B 5/02; A61B 5/02; G08B 23/00; A61N 1/38; A61N 1/08; A61H 31/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & keywords: doppler, gel pad, ultrasound, pulse, speaker, color, flow

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012-0245464 A1 (BAO TRAN) 27 September 2012 See abstract, paragraphs [0041],[0165]-[0318], claim 1 and figures 1-14.	1-20
A	WO 2008-042559 A2 (KONINKLIJKE PHILIPS ELECTRONICS N. V. et al.) 10 April 2008 See abstract, pages 3-8 and figures 1-4.	1-20
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A	US 2009-0306525 A1 (ROBERT PINTER et al.) 10 December 2009 See abstract, claims 1-18 and figures 1-4.	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Information on patent family members

International application No.

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