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(54) **ULTRASOUND DIAGNOSIS APPARATUS, WEARABLE DEVICE, METHOD OF CONTROLLING  
ULTRASOUND DIAGNOSIS APPARATUS, METHOD OF CONTROLLING WEARABLE DEVICE,  
AND RECORDING MEDIUM HAVING METHODS RECORDED THEREON**

ULTRASCHALLDIAGNOSEVORRICHTUNG, TRAGBARE VORRICHTUNG, VERFAHREN ZUR  
STEUERUNG DER ULTRASCHALLDIAGNOSEVORRICHTUNG, VERFAHREN ZUR STEUERUNG  
DER TRAGBAREN VORRICHTUNG UND AUFZEICHNUNGSMEDIUM MIT DARAUFGESPEICHERTEN  
VERFAHREN

APPAREIL DE DIAGNOSTIC À ULTRASON, DISPOSITIF PORTABLE, PROCÉDÉ DE COMMANDE  
D'ULTRASON, APPAREIL DE DIAGNOSTIC, PROCÉDÉ DE COMMANDE D'UN DISPOSITIF  
PORTABLE ET SUPPORT D'ENREGISTREMENT AYANT DES PROCÉDÉS ENREGISTRÉS SUR  
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(73) Proprietor: **SAMSUNG MEDISON CO., LTD.  
Hongcheon-gun, Gangwon-do (KR)**

(72) Inventors:  
• **Yang, Sun-mo**  
**Gangwon-do (KR)**  
• **Park, Jin-hwan**  
**Gangwon-do (KR)**

- **Yoo, Jun-sang**  
**Gangwon-do (KR)**
- **Lee, Kwang-hee**  
**Gangwon-do (KR)**
- **Lee, Seung-ju**  
**Gangwon-do (KR)**
- **Hwang, Yoon-gu**  
**Gangwon-do (KR)**

(74) Representative: **Hylarides, Paul Jacques et al**  
**Arnold & Siedsma**  
**Bezuidenhoutseweg 57**  
**2594 AC Den Haag (NL)**

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## Description

### BACKGROUND

#### 1. Field

**[0001]** One or more exemplary embodiments relate to an ultrasound diagnosis apparatus, a method of controlling the ultrasound diagnosis apparatus, a wearable device for transmitting or receiving data to or from the ultrasound diagnosis apparatus, and a method of controlling the wearable device.

#### 2. Description of the Related Art

**[0002]** Ultrasound diagnosis apparatuses transmit ultrasound signals generated by transducers of a probe to an object and receive echo signals reflected from the object, thereby obtaining at least one image of an internal part of the object (e.g., soft tissue or blood flow). In particular, ultrasound diagnosis apparatuses are used for medical purposes including observing an internal area of an object, detecting foreign substances, and assessing injuries. Such ultrasound diagnosis apparatuses provide high stability, display images in real time, and are safe due to no radiation exposure, compared to X-ray apparatuses. Therefore, an ultrasound diagnosis apparatus is widely used together with other types of imaging diagnosis apparatus including a computed tomography (CT) apparatus, a magnetic resonance imaging (MRI) apparatus, and the like.

**[0003]** WO2014054810 discloses an ultrasonic diagnostic device that transmits a warning to the external terminal device.

**[0004]** CN203506759U discloses a novel fetal heart rate monitoring device connected with a display wrist strap device through wireless signals.

**[0005]** Wearable devices refer to all types of electronic devices that are worn on the body to perform computing tasks. Since wearable devices communicate with a user near the user, they have various advantages and are being actively developed all over the world. Examples of wearable devices include a digital armband for checking a user's health and fitness status, a smartwatch that incorporates the functionality of a smartphone into an actual watch, and smart glasses that combine eye glasses with a smartphone. Due to their benefits, there is demand for wearable devices in the field of medical equipment.

### SUMMARY

**[0006]** One or more exemplary embodiments include an ultrasound diagnosis apparatus and a method of controlling the ultrasound diagnosis apparatus and a wearable device and a method of controlling the wearable device, which allow a user to easily recognize information that is generated based on a signal acquired by the ultrasound diagnosis apparatus through the wearable de-

vice via which the information is output.

**[0007]** Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the presented exemplary embodiments.

**[0008]** According to one or more exemplary embodiments, an ultrasound diagnosis apparatus includes: an image processor configured to acquire ultrasound data of an object; a controller configured to generate a wearable signal carrying information corresponding to a difference between the acquired ultrasound data and reference ultrasound data; and a (first) communication module configured to transmit the wearable signal to a wearable device.

**[0009]** The acquired ultrasound data may include ultrasound Doppler data, and the controller may compare first Doppler spectrum data corresponding to the ultrasound Doppler data with second Doppler spectrum data corresponding to the reference ultrasound data, thereby generating the wearable signal based on differences between values of the first and second Doppler spectrum data.

**[0010]** The controller may adjust the intensity of the wearable signal based on the differences between the values of the first and second Doppler spectrum data.

**[0011]** The controller may adjust the intensity of the wearable signal based on differences between peak values.

**[0012]** The controller may determine an item requiring examination of the object based on the differences between the peak values and control the wearable device to display the determined item.

**[0013]** If at least one of the differences between the peak values exceeds a predetermined reference value, the controller may control the wearable device to generate an alarm.

**[0014]** The image processor may acquire ultrasound Doppler data of the object, and the controller may compare a period in a first graph representing a Doppler spectrum corresponding to the acquired ultrasound Doppler data with a period in a second graph representing a Doppler spectrum obtained from predetermined ultrasound data and, if a difference between the periods in the first and second graphs exceeds a predetermined reference value, control the wearable device to generate an alarm.

**[0015]** The image processor may acquire ultrasound color data of the object, and the controller may compare the acquired ultrasound color data with predetermined ultrasound color data, thereby generating a wearable signal based on a difference in color between the acquired ultrasound color data and the predetermined ultrasound color data.

**[0016]** Based on the difference in color, the controller may control the wearable device to display the acquired ultrasound color data in a color corresponding to the difference in color.

**[0017]** If a value corresponding to the difference in color is greater than a predetermined reference value,

the controller may control the wearable device to generate an alarm.

**[0018]** The reference ultrasound data may include standard ultrasound data and history ultrasound data of the object.

**[0019]** The ultrasound diagnosis apparatus may further include a wearable device configured to receive the wearable signal transmitted from the communication module, convert the wearable signal into at least one selected from the intensity of vibration, variation in color, and strength of sound, and output the at least one result obtained by the conversion.

**[0020]** According to one or more exemplary embodiments, a wearable device includes: a (second) communication module configured to receive a wearable signal carrying information corresponding to a difference between acquired ultrasound data and reference ultrasound data; and an output unit configured to output a user interface signal corresponding to the difference based on the wearable signal.

**[0021]** The output unit may include a vibration motor configured to output, based on the difference, a vibration that has varying intensity according to the wearable signal.

**[0022]** The output unit may include a display configured to output, based on the difference, a screen depicting the wearable signal as a variation in color.

**[0023]** The output unit may further include an audio output unit configured to output, based on the difference, an audio signal representing the wearable signal as strength of sound.

**[0024]** According to one or more exemplary embodiments, a method of controlling an ultrasound diagnosis apparatus includes: acquiring ultrasound data of an object; generating a wearable signal carrying information corresponding to a difference between the acquired ultrasound data and reference ultrasound data; and transmitting the wearable signal to a wearable device.

**[0025]** According to the one or more exemplary embodiments, a user may easily determine a status of an object by sensing the status through the skin or vision by comparing ultrasound data of an object against reference data via a wearable device.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0026]** These and/or other aspects will become apparent and more readily appreciated from the following description of the exemplary embodiments, taken in conjunction with the accompanying drawings in which:

FIG. 1 is a block diagram of a configuration of an ultrasound diagnosis apparatus according to an exemplary embodiment;

FIG. 2 is a diagram for explaining representation of ultrasound Doppler data via a wearable device;

FIG. 3 is a diagram for explaining representation of ultrasound color data via a wearable device;

FIG. 4 is a block diagram of a configuration of an ultrasound diagnosis apparatus according to another exemplary embodiment;

FIG. 5 is a block diagram of a configuration of a wearable device according to an exemplary embodiment; FIG. 6 is a diagram for explaining a signal generated based on a difference between reference ultrasound data and acquired ultrasound data

FIG. 7 illustrates a comparison between elastography images showing tissue stiffness;

FIG. 8 is a flowchart of a method of controlling an ultrasound diagnosis apparatus according to an exemplary embodiment;

FIG. 9 is a diagram for explaining exchange of signals between an ultrasound diagnosis apparatus and a wearable device;

FIG. 10 is a diagram for explaining a form in which a wearable signal is output via an output unit of a wearable device; and

FIGS. 11A through 11D are a diagram for explaining conversion of a signal generated based on a difference between acquired ultrasound data and reference ultrasound data into a user interface signal.

#### DETAILED DESCRIPTION

**[0027]** Reference will now be made in detail to exemplary embodiments, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The exemplary embodiments are not intended to limit the present disclosure but to aid in the understanding of implementation of the embodiments. In the present description, well-known functions and components will not be described so as not to unnecessarily obscure the essence of the present disclosure. Expressions such as "at least one of," when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list.

**[0028]** Hereinafter, the terms used in the specification will be briefly described, and then the present disclosure will be described in detail.

**[0029]** The terms used in this specification are those general terms currently widely used in the art in consideration of functions regarding the inventive concept, but the terms may vary according to the intention of those of ordinary skill in the art, precedents, or new technology in the art. Also, some terms may be arbitrarily selected by the applicant, and in this case, the meaning of the selected terms will be described in detail in the detailed description of the present specification. Thus, the terms used in the specification should be understood not as simple names but based on the meaning of the terms and the overall description of the present disclosure.

**[0030]** When a part "includes" or "comprises" an element, unless there is a particular description contrary thereto, the part can further include other elements, not excluding the other elements. In addition, terms such as

"... unit", "... module", or the like refer to units that perform at least one function or operation, and the units may be implemented as hardware or software or as a combination of hardware and software.

**[0031]** Throughout the specification, an "ultrasound image" refers to an image of an object, which is obtained using ultrasound waves. Furthermore, an "object" may be a human, an animal, or a part of a human or animal. For example, the object may be an organ (e.g., the liver, heart, womb, brain, breast, or abdomen), a blood vessel, or a combination thereof. Also, the object may be a phantom. The phantom means a material having a density, an effective atomic number, and a volume that are approximately the same as those of an organism. For example, the phantom may be a spherical phantom having properties similar to a human body.

**[0032]** Throughout the specification, a "user" may be, but is not limited to, a medical expert, for example, a medical doctor, a nurse, a medical laboratory technologist, or a medical imaging expert, or a technician who repairs medical apparatuses.

**[0033]** Hereinafter, exemplary embodiments will be described in detail with reference to the figures.

**[0034]** FIG. 1 is a block diagram showing a configuration of an ultrasound diagnosis apparatus 1000 according to an embodiment of the present disclosure. Referring to FIG. 1, the ultrasound diagnosis apparatus 1000 may include a probe 20, an ultrasound transceiver 1100, an image processor 1200, a communication module 1300, a display 1400, a memory 1500, an input device 1600, and a controller 1700, which may be connected to one another via buses 1800.

**[0035]** The ultrasound diagnosis apparatus 1000 may be a cart type apparatus or a portable type apparatus. Examples of portable ultrasound diagnosis apparatuses may include, but are not limited to, a picture archiving and communication system (PACS) viewer, a smartphone, a laptop computer, a personal digital assistant (PDA), and a tablet PC.

**[0036]** The probe 20 transmits ultrasound waves to an object 10 in response to a driving signal applied by the ultrasound transceiver 1100 and receives echo signals reflected by the object 10. The probe 20 includes a plurality of transducers, and the plurality of transducers oscillate in response to electric signals and generate acoustic energy, that is, ultrasound waves. Furthermore, the probe 20 may be connected to the main body of the ultrasound diagnosis apparatus 1000 by wire or wirelessly, and according to embodiments, the ultrasound diagnosis apparatus 1000 may include a plurality of probes 20.

**[0037]** A transmitter 1110 supplies a driving signal to the probe 20. The transmitter 110 includes a pulse generator 1112, a transmission delaying unit 1114, and a pulser 1116. The pulse generator 1112 generates pulses for forming transmission ultrasound waves based on a predetermined pulse repetition frequency (PRF), and the transmission delaying unit 1114 delays the pulses by delay times necessary for determining transmission direc-

tionality. The pulses which have been delayed correspond to a plurality of piezoelectric vibrators included in the probe 20, respectively. The pulser 1116 applies a driving signal (or a driving pulse) to the probe 20 based on timing corresponding to each of the pulses which have been delayed.

**[0038]** A receiver 1120 generates ultrasound data by processing echo signals received from the probe 20. The receiver 1120 may include an amplifier 1122, an analog-to-digital converter (ADC) 1124, a reception delaying unit 1126, and a summing unit 1128. The amplifier 1122 amplifies echo signals in each channel, and the ADC 1124 performs analog-to-digital conversion with respect to the amplified echo signals. The reception delaying unit 1126 delays digital echo signals output by the ADC 124 by delay times necessary for determining reception directionality, and the summing unit 1128 generates ultrasound data by summing the echo signals processed by the reception delaying unit 1166. In some embodiments, the receiver 1120 may not include the amplifier 1122. In other words, if the sensitivity of the probe 20 or the capability of the ADC 1124 to process bits is enhanced, the amplifier 1122 may be omitted.

**[0039]** The image processor 1200 generates an ultrasound image by scan-converting ultrasound data generated by the ultrasound transceiver 1100 and displays the ultrasound image. The ultrasound image may be not only a grayscale ultrasound image obtained by scanning an object in an amplitude (A) mode, a brightness (B) mode, and a motion (M) mode, but also a Doppler image showing a movement of an object via a Doppler effect. The Doppler image may be a blood flow Doppler image showing flow of blood (also referred to as a color Doppler image), a tissue Doppler image showing a movement of tissue, or a spectral Doppler image showing a moving speed of an object as a waveform. Furthermore, an M mode ultrasound image may be a grayscale image or Doppler image obtained by scanning an object in an M mode.

**[0040]** A B mode processor 1212 extracts B mode components from ultrasound data and processes the B mode components. An image generator 1220 may generate an ultrasound image indicating signal intensities as brightness based on the extracted B mode components 1212.

**[0041]** Similarly, a Doppler processor 1214 may extract Doppler components from ultrasound data, and the image generator 1220 may generate a Doppler image indicating a movement of an object as colors or waveforms based on the extracted Doppler components.

**[0042]** According to an embodiment, the image generator 1220 may generate a three-dimensional (3D) ultrasound image via volume-rendering with respect to volume data and may also generate an elasticity image by imaging deformation of the object 10 due to pressure. Furthermore, the image generator 1220 may display various pieces of additional information in an ultrasound image by using text and graphics. In addition, the generated

ultrasound image may be stored in the memory 1500.

**[0043]** The display 1400 displays the generated ultrasound image. The display 1400 may display not only an ultrasound image, but also various pieces of information processed by the ultrasound diagnosis apparatus 1000 on a screen image via a graphical user interface (GUI). In addition, the ultrasound diagnosis apparatus 1000 may include two or more displays 1400 according to embodiments.

**[0044]** The communication module 1300 is connected to a network 30 by wire or wirelessly to communicate with an external device or a server. The communication module 1300 may exchange data with a hospital server or another medical apparatus in a hospital, which is connected thereto via a PACS. Furthermore, the communication module 1300 may perform data communication according to the digital imaging and communications in medicine (DICOM) standard.

**[0045]** The communication module 1300 may transmit or receive data related to diagnosis of an object, e.g., an ultrasound image, ultrasound data, and Doppler data of the object, via the network 30 and may also transmit or receive medical images captured by another medical apparatus, e.g., a computed tomography (CT) apparatus, a magnetic resonance imaging (MRI) apparatus, or an X-ray apparatus. Furthermore, the communication module 1300 may receive information about a diagnosis history or medical treatment schedule of a patient from a server and utilizes the received information to diagnose the patient. Furthermore, the communication module 1300 may perform data communication not only with a server or a medical apparatus in a hospital, but also with a portable terminal of a medical doctor or patient.

**[0046]** The communication module 1300 is connected to the network 30 by wire or wirelessly to exchange data with a server 32, a medical apparatus 34, or a portable terminal 36. The communication module 1300 may include one or more components for communication with external devices. For example, the communication module 1300 may include a local area communication module 1310, a wired communication module 1320, and a mobile communication module 1330.

**[0047]** The local area communication module 1310 refers to a module for local area communication within a predetermined distance. Examples of local area communication techniques according to an embodiment may include, but are not limited to, wireless LAN, Wi-Fi, Bluetooth, ZigBee, Wi-Fi Direct (WFD), ultra wideband (UWB), infrared data association (IrDA), Bluetooth low energy (BLE), and near field communication (NFC).

**[0048]** The wired communication module 1320 refers to a module for communication using electric signals or optical signals. Examples of wired communication techniques according to an embodiment may include communication via a twisted pair cable, a coaxial cable, an optical fiber cable, and an Ethernet cable.

**[0049]** The mobile communication module 1330 transmits or receives wireless signals to or from at least one

selected from a base station, an external terminal, and a server on a mobile communication network. The wireless signals may be voice call signals, video call signals, or various types of data for transmission and reception of text/multimedia messages.

**[0050]** The memory 1500 stores various data processed by the ultrasound diagnosis apparatus 1000. For example, the memory 1500 may store medical data related to diagnosis of an object, such as ultrasound data and an ultrasound image that are input or output, and may also store algorithms or programs which are to be executed in the ultrasound diagnosis apparatus 1000.

**[0051]** The memory 1500 may be any of various storage media, e.g., a flash memory, a hard disk drive, EEPROM, etc. Furthermore, the ultrasound diagnosis apparatus 1000 may utilize web storage or a cloud server that performs the storage function of the memory 1500 online.

**[0052]** The input device 1600 refers to a means via which a user inputs data for controlling the ultrasound diagnosis apparatus 1000. The input device 1600 may include hardware components, such as a keypad, a mouse, a touch pad, a touch screen, and a jog switch. However, embodiments are not limited thereto, and the input device 1600 may further include any of various other input units including an electrocardiogram (ECG) measuring module, a respiration measuring module, a voice recognition sensor, a gesture recognition sensor, a fingerprint recognition sensor, an iris recognition sensor, a depth sensor, a distance sensor, etc.

**[0053]** The controller 1700 may control all operations of the ultrasound diagnosis apparatus 1000. In other words, the controller 1700 may control operations among the probe 20, the ultrasound transceiver 1100, the image processor 1200, the communication module 1300, the display 1400, the memory 1500, and the input device 1600 shown in FIG. 1.

**[0054]** All or some of the probe 20, the ultrasound transceiver 1100, the image processor 1200, the communication module 1300, the display 1400, the memory 1500, the input device 1600, and the controller 1700 may be implemented as software modules. Furthermore, at least one selected from the ultrasound transceiver 1100, the image processor 1200, and the communication module 1300 may be included in the controller 1700. However, embodiments of the present invention are not limited thereto.

**[0055]** FIG. 2 is a diagram for explaining an output of ultrasound Doppler data via a wearable device 230. FIG. 2 shows an ultrasound image 211 and an ultrasound Doppler spectrum 212.

**[0056]** The image processor 1200 may generate the ultrasound image 211 and the ultrasound Doppler spectrum 212 based on ultrasound echo signals acquired via the probe 20. The ultrasound image 211 and the ultrasound Doppler spectrum 212 may generally be represented via a screen 210 of an ultrasound diagnosis apparatus (e.g., the ultrasound diagnosis apparatus 1000 of FIG. 1) or be provided to a user via a speaker (not

shown) of the ultrasound diagnosis apparatus.

**[0057]** An ultrasound diagnosis apparatus according to an exemplary embodiment may provide a signal generated therein to a user via the wearable device 230. The signal generated in the ultrasound diagnosis apparatus may include ultrasound Doppler data and ultrasound color data. A signal detected by the ultrasound diagnosis apparatus may include a biosignal such as an electrocardiogram (ECG) signal.

**[0058]** The wearable device 230 may be in the form of a smartwatch, smart glasses, a ring, a smartphone, and a personal digital assistant (PDA), but is not limited thereto.

**[0059]** Furthermore, according to an exemplary embodiment, the ultrasound diagnosis apparatus may adjust the intensity of provision of a signal generated therein such as the intensity of vibration, sound loudness, and brightness while transmitting the signal to the wearable device 230. For example, an ultrasound image may be represented the same on the wearable device 230 as on the ultrasound diagnosis apparatus, but the intensity of vibration or sound from the wearable device 230 may be adjusted. Thus, according to an exemplary embodiment, a signal that can be distinguished by a user in more ways than an image may be provided intuitively to a user, thus allowing the user to intuitively recognize a user interface signal that would otherwise not be recognized via the screen 210 of the ultrasound diagnosis apparatus. In this case, the user interface signal may be a signal that can be recognized through at least one of visual, auditory, and tactile senses and provided for the user to recognize predetermined information.

**[0060]** FIG. 3 is a diagram for explaining representation of an ultrasound color image 311 via a wearable device 330. An ultrasound diagnosis apparatus according to an exemplary embodiment is configured to represent a wearable signal including information obtained based on acquired ultrasound data via the wearable device 330, thereby allowing a user to sense an ultrasound signal through a tactile or auditory sense while viewing the ultrasound color image 311. Thus, this configuration enables a user to conveniently diagnose an object.

**[0061]** For example, according to an exemplary embodiment, both a diagnostician and an examinee may sense a wearable signal through at least one of visual, auditory, and tactile senses. In detail, if a pregnant woman and a doctor wear the wearable device 330, the pregnant woman and the doctor may directly sense information representing a status of her fetus via the wearable device 330 while the doctor performs a diagnostic ultrasound examination 340 of the fetus.

**[0062]** Furthermore, according to an exemplary embodiment, if signals are provided from the ultrasound diagnosis apparatus to the wearable device 330, the wearable device 330 may change a method of generating each signal according to a user's selection. For example, the user may turn on or off a screen 310 or a speaker 320 of the ultrasound diagnosis apparatus, or at least

one of vibration, sound, and a screen of the wearable device 330.

**[0063]** FIG. 4 is a block diagram of a configuration of an ultrasound diagnosis apparatus 400 according to another exemplary embodiment.

**[0064]** Referring to FIG. 4, the ultrasound diagnosis apparatus 400 according to the present exemplary embodiment includes an image processor 410, a controller 420, and a communication module 430. The ultrasound diagnosis apparatus 400 may correspond to the ultrasound diagnosis apparatus 1000 of FIG. 1.

**[0065]** The image processor 410 may correspond to the image processor 1200 shown in FIG. 1.

**[0066]** The image processor 410 acquires ultrasound data of an object. The ultrasound data may correspond to an ultrasound echo signal acquired via the probe 20. Furthermore, the ultrasound data may be data generated based on an ultrasound echo signal. For example, the ultrasound data may be ultrasound Doppler data, an ultrasound image, or ultrasound color data. For example, the image processor 410 may acquire ultrasound Doppler data or ultrasound color data related to a fetus via ultrasound examination of a pregnant woman's abdomen. As another example, the image processor 410 may acquire ultrasound Doppler data or ultrasound color data via ultrasound examination of a patient's organ. The ultrasound color data may mean data that may be used to generate an ultrasound color image.

**[0067]** The controller 420 controls overall operations of the ultrasound diagnosis apparatus 400. In detail, the controller 420 produces a wearable signal that has information indicating a difference between acquired ultrasound data and reference ultrasound data. In this case, the reference ultrasound data may include standard ultrasound data and history ultrasound data of an object. The standard ultrasound data may correspond to an average value of values of a plurality of ultrasound data respectively acquired from a plurality of different objects.

**[0068]** A wearable signal may be a signal that can be generated and transmitted by the ultrasound diagnosis apparatus 400 and be received by and output from a wearable device. In detail, the ultrasound diagnosis apparatus 400 may change and generate ultrasound data according to a format of a signal that is processed by the wearable device. For example, if the wearable device is able to recognize or processes an audio signal generated according to a predetermined audio processing standard, the ultrasound diagnosis apparatus 400 may generate a wearable signal having a form of an audio signal that conforms to the predetermined audio processing standard and transmit the wearable signal to the wearable device. As another example, if the wearable device is able to recognize or processes an image signal generated according to a predetermined image processing standard, the ultrasound diagnosis apparatus 400 may generate a wearable signal having a form of an image signal that conforms to the predetermined image processing standard and transmit the wearable signal to

the wearable device. Thus, the wearable device may receive a wearable signal and represent the wearable signal by at least one of vibration, an image, and sound from the wearable device.

**[0069]** Standard ultrasound data may be ultrasound data for a normal group of an object. For example, if acquired ultrasound data is ultrasound Doppler data related to the heart of a fetus, the standard ultrasound data may be ultrasound Doppler data related to the heart of a fetus that is selected as belonging to a normal group from among fetuses having the same gestational age. Alternatively, the standard ultrasound data may be average ultrasound Doppler data for fetuses of the same gestational age.

**[0070]** History ultrasound data of an object may be ultrasound data previously acquired from the object. For example, if an ultrasound image of a 20-week old fetus is captured using the ultrasound diagnosis apparatus 400, two ultrasound images of the fetus that were captured at 12-th and 16-th weeks may be history ultrasound data of the fetus.

**[0071]** According to an exemplary embodiment, a wearable signal may be acquired by comparing acquired ultrasound data with reference ultrasound data. Furthermore, the wearable signal may have information indicating a difference between the acquired ultrasound data and the reference ultrasound data, as described in more detail below with reference to FIGS. 6 and 7.

**[0072]** The communication module 430 may correspond to the communication module 1300 shown in FIG. 1.

**[0073]** The communication module 430 transmits a wearable signal generated in the ultrasound diagnosis apparatus 400 to a wearable device.

**[0074]** Furthermore, the communication module 430 may synchronize with the wearable device via a synchronization signal that is periodically transmitted to or received from the wearable device. Synchronizing the ultrasound diagnosis apparatus 400 with the wearable device may mean that the time when an image or audio signal is output from the ultrasound diagnosis apparatus 400 is synchronized with the time when a wearable signal is output from the wearable device. For example, sound and an image of a fetal heartbeat that are obtained using fetal ultrasound Doppler data may be output from the ultrasound diagnosis apparatus 400 and the wearable device at the same time in real-time.

**[0075]** In detail, although the wearable device receives a wearable signal from the ultrasound diagnosis apparatus 400 for output, the wearable device may exchange a synchronization signal with the ultrasound diagnosis apparatus 400 to check the time that the wearable signal was output therefrom.

**[0076]** FIG. 5 is a block diagram of a configuration of a wearable device 500 according to an exemplary embodiment.

**[0077]** Referring to FIG. 5, the wearable device 500 according to the present exemplary embodiment in-

cludes a communication module 510 and an output unit 520. The output unit 520 may include at least one of a display 521, an audio output unit 523, and a vibration motor 525.

**[0078]** The wearable device 500 may receive a wearable signal transmitted via the communication module 430 of the ultrasound diagnosis apparatus 400 and convert the wearable signal into at least one of the intensity of vibration, variation in color, and strength of sound to be output.

**[0079]** The communication module 510 of the wearable device 500 may receive a wearable signal generated based on a difference between ultrasound data acquired by the ultrasound diagnosis apparatus 400 and reference ultrasound data.

**[0080]** The wearable device 500 may output a user interface signal corresponding to the difference between the acquired ultrasound data and the reference ultrasound data via the output unit 520 based on the wearable signal.

**[0081]** The display 521 included in the output unit 520 may output a screen that depicts a wearable signal as a variation in color on the basis of a difference between acquired ultrasound data and reference ultrasound data. For example, a color value difference for each region may be depicted as a color by comparing ultrasound color data for the acquired ultrasound data with ultrasound color data for the reference ultrasound data, as described in more detail below with reference to FIG. 7.

**[0082]** The audio output unit 523 included in the output unit 520 may output an audio signal representing a wearable signal as strength of sound based on a difference between acquired ultrasound data and reference ultrasound data, as described in more detail with reference to FIG. 6.

**[0083]** The vibration motor 525 included in the output unit 520 may output vibration that has varying intensity according to a wearable signal, based on a difference between acquired ultrasound data and reference ultrasound data.

**[0084]** The output unit 520 will be described in more detail below with reference to FIGS. 10 and 11.

**[0085]** FIG. 6 is a diagram for explaining a signal generated based on a difference between reference ultrasound data and acquired ultrasound data. In detail, FIG. 6 is a diagram for explaining generation of a wearable signal.

**[0086]** According to an exemplary embodiment, the image processor 410 of the ultrasound diagnosis apparatus 400 may acquire ultrasound Doppler data of an object. It is assumed hereinafter that ultrasound data acquired by the image processor 410 is ultrasound Doppler data.

**[0087]** According to an exemplary embodiment, the controller 420 of the ultrasound diagnosis apparatus 400 may compare first Doppler spectrum data corresponding to acquired ultrasound Doppler data with second Doppler spectrum data corresponding to reference ultrasound data, thereby generating a wearable signal based on a dif-

ference between values of the first and second Doppler spectrum data. In this case, a value of Doppler spectrum data may be one particular value contained in the Doppler spectrum data. For example, the value of Doppler spectrum data may be a maximum value, a minimum value, or a peak value (if converted into a graph) of the Doppler spectrum data.

**[0088]** For example, the controller 420 of the ultrasound diagnosis apparatus 400 may compare a first graph 600 representing a Doppler spectrum obtained from acquired ultrasound Doppler data with a second graph 610 representing a Doppler spectrum obtained from reference ultrasound data, thereby generating a wearable signal that has information indicating differences between at least one peak value in the first graph 600 and at least one peak value in the second graph 610.

**[0089]** Referring to FIG. 6, the first and second graphs 600 and 610 represent Doppler spectra respectively obtained from reference ultrasound Doppler data and acquired ultrasound Doppler data of an object.

**[0090]** A third graph 620 is created by comparing the first and second graphs 600 and 610 with each other. For example, the third graph 620 may be created based on the differences between the at least one peak value in the first graph 600 and the at least one peak value in the second graph 610. In detail, heights 621 and 622 of oblique lined portions 625 and 626 represent differences between each of the peak values in the first and second graphs 600 and 610. While FIG. 6 is an example where differences between each of the peak values in the first graph 600 are equal to a corresponding peak value in the second graph 610, the differences may vary according to a difference between acquired ultrasound Doppler data of the object and reference ultrasound Doppler data.

**[0091]** According to an exemplary embodiment, the controller 420 of the ultrasound diagnosis apparatus 400 may adjust the intensity of a wearable signal based on differences between peak values. In detail, the wearable device 500 may output sound, color, or vibration having intensity that is proportional to a difference between peak values in the first and second graphs 600 and 610. For example, if a difference between each peak value in the first graph 600 and a corresponding peak value in the second graph 610 is small, the wearable device 500 may output vibration having low intensity that is proportional to the difference. On the other hand, if the difference is large, the wearable device 500 may output vibration having high intensity that is proportional to the difference.

**[0092]** According to an exemplary embodiment, the controller 420 of the ultrasound diagnosis apparatus 400 may determine an item of an object that requires further examination based on differences between peak values and display the determined item on the wearable device.

**[0093]** For example, if an absolute value of a difference between peak values exceeds a predetermined value, the controller 420 of the ultrasound diagnosis apparatus 400 may determine that there is an abnormality in the object and thus determine items which require further

examination. In detail, if the first graph 600 represents a Doppler spectrum of the heart of a fetus in a normal group, and the second graph 610 represents a Doppler spectrum of the heart of a fetus as an object, a difference between peak values in the first and second graphs 600 and 610 may exceed a predetermined value. In this case, the ultrasound diagnosis apparatus 400 may inform a user that the fetus has a heartbeat that is weaker or extremely stronger than an average heartbeat of a fetus and suggest a further examination to the user.

**[0094]** Furthermore, according to another exemplary embodiment, the controller 420 of the ultrasound diagnosis apparatus 400 may determine an item of the object that requires further examination based on a difference between periods in the first and second graphs 600 and 610 and display the determined item on the wearable device 500.

**[0095]** For example, if the first graph 600 represents a Doppler spectrum of the heart of a fetus as an object and the second graph 610 represents a Doppler spectrum of the heart of a fetus in a normal group, a difference between periods in the first and second graphs 600 and 610 may exceed a predetermined value. In this case, the ultrasound diagnosis apparatus 400 may inform a user that the fetus is under stress and suggest that further examination is needed.

**[0096]** According to an exemplary embodiment, if at least one of differences between peak values in the first and second graphs 600 and 610 exceeds a predetermined reference value, the controller 420 of the ultrasound diagnosis apparatus 400 may control the wearable device 500 to generate an alarm that will be then provided to the user via a sound, vibration, or screen.

**[0097]** For example, if a difference between peak values at a time point when the peak values occur exceeds a predetermined reference value, the controller 420 of the ultrasound diagnosis apparatus 400 may control the wearable device 500 to generate vibration. In this case, the user may sense the vibration via the wearable device 500 each time the difference exceeds the predetermined reference value.

**[0098]** Furthermore, the controller 420 of the ultrasound diagnosis apparatus 400 may compare periods in the first and second graphs 600 and 610 with each other. In this case, if a difference between the periods in the first and second graphs 600 and 610 exceeds a predetermined reference value, the controller 410 of the ultrasound diagnosis apparatus 400 may control the wearable device 500 to generate an alarm sound that may inform the user that there is a problem in a period of an ultrasound wave from an object.

**[0099]** Furthermore, the wearable device 500 may represent highest/lowest peaks of a Doppler signal as strong/weak vibration by using the first graph 600 representing a Doppler spectrum obtained from acquired ultrasound Doppler data. Furthermore, the wearable device 500 may represent highest/lowest peaks of a Doppler signal as a variation in color by using the first graph

600. For example, the wearable device 500 may output a red color at the highest peak of the Doppler signal and a blue color at the lowest peak thereof.

**[0100]** Although FIG. 6 shows the first and second graphs 600 and 610 as examples of Doppler spectra, exemplary embodiments are not limited thereto. For example, Doppler spectrum data may be compared with each other as described above without being converted into graphs.

**[0101]** FIG. 7 illustrates a comparison between elastography images showing tissue stiffness.

**[0102]** According to an exemplary embodiment, the image processor 410 of the ultrasound diagnosis apparatus 400 may acquire ultrasound color data of an object. In this case, the controller 420 may compare an ultrasound color image generated based on the acquired ultrasound color data with a predetermined ultrasound color image, thereby generating a wearable signal based on a difference between colors of the ultrasound color images.

**[0103]** According to an exemplary embodiment, the controller 420 may control the wearable device 500 to display the acquired ultrasound color data in a color corresponding to the difference between colors.

**[0104]** Referring to FIG. 7, 710 and 720 respectively represent elastography images of reference ultrasound color data and ultrasound color data of an object.

**[0105]** In detail, the elastography images 710 and 720 respectively depict a healthy person's liver and the object.

**[0106]** As seen on FIG. 7, the elastography image 710 of the healthy person's liver shows a shear stiffness value of 1.98 kilopascals (kPa), and the elastography image 720 of the object shows a shear stiffness value of 6.95 kPa, which is higher than that of the healthy person's liver.

**[0107]** In this case, the ultrasound diagnosis apparatus 400 may transmit 3.97 kPa that is a difference between the shear stiffness values shown in the elastography images 710 and 720 to the wearable device 500.

**[0108]** Furthermore, according to an exemplary embodiment, if a value corresponding to a difference between colors exceeds a predetermined reference value, the ultrasound diagnosis apparatus 400 may control the wearable device 500 to generate an alarm. In this case, the alarm may be in the form of sound, an image, or vibration.

**[0109]** The ultrasound diagnosis apparatus 400 may also generate new elastography data having a color corresponding to a difference between stiffness values of regions in the elastography image 710 of reference ultrasound color data and the elastography image 720 of ultrasound color data of the object.

**[0110]** For example, the new elastography data may be visually represented for the user on a display of the wearable device 500. In detail, if a difference between stiffness values of regions in the elastography images 710 and 720 is greater than a predetermined value, each region in the new elastography data displayed on the wearable device 500 may be represented in red. On the

other hand, if the difference is less than or equal to the predetermined value, a corresponding region may be represented in blue. Selection of these colors is merely an example, and exemplary embodiments are not limited thereto.

**[0111]** A difference in tissue stiffness may be represented using at least one of the intensity of variation and variation in color. For example, if the difference in tissue stiffness is large, the wearable device 500 may generate vibration having a high intensity or represent the difference in tissue stiffness in a deeper color.

**[0112]** FIG. 8 is a flowchart of a method of controlling the ultrasound diagnosis apparatus 400, according to an exemplary embodiment.

**[0113]** Referring to FIGS. 4, 5, and 8, the image processor 410 of the ultrasound diagnosis apparatus 400 acquires ultrasound data of an object (operation 810).

**[0114]** The controller 420 generates a wearable signal that is to be output from the wearable device 500 based on a difference between acquired ultrasound data and predetermined ultrasound data (operation 820).

**[0115]** The communication module 430 may transmit the wearable signal to the wearable device 500 (operation 830).

**[0116]** According to an exemplary embodiment, the ultrasound diagnosis apparatus 400 may control a difference between ultrasound data of the object and reference ultrasound data to be displayed on the wearable device 500. Furthermore, the ultrasound diagnosis apparatus 400 may control a difference between previously generated history data of the object and current ultrasound data of the object to be displayed on the wearable device 500.

**[0117]** According to an exemplary embodiment, the wearable device 500 allows the user to recognize a signal intensity by sensing at least one of vibration and sound without viewing a screen.

**[0118]** According to an exemplary embodiment, the ultrasound diagnosis apparatus 400 may transmit a signal generated from a fetus, e.g., the fetus's heart rate, simultaneously to a plurality of wearable devices 500.

**[0119]** According to an exemplary embodiment, the wearable device 500 may automatically adjust the intensity of a signal (vibration, sound, and image represented thereon according to the magnitude of a signal representing a difference between values for reference ultrasound data and acquired ultrasound data.

**[0120]** According to an exemplary embodiment, the ultrasound diagnosis apparatus 400 may determine an item requiring examination according to the magnitude of a signal representing a difference between values for reference ultrasound data and acquired ultrasound data and transmit the item to the wearable device 500.

**[0121]** In this case, the wearable device 500 may inform the user of an item requiring examination by displaying the item on a display thereof.

**[0122]** Furthermore, the ultrasound diagnosis apparatus 400 may analyze the periodicity of a fetus's heartbeat,

quantify a stress level of the fetus, and provide the stress level of the fetus to the user. In addition, the ultrasound diagnosis apparatus 400 may analyze the periodicity of a fetus's heartbeat and provide the result of the analysis to the user as a sensory signal. For example, if the periodicity of the fetus's heartbeat is abnormal, the ultrasound diagnosis apparatus 400 may represent the abnormal periodicity as vibration and provide the vibration to the user, thereby allowing a user to recognize that the fetus has a high stress level.

**[0123]** FIG. 9 is a diagram for explaining exchange of signals between an ultrasound diagnosis apparatus 900 and a wearable device 910.

**[0124]** The ultrasound diagnosis apparatus 900 may acquire ultrasound data from an object. Then, the ultrasound diagnosis apparatus 900 may generate a wearable signal to be transmitted to the wearable device 910. The wearable signal may be generated by comparing acquired ultrasound data against reference ultrasound data.

**[0125]** The ultrasound diagnosis apparatus 900 may transmit the generated wearable signal to the wearable device 910.

**[0126]** The wearable device 910 may output the received wearable signal as a sensory signal and provide the sensory signal to the user.

**[0127]** In this case, the ultrasound diagnosis apparatus 900 may exchange a synchronization signal with the wearable device 910 in order to synchronize a sensory signal output from by the wearable device 910 with an ultrasound signal represented via a display or speaker of the ultrasound diagnosis apparatus 900.

**[0128]** FIG. 10 is a diagram for explaining a form in which a wearable signal is output via an output unit of smart glasses 1060 that is an example of the wearable device 500.

**[0129]** According to an exemplary embodiment, the wearable device 500 may output a user interface signal corresponding to a difference between ultrasound data acquired by the ultrasound diagnosis apparatus (400 of FIG. 4) and reference ultrasound data, based on a wearable signal generated based on the difference.

**[0130]** According to an exemplary embodiment, the wearable device 500 may receive a wearable signal transmitted from the communication module (430 of FIG. 4) and convert the wearable signal into a variation in color to be output.

**[0131]** Referring to FIG. 10, a user 1050 is wearing the smart glasses 1060 that is an example of the wearable device 500.

**[0132]** For example, the smart glasses 1060 may provide a color ultrasound image 1010 of a fetus to the user 1050 via a display.

**[0133]** According to an exemplary embodiment, the smart glasses 1060 may receive a wearable signal transmitted from the communication module 430 and convert the wearable signal into sound having certain strength to be output).

**[0134]** For example, a fetal heartbeat sound may be provided to the user 1050 via an audio output unit of the smart glasses 1060.

**[0135]** According to an exemplary embodiment, the smart glasses 1060 may receive a wearable signal transmitted from the communication module 430 and convert the wearable signal into intensity of vibration to be output. For example, the smart glasses 1060 may convert a fetal heartbeat into vibration and provide the vibration to the user 1050 via a vibration motor.

**[0136]** FIGS. 11A through 11D are a diagram for explaining conversion of a signal generated based on a difference between acquired ultrasound data and reference ultrasound data into a user interface signal.

**[0137]** FIG. 11A illustrates a difference between first and second graphs respectively representing Doppler spectra corresponding to acquired ultrasound Doppler data and reference ultrasound data. To obtain the difference, the controller 420 of the ultrasound diagnosis apparatus 400 may compare the first and second graphs with each other.

**[0138]** FIG. 11B illustrates a wearable signal generated based on differences between at least one peak value in the first graph and at least one peak value in the second graph. For example, the magnitude of the wearable signal may be determined based on a value corresponding to a difference between each of peak values in the first and second graphs. Referring to FIG. 11B, the wearable signal is composed of high- and low-amplitude sound waves that appear alternately.

**[0139]** FIG. 11C illustrates vibration generated by the wearable device 500 based on a wearable signal. Referring to FIG. 11C, high- and low-intensity vibrations occur alternately according to the magnitude of the wearable signal.

**[0140]** FIG. 11D illustrates sound generated by the wearable signal 500 based on a wearable signal. Referring to FIG. 11D, the sound based on the wearable signal is represented as a sound pitch. In addition, the sound may be output as strength thereof.

**[0141]** The exemplary embodiments may be written as computer programs and may be implemented in general-use digital computers that execute the programs using a computer-readable recording medium.

**[0142]** Computer-readable media may be any available media that can be accessed by a computer and include both volatile and nonvolatile media and both detachable and non-detachable media. Furthermore, the computer-readable media may include computer storage media and communication media. The computer storage media include both volatile and nonvolatile and both detachable and non-detachable media implemented by any method or technique for storing information such as computer-readable instructions, data structures, program modules, or other data. The communication media typically embody computer-readable instructions, data structures, program modules, other data of a modulated data signal, or other transmission mechanism, and they in-

clude any information transmission media.

**[0143]** The above description is provided for illustration, and it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from essential features and the spirit and scope of the present inventive concept as defined by the following claims. Accordingly, the above embodiments and all aspects thereof are examples only and are not limiting. For example, each component defined as an integrated component may be implemented in a distributed fashion. Likewise, components defined as separate components may be implemented in an integrated manner.

**[0144]** The scope of the present inventive concept is defined not by the detailed description thereof but by the appended claims, and all the changes or modifications within the scope of the appended claims and their equivalents will be construed as being included in the present inventive concept.

## Claims

1. An ultrasound diagnosis apparatus (400,900,1000), comprising:

an image processor (410,1200) configured to acquire ultrasound data of an object based on ultrasound echo signal acquired via a probe;  
 a controller (420,1700) configured to generate a wearable signal to be received by and output from a wearable device, the wearable signal carrying information corresponding to a difference between the acquired ultrasound data and reference ultrasound data; and  
 a communication module (430,1300) configured to transmit the wearable signal to the wearable device which is configured to receive and convert the wearable signal into at least one selected from the intensity of vibration, variation in color, and strength of sound, and output the at least one result obtained by the conversion, wherein the acquired ultrasound data comprises ultrasound Doppler data, and  
 wherein the controller is further configured to compare first Doppler spectrum data corresponding to the ultrasound Doppler data with second Doppler spectrum data corresponding to the reference ultrasound data, thereby generating the wearable signal based on differences between values of the first and second Doppler spectrum data  
 wherein the controller is further configured to adjust the intensity of the wearable signal based on the differences between the values of the first and second Doppler spectrum data.

2. The ultrasound diagnosis apparatus of claim 1,

wherein the controller is further configured to determine an item of the object that requires examination based on the differences between the values of the first and second Doppler spectrum data and to control the wearable device to display the determined item.

3. The ultrasound diagnosis apparatus of claim 1 or 2, wherein if the difference between the values of the first and second Doppler spectrum data is greater than a predetermined reference value, the controller is further configured to control the wearable device to generate an alarm.

4. The ultrasound diagnosis apparatus of any of the preceding claims, wherein the image processor is further configured to acquire ultrasound color data showing tissue stiffness of the object, and wherein the controller is further configured to compare the acquired ultrasound color data with predetermined ultrasound color data, thereby generating a wearable signal based on a difference in color between the acquired ultrasound color data and the predetermined ultrasound color data, and to control the wearable device to display the acquired ultrasound color data in a color corresponding to the difference in color, based on the difference in color.

5. A wearable device (230,330,500,910), comprising:

a communication module (510) configured to receive a wearable signal from an ultrasound diagnostic apparatus as claimed in any of the preceding claims carrying information corresponding to differences between values of first Doppler spectrum data corresponding to the acquired ultrasound Doppler data of an object acquired by the ultrasound diagnosis apparatus and second Doppler spectrum data corresponding to reference ultrasound data; and  
 an output unit (520) configured to output a user interface signal which is provided through at least one selected from the intensity of vibration, variation in color, and strength of sound corresponding to the difference based on the wearable signal.

6. A method of controlling an ultrasound diagnosis apparatus (400,900,1000), the method comprising:

acquiring (810) ultrasound data of an object;  
 generating (820) a wearable signal to be received by and output from a wearable device, the wearable signal carrying information corresponding to a difference between the acquired ultrasound data and reference ultrasound data; and  
 transmitting (830) the wearable signal to the

wearable device which receives and converts the wearable signal into at least one selected from the intensity of vibration, variation in color, and strength of sound, and outputs the at least one result obtained by the conversion  
 wherein the acquired ultrasound data comprises ultrasound Doppler data, and  
 wherein the generating of the wearable signal comprises comparing first Doppler spectrum data corresponding to the ultrasound Doppler data with second Doppler spectrum data corresponding to the reference ultrasound data to thereby generate the wearable signal based on differences between values of the first and second Doppler spectrum data  
 wherein the generating of the wearable signal comprises adjusting the intensity of the wearable signal based on the differences between the values of the first and second Doppler spectrum data.

7. The method of claim 6, further comprising:

determining an item of the object that requires examination based on the differences between the values of the first and second Doppler spectrum data; and  
 controlling the wearable device to display the determined item.

8. The method of claim 6 or 7, further comprising, if the difference between the values of the first and second Doppler spectrum data is greater than a predetermined reference value, controlling the wearable device to generate an alarm.

9. The method of any of claims 6-8, wherein the generating of the wearable signal comprises:

comparing a period in a first graph representing the first Doppler spectrum data with a period in a second graph representing the second Doppler spectrum data; and  
 controlling the wearable device to generate an alarm if a difference between the periods in the first and second graphs exceeds a predetermined reference value.

10. The method of any of claims 6-9, wherein the acquiring of the ultrasound data of the object comprises acquiring ultrasound color data showing tissue stiffness, and  
 wherein the generating of the wearable signal comprises comparing the acquired ultrasound color data with predetermined ultrasound color data and generating the wearable signal based on a difference in color between the acquired ultrasound color data

and the predetermined ultrasound color data, and controlling the wearable device to display the acquired ultrasound color data in a color corresponding to the difference in color.

11. A method of controlling a wearable device, the method comprising:

receiving, by wearable device, a wearable signal from an ultrasound diagnosis apparatus as claimed in any of claims 1-4 generated based on differences between values of the first Doppler spectrum data the second Doppler spectrum data; and  
 outputting a user interface signal which is provided through at least one selected from the intensity of vibration, variation in color, and strength of sound corresponding to the difference based on the wearable signal.

**Patentansprüche**

1. Ultraschall Diagnosevorrichtung (400, 900, 1000), die umfasst:

eine Bildverarbeitungseinrichtung (410, 1200), die dazu konfiguriert ist, Ultraschall Daten eines Objekts basierend auf einem über eine Sonde erfassten Ultraschallechosignal zu erfassen;  
 eine Steuerung (420, 1700), die dazu konfiguriert ist, ein Signal eines am Körper tragbaren Geräts zu erzeugen, das an einem am Körper tragbaren Gerät empfangen und von diesem ausgegeben werden kann, wobei das Signal des am Körper tragbaren Geräts Informationen entsprechend einer Differenz zwischen den erfassten Ultraschall Daten und Referenzultraschall Daten beinhaltet; und  
 ein Kommunikationsmodul (430, 1300), das dazu konfiguriert ist, das Signal des am Körper tragbaren Geräts an das am Körper tragbare Gerät zu übertragen, welches Gerät dazu konfiguriert ist, das Signal des am Körper tragbaren Geräts zu empfangen und in wenigstens eines von Vibrationsintensität, Farbvariation und Klangstärke umzuwandeln und das wenigstens eine durch die Umwandlung erhaltene Ergebnis auszugeben,  
 wobei die erfassten Ultraschall Daten Doppler-Ultraschall Daten umfassen, und  
 wobei die Steuerung weiterhin dazu konfiguriert ist, erste Doppler-Spektrumsdaten entsprechend den Doppler-Ultraschall Daten mit zweiten Doppler-Spektrumsdaten entsprechend den Referenzultraschall Daten zu vergleichen, wodurch basierend auf Differenzen zwischen den Werten der ersten Doppler-Spektrumsdaten

- und der zweiten Doppler-Spektrumsdaten das Signal des am Körper tragbaren Geräts erzeugt wird,  
wobei die Steuerung weiterhin dazu konfiguriert ist, die Intensität des Signals des am Körper tragbaren Geräts basierend auf den Differenzen zwischen den Werten der ersten Doppler-Spektrumsdaten und der zweiten Doppler-Spektrumsdaten anzupassen.
2. Ultraschall Diagnosevorrichtung nach Anspruch 1, wobei die Steuerung weiterhin dazu konfiguriert ist, basierend auf den Differenzen zwischen den Werten der ersten und zweiten Doppler-Spektrumsdaten ein Merkmal des Objekts, das eine Untersuchung erfordert, zu bestimmen und das am Körper tragbare Gerät derart zu steuern, dass es das bestimmte Merkmal anzeigt.
3. Ultraschall Diagnosevorrichtung nach Anspruch 1 oder 2, wobei, wenn die Differenz zwischen den Werten der ersten und zweiten Doppler-Spektrumsdaten größer als ein vorbestimmter Referenzwert ist, die Steuerung weiterhin dazu konfiguriert ist, das am Körper tragbare Gerät derart zu steuern, dass es einen Alarm erzeugt.
4. Ultraschall Diagnosevorrichtung nach einem der vorstehenden Ansprüche, wobei die Bildverarbeitungseinrichtung weiterhin dazu konfiguriert ist, Ultraschallfarbdaten zu erfassen, die eine Gewebesteifigkeit des Objekts anzeigen, und wobei die Steuerung weiterhin dazu konfiguriert ist, die erfassten Ultraschallfarbdaten mit vorbestimmten Ultraschallfarbdaten zu vergleichen, wodurch basierend auf einer Differenz in der Farbe zwischen den erfassten Ultraschallfarbdaten und den vorbestimmten Ultraschallfarbdaten ein Signal des am Körper tragbaren Geräts erzeugt wird, und dazu, das am Körper tragbare Gerät derart zu steuern, dass es basierend auf der Differenz in der Farbe die erfassten Ultraschallfarbdaten in einer Farbe entsprechend der Differenz in der Farbe anzeigt.
5. Am Körper tragbares Gerät (230, 330, 500, 910), das umfasst:
- ein Kommunikationsmodul (510), das dazu konfiguriert ist, ein von einer Ultraschall Diagnosevorrichtung nach einem der vorstehenden Ansprüche stammendes Signal des am Körper tragbaren Geräts zu empfangen, welches Signal Informationen entsprechend Differenzen zwischen den Werten von ersten, von der Ultraschall Diagnosevorrichtung erfassten Doppler-Spektrumsdaten entsprechenden Doppler-Spektrumsdaten eines Objekts und zweiten Doppler-Spektrumsdaten entsprechend Referenzultraschalldaten beinhaltet; und eine Ausgabeeinheit (520), die dazu konfiguriert ist, ein Benutzeroberflächensignal auszugeben, das entsprechend der Differenz basierend auf dem Signal des am Körper tragbaren Geräts durch wenigstens eines von Vibrationsintensität, Farbvariation und Klangstärke bereit gestellt wird.
6. Verfahren zur Steuerung einer Ultraschall Diagnosevorrichtung (400, 900, 1000), wobei das Verfahren umfasst:
- Erfassen (810) von Ultraschalldaten eines Objekts;  
Erzeugen (820) eines Signals des am Körper tragbaren Geräts, das an einem am Körper tragbaren Gerät empfangen und von diesem ausgegeben werden kann, wobei das Signal des am Körper tragbaren Geräts Informationen entsprechend einer Differenz zwischen den erfassten Ultraschalldaten und Referenzultraschalldaten beinhaltet; und  
Übertragen (830) des Signals des am Körper tragbaren Geräts an das am Körper tragbare Gerät, welches das Signal des am Körper tragbaren Geräts empfängt und in wenigstens eines von Vibrationsintensität, Farbvariation und Klangstärke umwandelt und das wenigstens eine durch die Umwandlung erhaltene Ergebnis ausgibt,  
wobei die erfassten Ultraschalldaten Doppler-Ultraschalldaten umfassen, und  
wobei das Erzeugen des Signals des am Körper tragbaren Geräts umfasst: Vergleichen von ersten Doppler-Spektrumsdaten entsprechend den Doppler-Ultraschalldaten mit zweiten Doppler-Spektrumsdaten entsprechend den Referenzultraschalldaten, um dadurch basierend auf Differenzen zwischen den Werten der ersten und zweiten Doppler-Spektrumsdaten das Signal des am Körper tragbaren Geräts zu erzeugen, wobei das Erzeugen des Signals des am Körper tragbaren Geräts umfasst: Anpassen der Intensität des Signals des am Körper tragbaren Geräts basierend auf den Differenzen zwischen den Werten der ersten und zweiten Doppler-Spektrumsdaten.
7. Verfahren nach Anspruch 6, das weiterhin umfasst:
- Bestimmen eines Merkmals des Objekts, das eine Untersuchung erfordert, basierend auf den Differenzen zwischen den Werten der ersten und zweiten Doppler-Spektrumsdaten; und  
Steuern des am Körper tragbaren Geräts derart, dass es das bestimmte Merkmal anzeigt.

8. Verfahren nach Anspruch 6 oder 7, das weiterhin umfasst: wenn die Differenz zwischen den Werten der ersten und zweiten Doppler-Spektrumsdaten größer als ein vorbestimmter Referenzwert ist, Steuern des am Körper tragbaren Geräts derart, dass es einen Alarm erzeugt. 5
9. Verfahren nach einem der Ansprüche 6 bis 8, wobei das Erzeugen des Signals des am Körper tragbaren Geräts umfasst: 10
- Vergleichen eines Zeitraums in einem ersten Diagramm, das die ersten Doppler-Spektrumsdaten repräsentiert, mit einem Zeitraum in einem zweiten Diagramm, das die zweiten Doppler-Spektrumsdaten repräsentiert; und 15
- Steuern des am Körper tragbaren Geräts derart, dass es einen Alarm erzeugt, wenn eine Differenz zwischen den Zeiträumen in dem ersten und dem zweiten Diagramm einen vorbestimmten Referenzwert überschreitet. 20
10. Verfahren nach einem der Ansprüche 6 bis 9, wobei das Erfassen der Ultraschalldaten des Objekts ein Erfassen von Ultraschallfarbdaten, die eine Gewebesteifigkeit anzeigen, umfasst, und wobei das Erzeugen des Signals des am Körper tragbaren Geräts umfasst: Vergleichen der erfassten Ultraschallfarbdaten mit vorbestimmten Ultraschallfarbdaten und Erzeugen des Signals des am Körper tragbaren Geräts basierend auf einer Differenz in der Farbe zwischen den erfassten Ultraschallfarbdaten und den vorbestimmten Ultraschallfarbdaten, und Steuern des am Körper tragbaren Geräts derart, dass es die erfassten Ultraschallfarbdaten in einer Farbe entsprechend der Differenz in der Farbe anzeigt. 25 30 35
11. Verfahren zur Steuerung eines am Körper tragbaren Geräts, wobei das Verfahren umfasst: 40
- Empfangen, an einem am Körper tragbaren Gerät, eines von einer Ultraschall Diagnosevorrichtung nach einem der Ansprüche 1 bis 4 stammenden Signals des am Körper tragbaren Geräts, das basierend auf Differenzen zwischen Werten der ersten Doppler-Spektrumsdaten und der zweiten Doppler-Spektrumsdaten erzeugt wurde; und 45
- Ausgeben eines Benutzeroberflächensignals, das entsprechend der Differenz basierend auf dem Signal des am Körper tragbaren Geräts durch wenigstens eines von Vibrationsintensität, Farbvariation und Klangstärke bereit gestellt wird. 50 55

## Revendications

1. Dispositif d'échographie diagnostique (400, 900, 1000), comprenant : 5
- un processeur d'images (410, 1200) conçu pour acquérir des données échographiques d'un objet en fonction d'un signal d'écho ultrasonore capté par une sonde,
- un organe de commande (420, 1700) conçu pour produire un signal d'accessoire connecté destiné à être reçu et émis par un accessoire corporel connecté, le signal d'accessoire connecté portant des informations correspondant à une différence entre les données échographiques acquises et des données échographiques de référence, et
- un module de communication (430, 1300) conçu pour transmettre le signal d'accessoire connecté à l'accessoire corporel connecté qui est conçu pour recevoir et convertir le signal d'accessoire connecté en au moins une caractéristique choisie parmi l'intensité des vibrations, la variation de couleurs et l'intensité sonore, et pour émettre l'au moins un résultat découlant de la conversion ;
- les données échographiques acquises comprenant des données Doppler échographiques, et l'organe de commande étant conçu en outre pour comparer des premières données de spectre Doppler correspondant aux données Doppler échographiques à des deuxièmes données de spectre Doppler correspondant aux données échographiques de référence, en produisant ainsi le signal d'accessoire connecté en fonction des différences entre les valeurs des premières et deuxièmes données de spectre Doppler, et l'organe de commande étant conçu en outre pour régler l'intensité du signal d'accessoire connecté en fonction des différences entre les valeurs des premières et deuxièmes données de spectre Doppler.
2. Dispositif d'échographie diagnostique selon la revendication 1, dans lequel l'organe de commande est conçu en outre pour déterminer une caractéristique de l'objet nécessitant un examen en fonction des différences entre les valeurs des premières et deuxièmes données de spectre Doppler et pour commander à l'accessoire corporel connecté d'afficher la caractéristique déterminée.
3. Dispositif d'échographie diagnostique selon la revendication 1 ou 2, dans lequel, si la différence entre les valeurs des premières et deuxièmes données de spectre Doppler est supérieure à une valeur de référence prédéterminée, l'organe de commande est conçu en outre pour commander à l'accessoire cor-

porel connecté de produire une alerte.

4. Dispositif d'échographie diagnostique selon l'une quelconque des revendications précédentes, dans lequel le processeur d'images est conçu en outre pour acquérir des données couleurs échographiques montrant la rigidité tissulaire de l'objet, et dans lequel l'organe de commande est conçu en outre pour comparer les données couleurs échographiques acquises à des données couleurs échographiques prédéterminées, en produisant ainsi un signal d'accessoire connecté en fonction d'une différence de couleur entre les données couleurs échographiques acquises et les données couleurs échographiques prédéterminées, et pour commander à l'accessoire corporel connecté d'afficher les données couleurs échographiques acquises dans une couleur correspondant à la différence de couleur, en fonction de la différence de couleur.

5. Accessoire corporel connecté (230, 330, 500, 910), comprenant :

un module de communication (510) conçu pour recevoir un signal d'accessoire connecté émanant d'un dispositif d'échographie diagnostique selon l'une quelconque des revendications précédentes portant des informations correspondant aux différences entre les valeurs de premières données de spectre Doppler, correspondant aux données Doppler échographiques d'un objet acquises par le dispositif d'échographie diagnostique, et de deuxièmes données de spectre Doppler correspondant à des données échographiques de référence ; et une unité de sortie (520) conçue pour émettre un signal d'interface utilisateur qui est fourni par le biais d'au moins une caractéristique choisie parmi l'intensité des vibrations, la variation de couleurs et l'intensité sonore, en correspondance à la différence, en fonction du signal d'accessoire connecté.

6. Procédé de commande d'un dispositif d'échographie diagnostique (400, 900, 1000), le procédé comprenant :

l'acquisition (810) de données échographiques d'un objet,  
la production (820) d'un signal d'accessoire connecté destiné à être reçu et émis par un accessoire corporel connecté, le signal d'accessoire connecté portant des informations correspondant à une différence entre les données échographiques acquises et des données échographiques de référence, et  
la transmission (830) du signal d'accessoire connecté auprès de l'accessoire corporel con-

necté qui reçoit et convertit le signal d'accessoire connecté en au moins une caractéristique choisie parmi l'intensité des vibrations, la variation de couleurs et l'intensité sonore, et qui émet l'au moins un résultat découlant de la conversion ;

les données échographiques acquises comprenant des données Doppler échographiques, et la production du signal d'accessoire connecté comprenant la comparaison de premières données de spectre Doppler correspondant aux données Doppler échographiques à des deuxièmes données de spectre Doppler correspondant aux données échographiques de référence pour ainsi produire le signal d'accessoire connecté en fonction de différences entre les valeurs des premières et deuxièmes données de spectre Doppler,

la production du signal d'accessoire connecté comprenant le réglage de l'intensité du signal d'accessoire connecté en fonction des différences entre les valeurs des premières et deuxièmes données de spectre Doppler.

7. Procédé selon la revendication 6, comprenant en outre :

la détermination d'une caractéristique de l'objet nécessitant un examen en fonction des différences entre les valeurs des premières et deuxièmes données de spectre Doppler, et la commande de l'accessoire corporel connecté afin qu'il affiche la caractéristique déterminée.

8. Procédé selon la revendication 6 ou 7, comprenant en outre, si la différence entre les valeurs des premières et deuxièmes données de spectre Doppler est supérieure à une valeur de référence prédéterminée, la commande de l'accessoire corporel connecté afin qu'il produise une alerte.

9. Procédé selon l'une quelconque des revendications 6 à 8, dans lequel la production du signal d'accessoire connecté comprend :

la comparaison d'une période présente dans un premier graphique représentant les premières données de spectre Doppler à une période présente dans un deuxième graphique représentant les deuxièmes données de spectre Doppler, et la commande de l'accessoire corporel connecté afin qu'il produise une alerte si une différence entre les périodes présentes dans les premier et deuxième graphiques dépasse une valeur de référence prédéterminée.

10. Procédé selon l'une quelconque des revendications

6 à 9, dans lequel l'acquisition des données échographiques de l'objet comprend l'acquisition de données couleurs échographiques montrant la rigidité tissulaire, et

dans lequel la production du signal d'accessoire connecté comprend la comparaison des données couleurs échographiques acquises aux données couleurs échographiques prédéterminées et la production du signal d'accessoire connecté en fonction d'une différence de couleur entre les données couleurs échographiques acquises et les données couleurs échographiques prédéterminées, et la commande de l'accessoire corporel connecté afin qu'il affiche les données couleurs échographiques acquises dans une couleur correspondant à la différence de couleur.

11. Procédé de commande d'un accessoire corporel connecté, le procédé comprenant :

la réception, par l'accessoire corporel connecté, d'un signal d'accessoire connecté émanant d'un dispositif d'échographie diagnostique selon l'une quelconque des revendications 1 à 4 et produit en fonction de différences entre les valeurs des premières données de spectre Doppler et des deuxièmes données de spectre Doppler, et  
l'émission d'un signal d'interface utilisateur qui est fourni par le biais d'au moins une caractéristique choisie parmi l'intensité des vibrations, la variation de couleurs et l'intensité sonore, en correspondance à la différence en fonction du signal d'accessoire connecté.

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FIG. 1

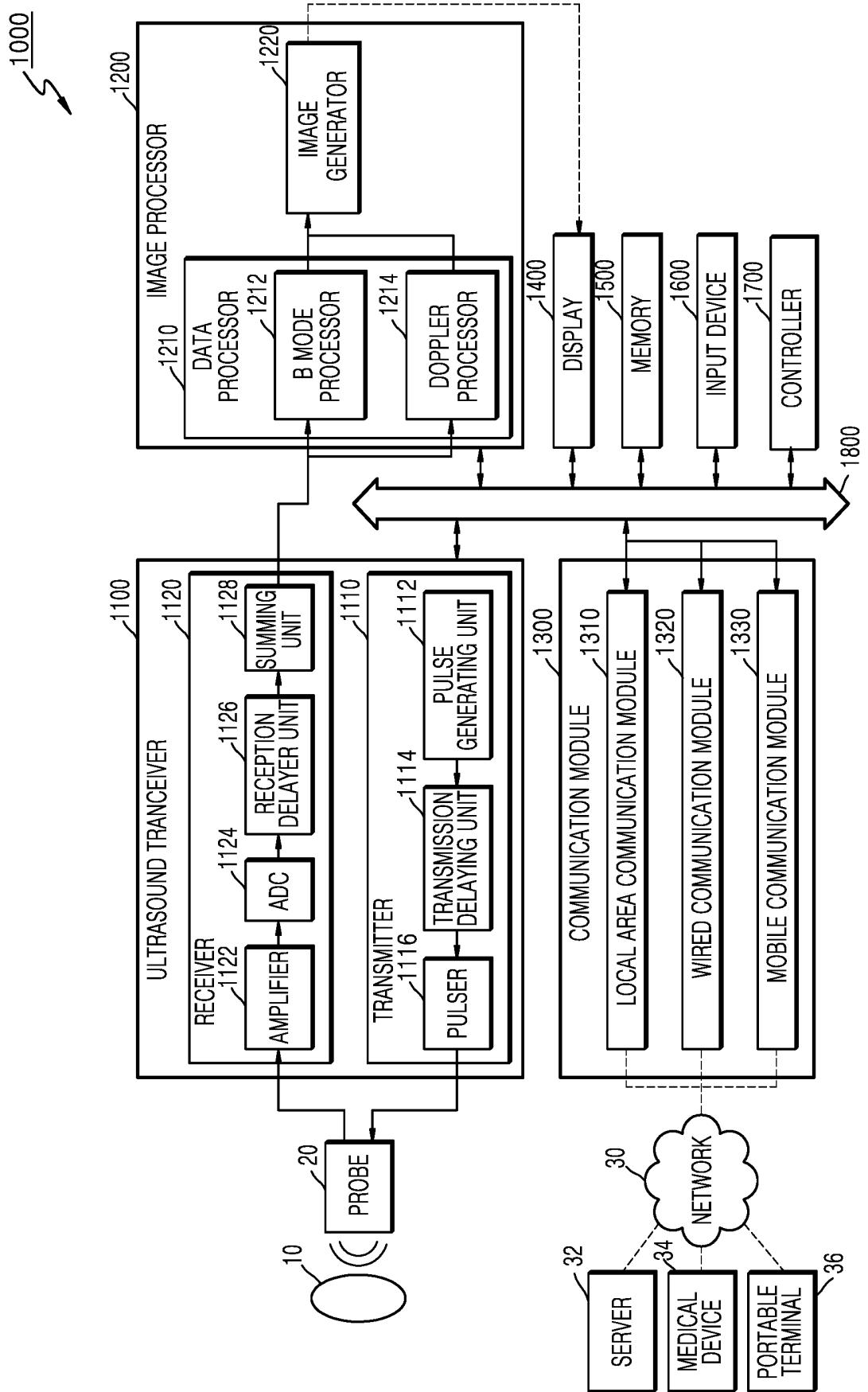


FIG. 2

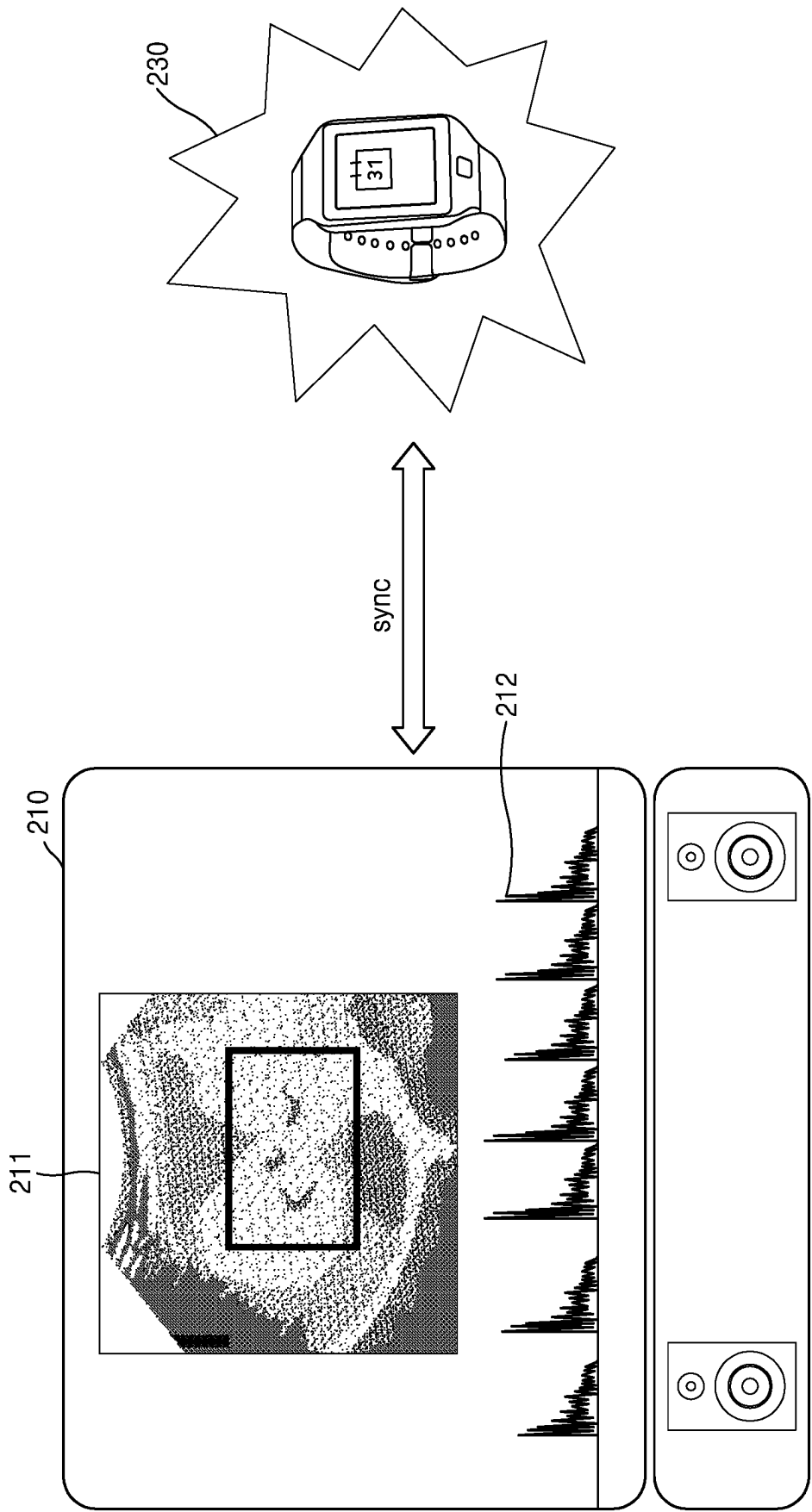


FIG. 3

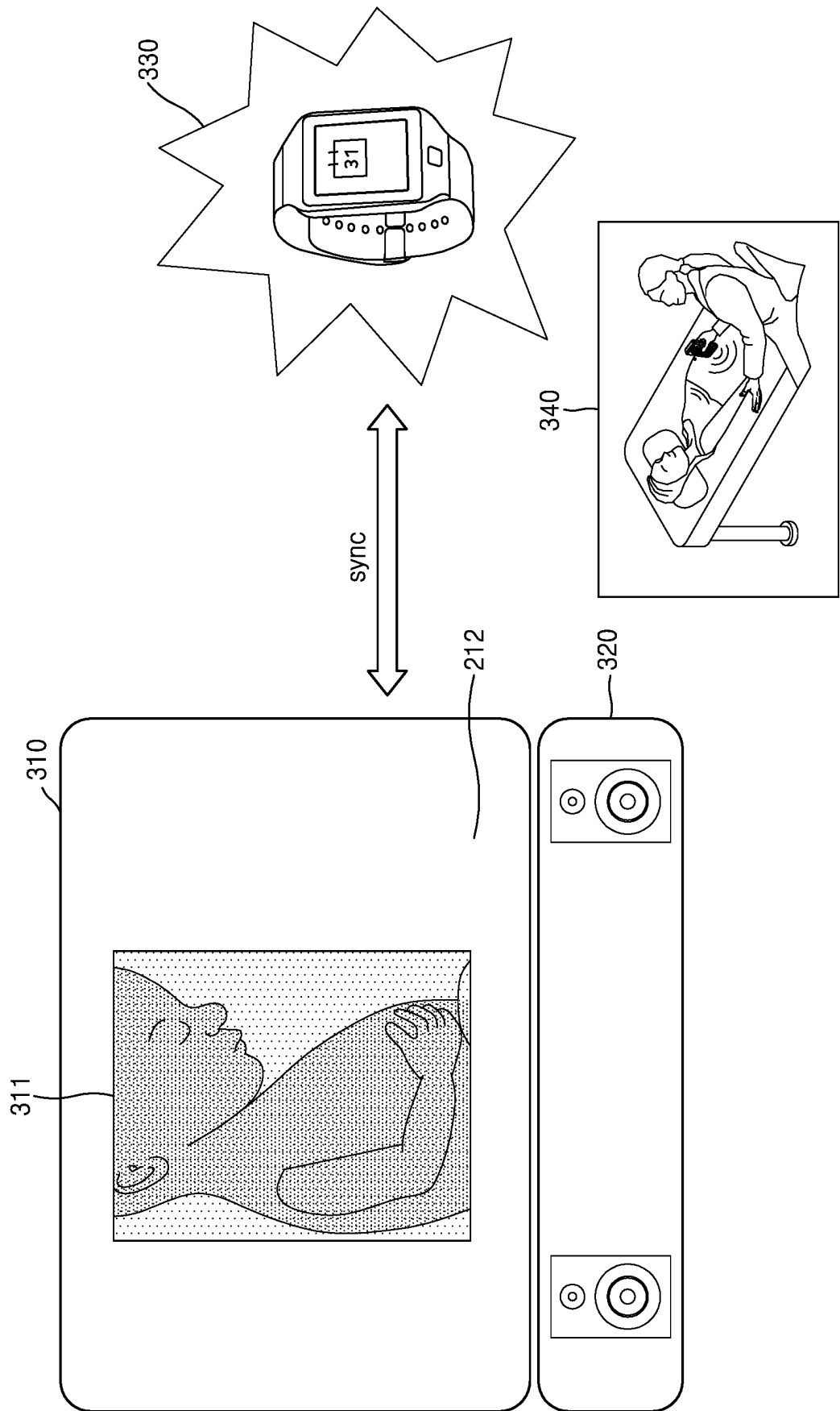


FIG. 4

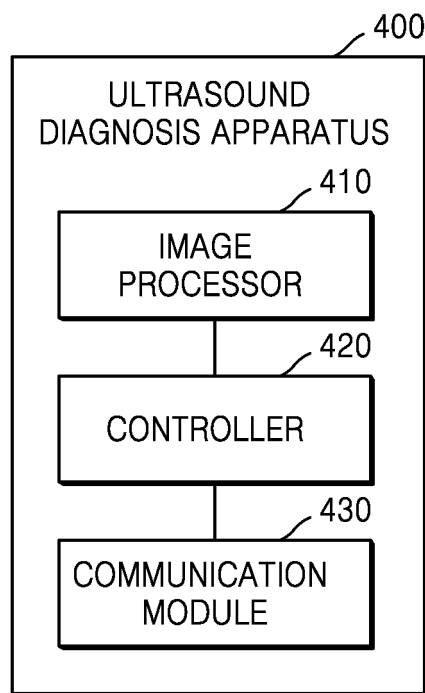


FIG. 5

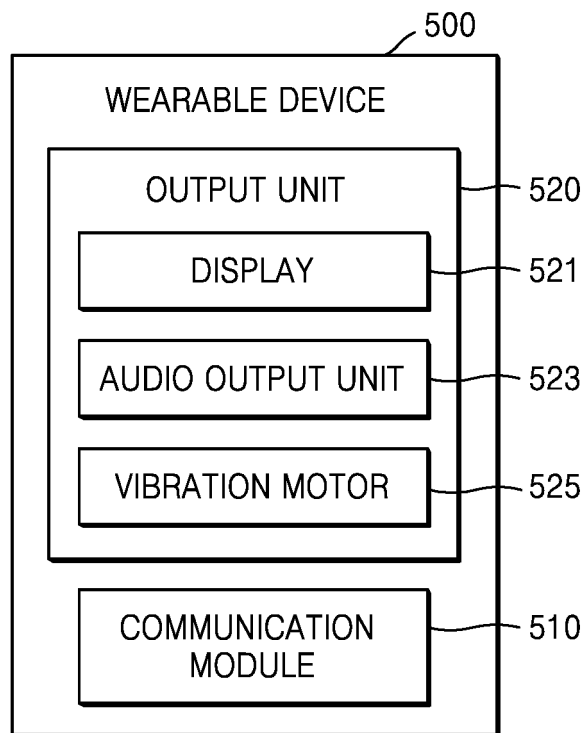


FIG. 6

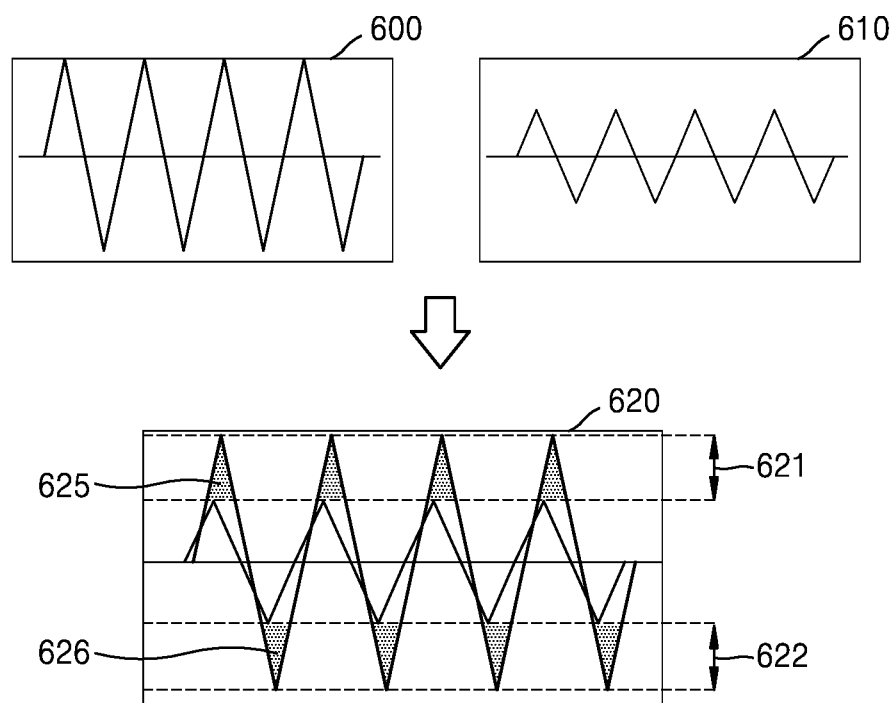


FIG. 7

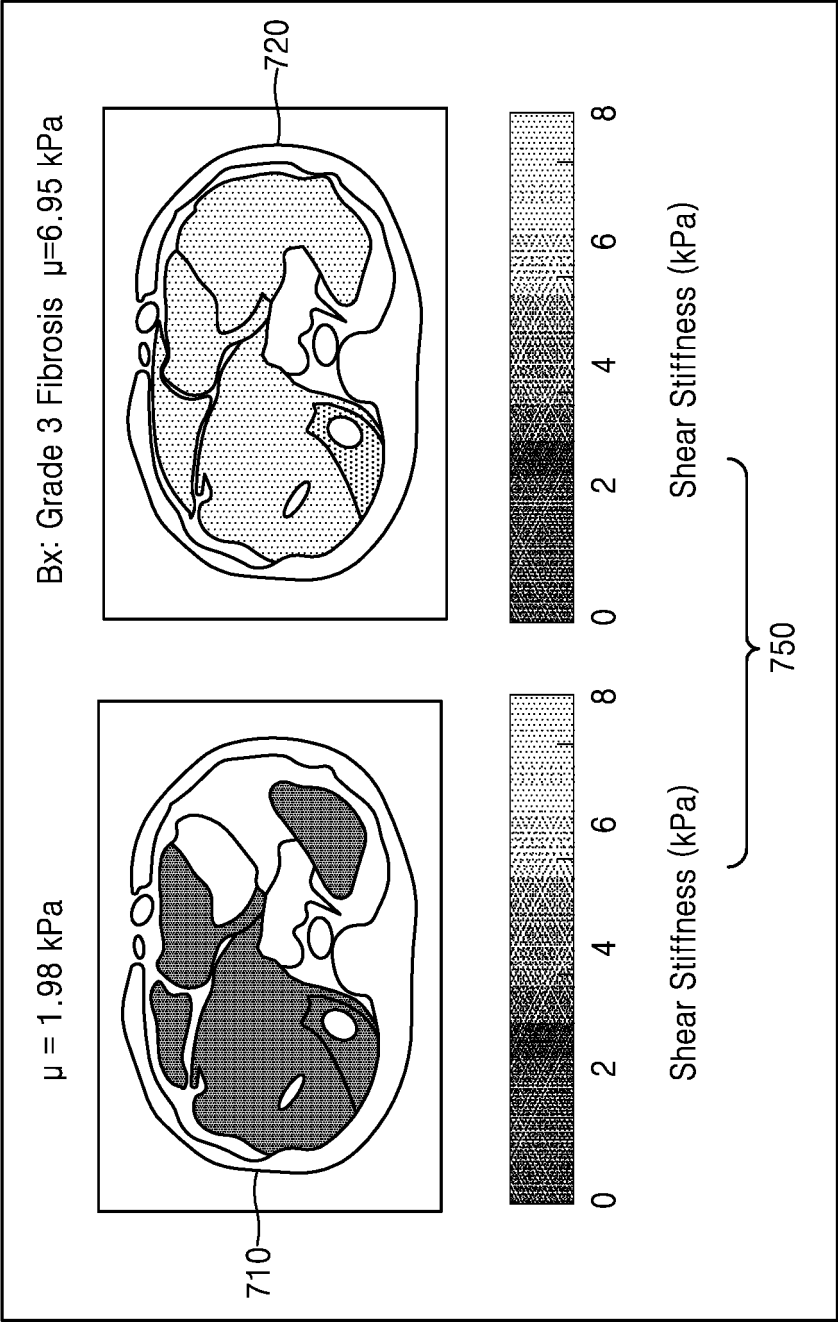


FIG. 8

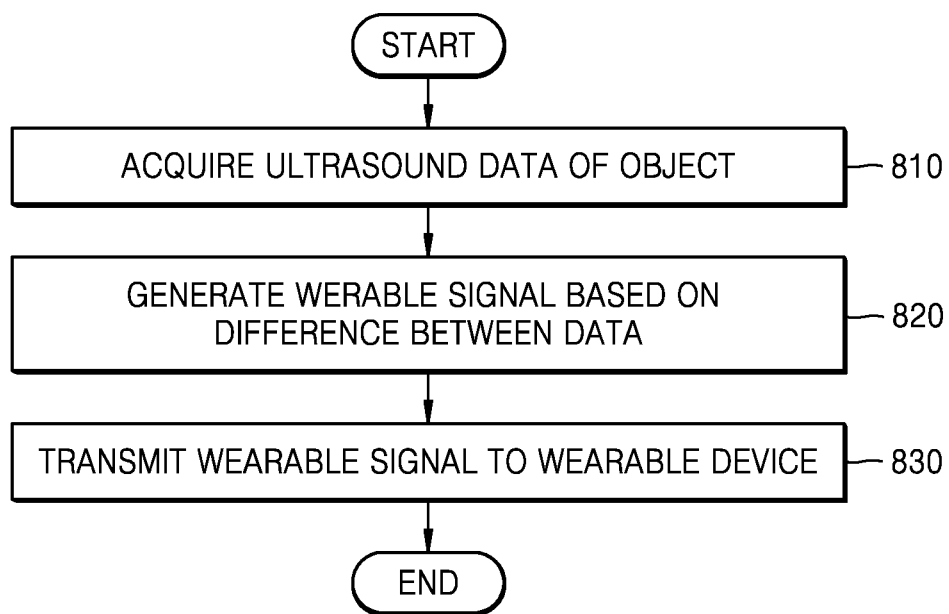


FIG. 9

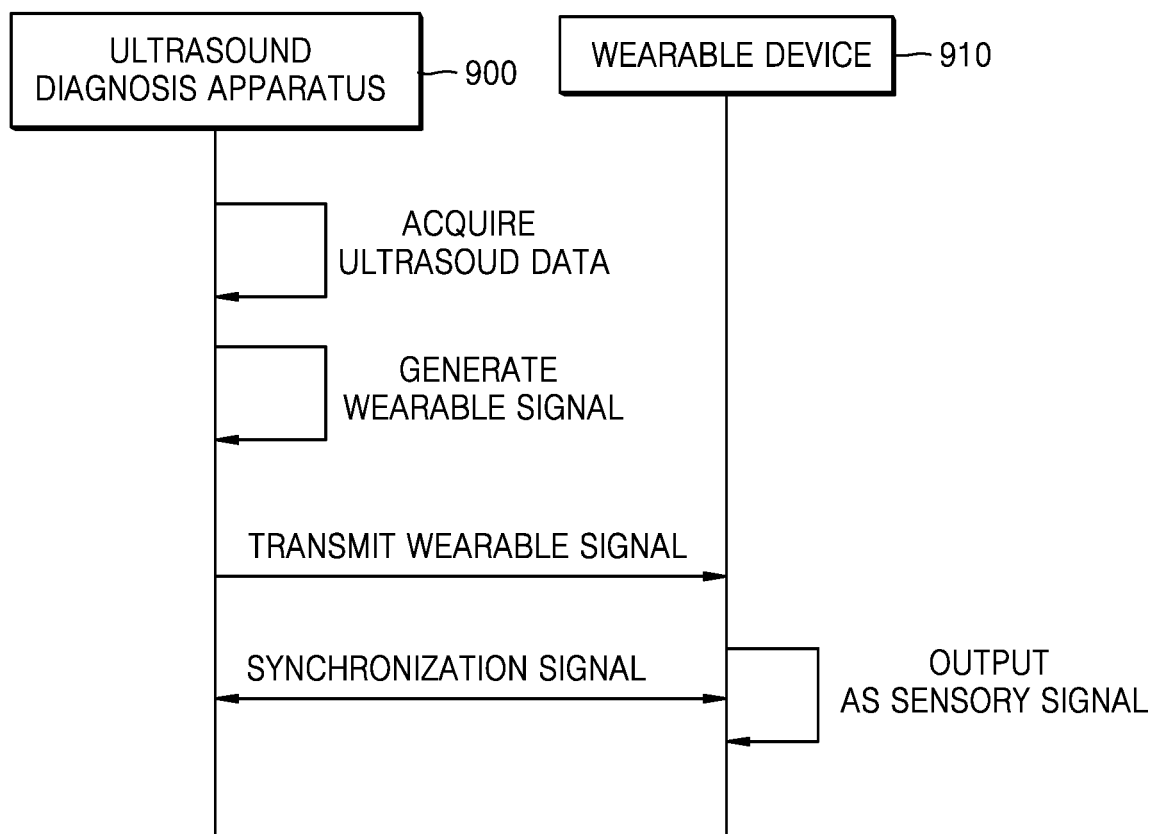


FIG. 10

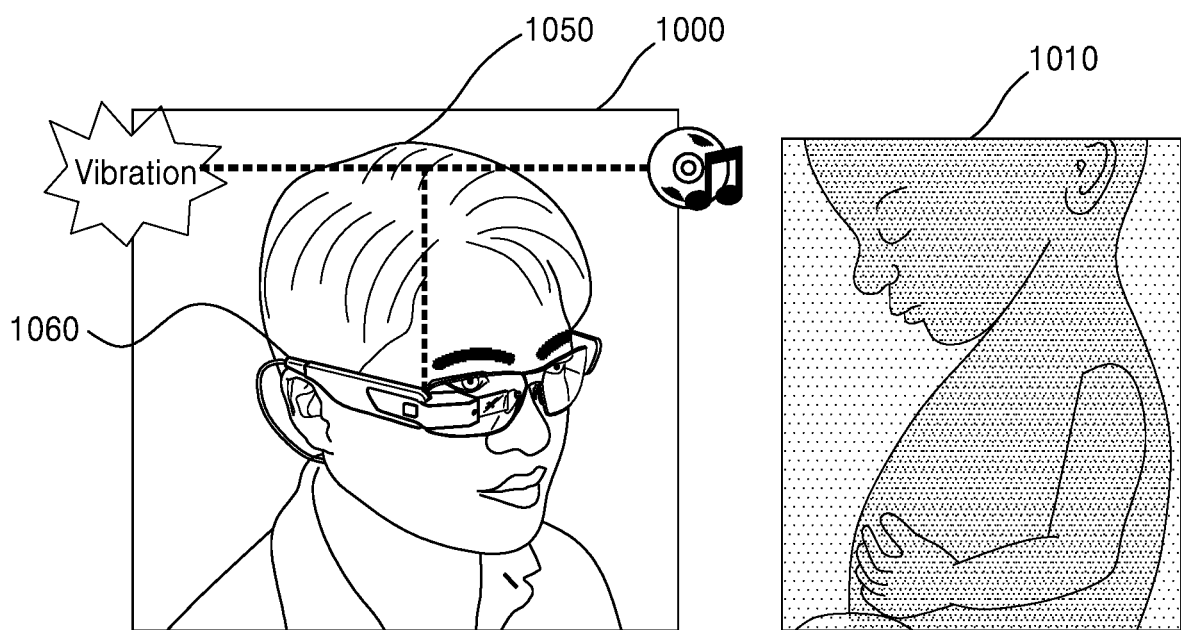


FIG. 11A

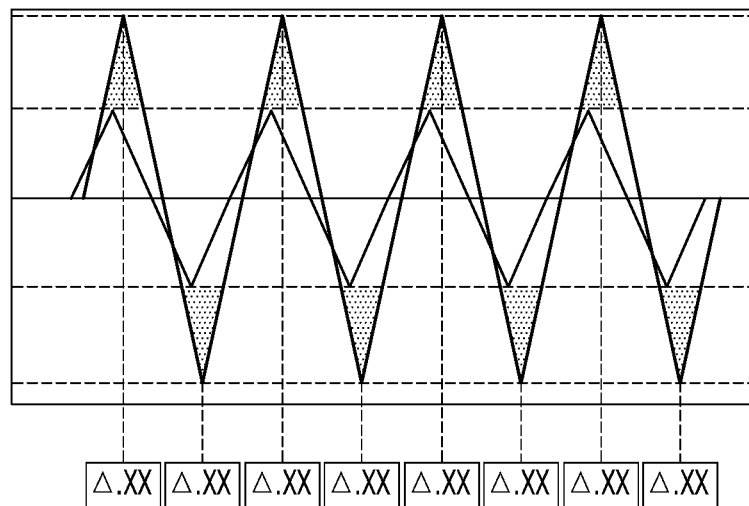


FIG. 11B

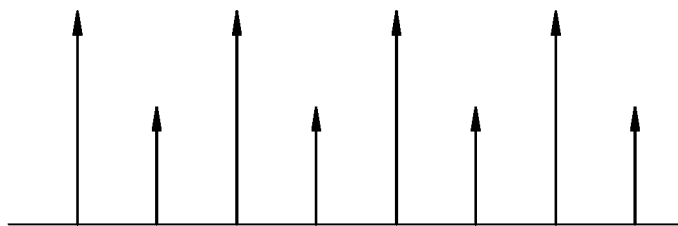
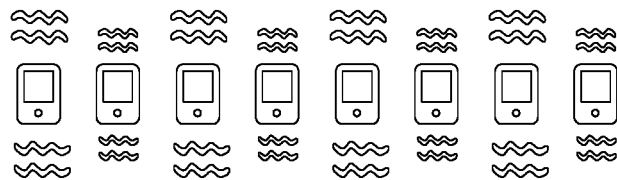
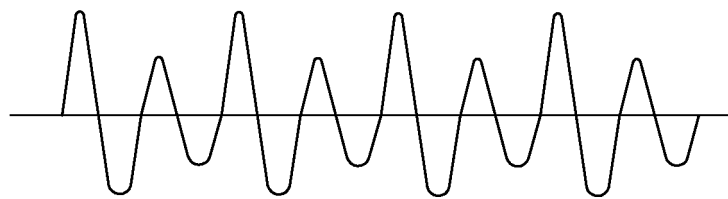


FIG. 11C



**FIG. 11D**



**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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- CN 203506759 U [0004]

|                |                                                                                                      |         |            |
|----------------|------------------------------------------------------------------------------------------------------|---------|------------|
| 专利名称(译)        | 超声诊断设备，可穿戴设备，控制超声诊断设备的方法，控制可穿戴设备的方法，以及具有记录在其上的方法的记录介质                                                |         |            |
| 公开(公告)号        | <a href="#">EP3040032B1</a>                                                                          | 公开(公告)日 | 2019-02-13 |
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| [标]申请(专利权)人(译) | 三星麦迪森株式会社                                                                                            |         |            |
| 申请(专利权)人(译)    | 三星MEDISON CO., LTD.                                                                                  |         |            |
| 当前申请(专利权)人(译)  | 三星MEDISON CO., LTD.                                                                                  |         |            |
| [标]发明人         | YANG SUN MO<br>PARK JIN HWAN<br>YOO JUN SANG<br>LEE KWANG HEE<br>LEE SEUNG JU<br>HWANG YOON GU       |         |            |
| 发明人            | YANG, SUN-MO<br>PARK, JIN-HWAN<br>YOO, JUN-SANG<br>LEE, KWANG-HEE<br>LEE, SEUNG-JU<br>HWANG, YOON-GU |         |            |
| IPC分类号         | A61B8/14 A61B8/00 A61B8/08                                                                           |         |            |
| CPC分类号         | A61B8/462 A61B8/14 A61B8/461 A61B8/486 A61B8/488 A61B8/56 A61B8/565                                  |         |            |
| 优先权            | 1020140195954 2014-12-31 KR                                                                          |         |            |
| 其他公开文献         | EP3040032A1                                                                                          |         |            |
| 外部链接           | <a href="#">Espacenet</a>                                                                            |         |            |

# 摘要(译)

提供一种超声波诊断装置，包括：图像处理器，被配置为获取对象的超声数据;控制器，被配置为生成携带与所获取的超声数据和参考超声数据之间的差相对应的信息的可穿戴信号;通信模块，用于将可穿戴信号发送给可穿戴设备。通过将超声数据与参考超声数据进行比较来获取可佩戴信号，并且包括关于超声数据和参考超声数据之间的差异的信息。

FIG. 1

