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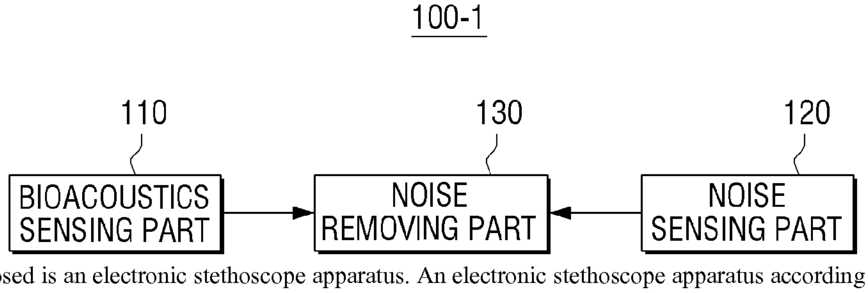
(54) **Title**: ELECTRONIC STETHOSCOPE APPARATUS, AUTOMATIC DIAGNOSTIC APPARATUS AND METHOD



(57) **Abstract**: Disclosed is an electronic stethoscope apparatus. An electronic stethoscope apparatus according to an exemplary embodiment of the present invention includes: a bioacoustics sensing part for sensing bioacoustics; a noise sensing part for sensing the noise generated in the bioacoustics sensing process; and a noise removing part for removing the sensed noised from the sensed bioacoustics and outputting the bioacoustics.

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Description

Title of Invention: ELECTRONIC STETHOSCOPE APPARATUS, AUTOMATIC DIAGNOSTIC APPARATUS AND METHOD

Technical Field

[1] The present invention relates to an electronic stethoscope apparatus, and more specifically to an electronic stethoscope apparatus which detects bioacoustics by removing noise efficiently, an automatic diagnostic device and method.

Background Art

[2] Since an electronic stethoscope apparatus uses a microphone to detect bioacoustics, there may be a high possibility of detecting noise as well according to the sensitivity of the microphone. Especially, this noise occurs frequently when a chest piece is rubbed against the body, and the extraneous noise of the chest piece may be detected.

[3] This occurrence of noise affects the accuracy of diagnosis, thus a method of removing noise properly is demanded.

[4] Meanwhile, bioacoustics has different signal features according to the body part and it is possible to diagnose disease when analyzing these signal features. In addition, so far, diseases have been diagnosed separately by using an ultrasonic device, a purse wave device, and an electrocardiography device, and now it is possible to make a more detailed diagnosis of a disease through merging several devices. Therefore, the techniques of measuring bio acoustic and diagnosing diseases by considering information of other devices are requested.

Disclosure of Invention

Technical Problem

[5] Exemplary embodiments of the present invention overcome the above disadvantages and other disadvantages not described above. Also, the present invention is not required to overcome the disadvantages described above, and an exemplary embodiment of the present invention may not overcome any of the problems described above.

[6] In view of the foregoing problems, one object of the present invention is to provide an electronic stethoscope apparatus which can remove noise properly.

[7] Another object of the present invention is to provide a technique of measuring bioacoustics and a technique of diagnosing diseases by considering information of other devices.

Solution to Problem

[8] To achieve the objects, an electronic stethoscope apparatus according to one embodiment of the present invention includes a bioacoustics detecting part which detects

bioacoustics, a noise detecting part which detects noise occurred during the process of detecting bioacoustics, and a noise removal part which outputs the bioacoustics after removing the detected noise from the bioacoustics.

[9] At this time, the bioacoustics detecting part may include a microphone.

[10] In addition, the noise detecting part includes a microphone and is installed in the chest piece of the electronic stethoscope apparatus. The noise removal part may output the detected bioacoustics by filtering with the frequency of the noise signal detected by the microphone.

[11] Furthermore, the noise detecting part includes a movement sensor which senses the movement of the electronic stethoscope apparatus. The noise removal part calculates the noise signal by using sensing value which is output from the movement sensor and may output the detected bioacoustics by filtering with the frequency of the noise signal.

[12] In addition, the electronic stethoscope apparatus according to another embodiment of the present invention includes a bioacoustics detecting part which detects bioacoustics, an electrocardiography signal detecting part which detects an electrocardiography signal, and a noise removal part which uses the detected electrocardiography signal to estimate the location of the cardiac sound from the detected bioacoustics and removes the noise from the bioacoustics..

[13] At this time, the electrocardiography signal detecting part may detect the feature of the detected electrocardiography signal, and the noise removal part may estimate the location of the cardiac sound from the detected bioacoustics by using the feature of the detected electrocardiography signal.

[14] Furthermore, the electronic stethoscope apparatus according to another exemplary embodiment of the present invention includes: a bioacoustics sensing part for sensing bioacoustics; a purse wave signal detecting part for detecting a purse wave signals; and a purse wave velocity calculation part for measuring the purse wave transfer velocity by using the distance and time between the first location of the sensed bioacoustics and the second location of the detected purse wave signal.

[15] In addition, the automatic diagnostic device according to another exemplary embodiment of the present invention includes: a bioacoustics sensing part for sensing bioacoustics; an ultrasonic image configuration part for irradiating an ultrasonic signal onto a body part and configuring an ultrasonic image by sensing the reflected ultrasonic signal; and an automatic diagnostic part for diagnosing diseases by using the sensed bioacoustics and the configured ultrasonic image.

[16] The automatic diagnostic method according to one exemplary embodiment of the present invention includes the steps of: sensing bioacoustics; sensing noise in the bioacoustics sensing process; and outputting the sensed bioacoustics after removing the

sensed noise from the sensed bioacoustics.

[17] At this point, the noise sensing step may be performed by using a microphone.

[18] In addition, the microphone is mounted on a chest piece of the electronic stethoscope apparatus, and the sensed bioacoustics may be output by filtering with a frequency of the sensed noise signal through the microphone in the noise removing step.

[19] Furthermore, the noise sensing step senses noise by using a movement sensor for sensing the movement of the electronic stethoscope apparatus, and the noise removing step may calculate a noise signal by using sensing value which is output from the movement sensor and may output the sensed bioacoustics by filtering with the frequency of the noise signal.

[20] Moreover, the automatic diagnostic method according to other exemplary embodiment of the present invention includes the steps of: sensing bioacoustics; detecting an electrocardiography signal; and removing noise from the sensed bioacoustics by estimating the location of a heart sound from the sensed bioacoustics by using the detected electrocardiography signal.

[21] At this point, the electrocardiography signal detecting step may detect the features of the detected electrocardiography signal, and the noise removing step may estimate the location of the heart sound from the sensed bioacoustics by using the features of the detected electrocardiography signal.

[22] In addition, the automatic diagnostic method according to another exemplary embodiment of the present invention, in the automatic stethoscope method, includes the steps of: sensing bioacoustics; detecting a purse wave signal; and estimating a purse wave transfer velocity by using the distance and time between the first location of the sensed bioacoustics and the second location of the detected purse wave signal.

[23] Furthermore, the automatic diagnostic method includes the steps of: sensing bioacoustics; irradiating an ultrasonic signal onto a body part and configuring an ultrasonic image by sensing the reflected ultrasonic signal; and diagnosing diseases by using the sensed bioacoustics and the configured ultrasonic image.

Advantageous Effects of Invention

[24] According to various exemplary embodiments as above, the present invention이provides the electronic stethoscope apparatus for removing noise properly.

[25] In addition, the present invention provides the technique of estimating bioacoustics and the technique of diagnosing diseases by also considering information of other devices.

Brief Description of Drawings

[26] The above and/or other aspects of the present invention will be more apparent by describing certain exemplary embodiments of the present invention with reference to the

accompanying drawings, in which:

[27] FIG. 1 is a block diagram illustrating a configuration of an electronic stethoscope apparatus according to an exemplary embodiment of the present invention.

[28] FIG. 2 to FIG. 5 are block diagrams illustrating a configuration of an electronic stethoscope apparatus according to various exemplary embodiments of the present invention.

[29] FIG. 6 is a reference diagram illustrating the method of separating target bioacoustics from bioacoustics where a plurality of source bioacoustics are synthesized.

[30] FIG. 7 is a block diagram illustrating a configuration of an electronic stethoscope apparatus according to other exemplary embodiment of the present invention.

[31] FIG. 8 is a block diagram of a configuration of an electronic stethoscope apparatus according to another exemplary embodiment of the present invention.

[32] FIG. 9 is a block diagram illustrating a block diagram illustrating a configuration of an electronic stethoscope apparatus according to another exemplary embodiment of the present invention.

[33] FIG. 10 is a reference diagram schematically illustrating an operation of an electronic stethoscope apparatus according to another exemplary embodiment of the present invention.

[34] FIG. 11 is a drawing illustrating a wave form of an electrocardiography signal.

[35] FIG. 12 is a drawing illustrating a location correlation between a stethoscope signal and an electrocardiography signal.

[36] FIG. 13 is a block diagram illustrating a configuration of an electronic stethoscope apparatus according to another exemplary embodiment of the present invention.

[37] FIG. 14 is a reference diagram schematically illustrating an operation of an electronic stethoscope apparatus according to another exemplary embodiment of the present invention.

[38] FIG. 15 is a drawing illustrating wave forms of a heart sound and a purse wave.

[39] FIG. 16 is a block diagram illustrating an operation of an electronic stethoscope apparatus according to another exemplary embodiment of the present invention.

[40] FIG. 17 is a reference diagram schematically illustrating an operation of an electronic stethoscope apparatus according to another exemplary embodiment of the present invention.

[41] FIG. 18 is a block diagram illustrating a configuration of a remote diagnosis system according to an exemplary embodiment of the present invention.

[42] FIG. 19 is a flowchart illustrating a remote diagnosis method.

[43] FIG. 20 to FIG. 23 are flowcharts of an automatic diagnostic method according to various exemplary embodiment of the present invention.

Best Mode for Carrying out the Invention

[44] -

Mode for the Invention

[45] Hereinafter, description will be given in detail of the present disclosure with reference to the accompanying drawings.

[46] FIG. 1 is a block diagram illustrating a configuration of an electronic stethoscope apparatus100-1according to an exemplary embodiment of the present invention.

[47] Referring to FIG. 1, the electronic stethoscope apparatus 100-1 includes a bioacoustics sensing part 110, a noise sensing part 120, and a noise removing part 130.

[48] The bioacoustics sensing part 110 is for sensing bioacoustics. Specifically, the bioacoustics sensing part 110 uses at least one stethoscope sensor to sense various types of bioacoustics. At this point, the bioacoustics may be at least one sound among a pulmonary sound, a heart sound, and an abdomen sound. Specially, each bioacoustics has different frequency features such as frequency bands and periods etc. For example, a heart sound may have a low frequency and a pulmonary sound may have relatively a low frequency. Also, bioacoustics sensed by the bioacoustics sensing part may be a sound of various bioacoustics combined.

[49] According to an exemplary embodiment of the present invention, the bioacoustics sensing part may include: a stethoscope sensor(not illustrated); a sensor driving part(not illustrated); an amplifying part(not illustrated); a filtering part(not illustrated); and a A/D converting part(not illustrated). The stethoscope sensor collects bioacoustics by physical contact or physical non-contact. Here, the stethoscope sensor is a sensor configured to collect bioacoustics and convert into electrical signal, and a microphone is a typical example of it. The microphone may be a microphone for physical contact comprising an impedance matching circuit using a piezzo film. The microphone may be mounted on a chest piece which makes physical contact for collecting bioacoustics.

[50] More than two stethoscope sensors may be included to collect bioacoustics from several locations.

[51] The sensor driving part operates a stethoscope sensor and outputs a great number of bioacoustics signals that are converted into electrical signals from the stethoscope sensor. Therefore, the sensor driving part may include as many sensor driving module as corresponding to the number of the stethoscope sensor.

[52] The amplifying part amplifies each of a plurality of bioacoustics, which are output from the sensor driving part, to reach the desired amplification gain.

[53] The filtering part may remove a high frequency or low frequency noise from collected bioacoustics. The function of the filtering part may be performed by a noise removing part 130 which is to be described later.

[54] The A/D converting part converts and outputs the bioacoustics filtered from the filtering part or the noise removing part into digital signals.

[55] The noise sensing part 120 senses the noise generated in the bioacoustics sensing process. The noise sensing part 120 may include a configuration similar to the mentioned bioacoustics sensing part.

[56] That is, the noise sensing part 120 may include: a noise sensing sensor(not illustrated); a sensor driving part(not illustrated); an amplifying part(not illustrated), a filtering part (not illustrated); and an A/D converting part(not illustrated).

[57] The noise sensing sensor is located within or outside the chest piece and may sense a noise.

[58] The noise sensing sensor includes a microphone and may sense such noise generated by contacting with skin in the bioacoustics sensing process. The sensed sound may be output after being properly processed such as amplification, filtering or A/D conversion.

[59] The noise sensing sensor may include a movement sensor. The movement sensor may be located mostly in the chest piece and the movement sensor senses the movement of the chest piece in this case. For example, the movement sensor senses the vibration of the chest piece generated in the bioacoustics measuring process.

[60] The movement sensor may be embodied as various sensors such as a gravitational acceleration sensor, a geomagnetic sensor, and a gyro sensor etc.

[61] For example, when the movement sensor is embodied as a fluxgate geomagnetic sensor using a fluxgate, the movement sensor includes a fluxgate core consist of high permeable magnetic materials such as permalloy; an driving coil that wound with a core; and a fluxgate sensor formed with detecting coil. The number of fluxgate core may be two or three. Each fluxgate core is manufactured in mutual orthogonal form. That is, the biaxial fluxgate sensor is embodied with X-axis and Y-axis fluxgates. The triaxial fluxgate sensor is embodied with X-axis, Y-axis, and Z-axis fluxgates. Accordingly, the size and the direction of external magnetic field is measured by detecting second harmonic component that is proportional to the external magnetic field by using a detecting coil once magnetism is induced after operating signal is allowed in each operating coil where each fluxgate core is wound. Therefore, rotation angle and rotation direction may be sensed by comparing the direction of previously measured magnetic field with the direction of currently measured magnetic.

[62] For another example, the movement sensor may include a gyro sensor. The gyro sensor is a sensor for measuring how much angle has moved in one second. That is, Coriolis force occurs when an object moves and the gyro sensor uses this formula of Coriolis force to sense angular speed that works in inertial frame. Therefore, rotation angle and rotation direction may be sensed.

[63] Meanwhile, the movement sensor may include an acceleration sensor additionally to compensate for influence according to tilting degre. That is, the movement sensor may calculate the exact rotation angle and rotation direction by considering even a tilt angle such as a pitch angle and a roll angle that is measured by the acceleration sensor.

[64] The noise removing part 130 removes the noise from the sensed bioacoustics and outputs it.

[65] Specifically, when the noise sensing part 120 includes a microphone, the noise removing part 130 outputs the sensed bioacoustics by filtering with the frequency of noise signal sensed by the microphone. The microphone senses a microphone input background noise signal as a reference signal. Then, the noise removing part 130 uses the reference signal to remove the background noise coming into the stethoscope sensor with the adaptation filter.

[66] When the noise sensing part 120 includes a movement sensor for sensing a movement of an electronic stethoscope apparatus 100-1, the noise removing part 130 uses the sensing value which is output from the movement sensor to calculate the noise signal and outputs the sensed bioacoustics by filtering it with the frequency of the noise signal. When a chest piece moves to horizontal or vertical direction and makes contact with a body, the noise is occurred accordingly and the noise sensing part 120 senses the noise. Then, the noise removing part 130 uses the movement direction and size of the bioacoustics sensing part 110 and the interrelationship among friction noise to remove the noise signal. The interrelation here means relationship of the size and the features of the noise occurred according to the movement direction and the movement size.

[67] FIG. 2 to FIG. 5 are block diagrams illustrating a configuration of an electronic stethoscope apparatus according to various exemplary embodiments of the present invention.

[68] Referring to FIG. 2, the electronic stethoscope apparatus 100-1according to an exemplary embodiment of the present invention includes a movement sensor which can be mounted on inner or outer surface of the chest piece. The movement sensor senses the movement of the chest piece in the stethoscope progress and outputs the movement data. The noise removing part 130 uses the movement data to estimate the noise occurring area. For an exemplary embodiment, the noise data corresponding to the accumulated movement data is stored in a storing part (not illustrated) and the measured movement data can be mapped. The noise removing part 130 outputs the sensed bioacoustics by filtering it with the frequency of the noise signal.

[69] Referring to FIG. 3, the electronic stethoscope apparatus100-2 according to other exemplary embodiment of the present invention includes a movement sensor mounted on inner or outer surface of the chest piece, and the microphone can be located outside

of the chest piece. In this case, the movement sensor senses the movement of the chest piece in the stethoscope progress and outputs the movement data. The noise removing part 130 uses the movement data to estimate the noise occurring area. The noise removing part 130 outputs the sensed bioacoustics by filtering it with the frequency of the noise signal. The microphone senses and outputs the noise generated in the bioacoustics measuring process from the outside of the chest piece. Then noise removing part 130 outputs the sensed bioacoustics by filtering it with the frequency of the sensed noise signal with the microphone.

[70] Referring to FIG. 4, the electronic stethoscope apparatus 100-2 according to another exemplary embodiment of the present invention includes a microphone mounted on inner or outer surface of the chest piece. In this case the microphone senses and outputs the noise generated in the bioacoustics measuring process. Then noise removing part 130 outputs the sensed bioacoustics by filtering it with the frequency of the sensed noise signal with the microphone.

[71] Referring to FIG. 5, the electronic stethoscope apparatus 100-5 according to another exemplary embodiment of the present invention includes a microphone mounted on the outer surface of the chest piece. In this case, it is similar to the above embodiment.

[72] Human body generates bioacoustics with different characteristics from various body parts. For example, a heart sound, a pulmonary sound, and an abdomen sound occur around a human abdomen. In this case, when locating a sensor of a stethoscope apparatus around the abdomen, the stethoscope apparatus senses bioacoustics synthesized with a heart sound, a pulmonary sound and an abdomen sound.

[73] Especially, when a doctor uses a stethoscope apparatus to diagnose the body condition of a person, if the doctor cannot detect the exact target bioacoustics then there might be a problem of making misdiagnosis since the doctor makes a diagnosis based on the bioacoustics that is not detected properly.

[74] Therefore, it is necessary to separate the target bioacoustics from the bioacoustics where a plurality of source bioacoustics is synthesized for a doctor to make a diagnose properly based on the bioacoustics.

[75] FIG. 6 is a reference diagram illustrating the method of separating target bioacoustics from bioacoustics where a plurality of source bioacoustics is synthesized.

[76] Referring to FIG. 6, the present invention may detect the target bioacoustics for diagnosis by considering the spatiality of the bioacoustics sensed by a multi stethoscope sensor (n channel stethoscope signal and separating the source bioacoustics.

[77] Whereas, the target bioacoustics may be detected by removing reference bioacoustics sensed by the second stethoscope sensor from the bioacoustics sensed by the first stethoscope sensor.

[78] FIG. 7 is a block diagram illustrating a configuration of an electronic stethoscope apparatus 100-2 according to other exemplary embodiment of the present invention.

[79] Referring to FIG. 7, the electronic stethoscope apparatus 100-2 according to other exemplary embodiment of the present invention includes a bioacoustics sensing part, 110, a separation part 140, and a output part 135.

[80] The bioacoustics sensing part 110 is already described, so the description will be omitted.

[81] The separation part 140 uses the spatiality of the bioacoustics to separate the sensed bioacoustics into a plurality of source bioacoustics. At this point, the spatiality of the bioacoustics can be a gain and delay of bioacoustics sensed through a plurality of stethoscope sensor. That is, the separation part 140 may analyze the gain and delay of source bioacoustics and separate a plurality of source bioacoustics from the sensed bioacoustics.

[82] The separation part 140 includes: a setting part 141; a estimating part 143; a clustering part 145; a recovery part 147; and an detecting part 149.

[83] The setting part 141 sets a signal mixing model which is reflected with spatiality of bioacoustics. For example, the setting part 141 may set the signal mixing model as Equation 1 below when receiving bioacoustics including two source bioacoustics from two stethoscope sensors.

[84] <Equation 1>

[85] $$x_1(t)=s_1(1)+s_2(t)$$

[86] $$x_1(t)=a_1 s_1(t\text{-}d_1)+a_2 s_2(t\text{-}d_2)$$

[87] Here, x1 and x2 are signals received by the stethoscope sensor. s1 and s2 are the first source bioacoustics signal and the second source bioacoustics signal. a1 and a2 are the gain damping ratios of the first and second source bioacoustics signals. d1 and d2 are the delay values of the first and the second source bioacoustics signals.

[88] The estimating part 143 uses the signal mixing model that is set by the setting part to estimate mixing parameter of bioacoustics signal received into each stethoscope sensor. The mixing parameter may include the gain damping ratio (a) and delay value (d).

[89] The clustering part 145 clusters the mixing parameter estimated by the estimating part 143 in the parameter space. Specifically, the clustering part 145 may cluster the estimated mixing parameters in the parameter space having x-axis as gain damping ratio(a) and y-axis as delay value (d).

[90] The recovery part 147 uses the mixing parameters clustered by the clustering part 145 to convert the bioacoustics into a time domain and recover a plurality of source

bioacoustics. For example, the recovery part 147 may convert the signal detected in the first domain from the parameter space into the time domain and recover the signal as the first source bioacoustics, and may convert the signal detected in the second domain into the time domain and recover the signal as the second source bioacoustics.

[91] The detecting part 149 detects the target bioacoustics among a plurality source bioacoustics recovered by the recover part 147. The target bioacoustics may be bioacoustics selected by the user but it is not limited to this, and may be defaulted in manufacturing process.

[92] Meanwhile, the stethoscope 100-2 may further include a user input part (not illustrated) for selecting the target bioacoustics which and user wants to detect.

[93] The output part 135 may output the detected target bioacoustics. At this point, the output part 135 may output the target bioacoustics in audio form, however, this is just an exemplary embodiment, so the target bioacoustics may be output in video form.

[94] By the stethoscope apparatus as described above, the user may effectively separate or detect the target bioacoustics that the user wants to diagnose.

[95] FIG. 8 is a block diagram of a configuration of an electronic stethoscope apparatus 100-3 according to another exemplary embodiment of the present invention.

[96] The stethoscope apparatus 100-3 includes: a bioacoustics sensing part 110 with the first stethoscope sensor 111 and the second stethoscope sensor 112; a detecting part 149; and an output part 135.

[97] The bioacoustics sensing part 110 uses a plurality of stethoscope sensor to sense a reference bioacoustics and a synthesis bioacoustics including a reference bioacoustics and a target bioacoustics. Especially, the bioacoustics sensing part 110, as illustrated in FIG. 8, includes the first 111 and the second 112 stethoscope sensor. The bioacoustics sensing part 110 senses the synthesis bioacoustics that is synthesized with a reference bioacoustics and a target bioacoustics through the first stethoscope sensor 111, and senses the reference bioacoustics through the second stethoscope sensor 112. Meanwhile, the method in which the bioacoustics sensing part 110 uses a plurality of the stethoscope sensor for signal process is already described so the description will be omitted.

[98] The detecting part 149 uses an adaptation filter to remove the reference bioacoustics sensed by the second stethoscope sensor 112 from the synthesis bioacoustics sensed by the first stethoscope sensor 111 and detect the target bioacoustics. Specifically, if the synthesis bioacoustics signal measured from the first stethoscope sensor 111 is input into the detecting part 149 in the state where reference bioacoustics is still mixed in, the adaptation filter of the detecting part observes the output value and changes the coefficient of the adaptation filter to perform feedback. With such operation, the adaptation filter may filter the reference bioacoustics signal from the measured

synthesis bioacoustics signal and detects the target bioacoustics.

[99] The output part 135 outputs the target bioacoustics detected by the detecting part 149. The output part 135 may output the target bioacoustics in audio form; however, this is just an exemplary embodiment, so the target bioacoustics may also be output in video.

[100] Especially, the described embodiment is useful when measuring the bioacoustics with noise accurately. For example, the purse sound of a mother may be mixed as noise with the heart sound of a fetus when listening to the heart sound of a fetus. Therefore, the synthesis bioacoustics synthesized with the heart sound of a fetus and the purse sound of a mother may be obtained by contacting the first stethoscope sensor 111 on the mother's abdomen. Also the purse sound of a mother can be obtained as a reference bioacoustics by contacting the second stethoscope sensor 112 on radial artery (where you can feel purse). With the method described above, the user may listen to the heart sound of a fetus more clearly by removing the purse sound of a mother which is a reference bioacoustics.

[101] The stethoscope apparatus according various exemplary embodiment of the present invention enables automatic disease diagnosis through outputted stethoscope signals. In addition, the accuracy of diagnosis can be higher when combining with several medical technologies. These various exemplary embodiments are described in the following.

[102] FIG. 9 is a block diagram illustrating a block diagram illustrating a configuration of an electronic stethoscope apparatus 100-4 according to another exemplary embodiment of the present invention. FIG. 10 is a reference diagram schematically illustrating an operation of an electronic stethoscope apparatus 100-4 according to another exemplary embodiment of the present invention. FIG. 11 is a drawing illustrating a wave form of an electrocardiography signal. FIG. 12 is a drawing illustrating a location correlation between a stethoscope signal and an electrocardiography signal.

[103] Referring to FIG. 9, the stethoscope device 100-4 according to another exemplary embodiment of the present invention includes: a bioacoustics sensing part 110; an electrocardiography signal detecting part 150; and a noise removing part 130.

[104] The function of the bioacoustics sensing part 110 is as described above, so description is omitted.

[105] The electrocardiography signal detecting part 150 is a configuration for detecting an electrocardiography signal. Specifically, the electrocardiography signal detecting part 150 detects subtle electronic signal sensed from skin through a pair of electrodes attached on the skin when the cardiac muscle depolarizes on every heartbeat. On resting phase, each cardiac muscle cell has negative charge and it is called a membrane potential. These negative charges are decreased due to the inflow of cations such as

Na+ and Ca++, so the depolarization occurs and the heart contracts. During each heartbeat, the heart provides an orderly depolarization wave form spreading out from the signal coming out from sinoatrial node to whole ventricle. A wave form of small voltage sensed by a pair of electrodes can be expressed on display in curve.

[106] Within one cycle of the electrocardiography signal, P wave, Q wave, R wave, S wave, and T wave are generally generated consecutively as illustrated in FIG. 11.

[107] P wave indicates the contraction of an atrium and a series of P wave, R wave and S wave (ORS complex) indicates the contraction of a ventricle, and T wave is feature of the relaxation of a ventricle.

[108] The electrocardiography signal detecting part 150 detects features of the QRS complex section, P wave and T wave (S1010). The QRS complex section is an electrocardiography signal section between the QRS complex starting point and the QRS complex ending point having the point where the size of the an electrocardiography signal(voltage, y-axis) is at the peak as a center. During the process, the noise of an electrocardiography signal is removed by itself as in FIG. 10. (This is distinguished from the operation of the noise removing part which is described later.)

[109] The noise removing part 130 uses the detected electrocardiography signal to estimate the location of the heart sound from the sensed bioacoustics. Then the noise removing part removes the noise from the sensed bioacoustics (S1020)

[110] The noise removing part 130 may remove the noise according to the signal feature of the bioacoustics and a respiration signal. Generally, a heart sound has feature of an impulse signal, whereas, a breathing or noise sound has feature of a white noise. In addition, a heart sound and a respiration signal has different frequency band, so it is possible to detect a heart sound using a frequency filter. However, sometimes it is possible not to remove the noise completely when detecting a heart sound, so it is necessary to locate a heart sound more precisely. Since disease can be diagnosed according to the location of noise generated based on the location of a heart sound.

[111] It is possible to diagnose a disease using the above mentioned signal features of a respiration signal. A normal respiration signal has the feature of white noise and the size decreases as it goes to high frequency. However, an abnormal respiration signal includes crackle, wheezing, stridor, and pleural rub etc., and has different frequency feature with the normal respiration signal in case of diseases related to respiration organs.

[112] As illustrated in FIG. 12, there is a correlation between the location of the stethoscope signal and the electrocardiography signal. That is, the heart sound of the stethoscope signal is located at the end part of the QRS section of the electrocardiography signal. Therefore, the noise removing part 130 uses the electrocardiography signal to locate the heart sound of the stethoscope signal. Especially, when a lot of

noise is included in the stethoscope signal, it may be difficult to locate the location of the heart sound with the stethoscope signal itself. In this case, it may locate the location of the heart sound of the stethoscope signal using the electrocardiography signal.

[113] The electronic stethoscope device 100-3 according to another exemplary embodiment of the present invention may remove the noise by detecting the features of the electrocardiography signal through the electrocardiography signal detecting part. Then the information is used to detect features of the stethoscope signal. That is, it may be used to remove the noise from the stethoscope signal and detect accurate features of a heart sound or a pulmonary sound.

[114] When auscultating a respiration signal, the noise removing part 130 filters the heart sound from the detected bioacoustics after estimating the location of the heart sound through the location of the features.

[115] The electronic stethoscope apparatus similar to the above mentioned exemplary embodiment may be further considered. An electronic stethoscope apparatus with a purse wave detecting means is described in the following.

[116] FIG. 13 is a block diagram illustrating a configuration of an electronic stethoscope apparatus 100-5 according to another exemplary embodiment of the present invention. FIG. 14 is a reference diagram schematically illustrating an operation of an electronic stethoscope apparatus 100-5 according to another exemplary embodiment of the present invention. FIG. 15 is a drawing illustrating wave forms of a heart sound and a purse wave.

[117] Referring to FIG. 13, the stethoscope apparatus 100-3 includes: a bioacoustics sensing part 110; a purse wave signal detecting part 160; and a purse wave velocity calculating part 165.

[118] The bioacoustics sensing part 110, as mentioned above, outputs the stethoscope signal. As mentioned above, the noise filtering is possible from the sensed bioacoustics and features of the stethoscope signal can be detected (S1410).

[119] The purse wave signal detecting part 160 detects a purse wave signal. The purse wave signal detecting part 160 measures the purse wave generated as a result of the repetition of the contraction and relaxation of a human heart from the bold vessel, and the purse wave signal detecting part is configured with the sensor elements having several physical features according to the measuring purpose. For example, a pressure sensor using elements such as piezzo element generating an output signal according to the pressure may be used. The purse wave signal detecting part 160 detects the purse wave signal and calculates the feature location (S1420).

[120] The purse wave velocity calculating part 165 uses the time between the first location of the sensed bioacoustics and the second location of the detected purse wave signal to

estimate the purse wave transfer velocity (S1430).

[121] Referring to FIG. 15, start location time (T1) of the heart sound is estimated from the exemplary embodiment of the present invention and the time (T2) of the incisura(v point) location is measured from the purse wave. Then it may estimate the purse wave transfer velocity by using both distance between the bioacoustics sensing part 110 and the purse wave signal detecting part 160 and time difference between the start location time(T1) of the heart sound and the time(T2) of the incisura (v point) location.

[122] In case the purse wave transfer velocity is slow, the blood vessel can be diagnosed as healthy. Since the wave of the purse wave is absorbed and the purse wave transfer velocity slows down in case of having soft and elastic blood vessel. The purse wave transfer velocity also slows down when having a big internal diameter of the blood vessel.

[123] The electronic stethoscope apparatus with ultrasonic detecting means is described in the following.

[124] FIG. 16 is a block diagram illustrating an operation of an electronic stethoscope apparatus 100-6 according to another exemplary embodiment of the present invention. FIG. 17 is a reference diagram schematically illustrating an operation of an electronic stethoscope apparatus 100-6 according to another exemplary embodiment of the present invention.

[125] Referring to FIG. 16, the electronic stethoscope apparatus 100-6 includes: a bioacoustics sensing part 110; an ultrasonic image configuration part 170; and an automatic diagnosis part 180.

[126] The bioacoustics sensing part 110 outputs the stethoscope signal (S1710). As mentioned above, the noise filtering is possible from the sensed bioacoustics.

[127] The ultrasonic image configuration part 170 irradiates the ultrasonic signal onto a body part and senses the ultrasonic echo signal reflected from the body part. For this, the ultrasonic image configuration part includes a probe included of a transducer with a vibrator; and a tuning coil for sensing the ultrasonic echo signal. In addition, the ultrasonic image configuration part includes an A/D converter for processing received signal and a signal processing part.

[128] The ultrasonic image configuration part 170 receives the ultrasonic signal reflected from the body part and generates the B-mode image having a black-and-white signal or the C-mode (color mode) image.

[129] The B-mode(Brightness-mode) image is an image configuring the body part where the ultrasonic is irradiated in black and white by using the ultrasonic echo signal reflected from the body part. When having the distance to the body part on the horizontal axis and the amplitude of the reflected echo on the vertical axis, the amplitude can be marked by replacing it with the brightness of the dots. B-mode can be

configured by using this method in black and white image.

[130] On the other hand, C- mode(color Doppler mode) image is an image configuring the body part where ultrasonic is irradiated in color by using the reflected ultrasonic echo signal. In case the ultrasonic echo signal is received and then the frequency deviation is occurred by the Doppler Effect, the ultrasonic image configuration part 170 may measure the velocity of blow flow by calculating the frequency deviation. Then the C-mode image can be configured using the same.

[131] The automatic diagnosis part 180 performs automatic diagnosis by using the ultrasonic image and the bioacoustics signal. Specifically, the automatic diagnosis part 180 performs automatic diagnosis by analyzing the heart sound and the ultrasonic image which is a cause of heart sound (S1730). For this, parameters on various diseases are stored in advance and managed, and the disease matching the parameters of ultrasonic image and bioacoustics signal is searched. Not only ultrasonic image, but also the ultrasonic sound converted from the ultrasonic image can be used.

[132] A remote diagnosis system 1000 according to various exemplary embodiment of the present invention is described in the following.

[133] FIG. 18 is a block diagram illustrating a configuration of a remote diagnosis system 1000 according to an exemplary embodiment of the present invention.FIG. 19 is a flowchart illustrating a remote diagnosis method.

[134] Referring to FIG. 18, the remote diagnosis system 1000 includes a mobile device 100 and a diagnosis server 200.

[135] The mobile device 100 detects or measures various bio-signals (S1910). The mobile device 100 removes and stores noise with above mentioned various method. Then the mobile device 100 analyzes the bio-signal (S1920). The result of the diagnosis can be displayed solely (S1930). However, the result can be displayed with the result of the diagnosis by the server 200 (S1940). The diagnosis server 200 builds and manages the database by individual/ by diseases after receiving bio-signal from the mobile device 100 (S1960). Then the diagnosis server generates and updates a training model for diagnosis using the DB (S1970). The training model is used in automatic diagnosis.

[136] The remote diagnosis can be performed by a doctor, or by an automatic diagnosis of the diagnosis server 200. The result of the diagnosis is transmitted to the mobile device 100 (S1935). The mobile device 100 displays the result of the diagnosis.

[137] As mentioned above, abnormal respiration signal can be detected through stethoscope signal. Therefore, it is possible to diagnosis diseases such as bronchitis, pulmonary edema, cardiac insufficiency, pneumonia, pulmonary infarction, and asthma etc. In addition, it is possible to diagnosis cardiac murmur, arrhythmia, and heart rate etc. related to heart diseases.

[138] With electrocardiography, it is possible to diagnose atrial fibrillation, atrial flutter,

ventricular tachycardia, myocardial infarction, ischemic heart disease, and valvular heart disease (causing abnormality of blood flow) through heart rate and arrhythmia.

[139] Arrhythmia, heart rate, Heart valve stenosis, and obstruction etc. maybe diagnosed through ultrasonic image or sound, and it is also possible to diagnose the condition of the blood vessel. That is, valvular heart disease, stenosis and obstruction causing abnormality of blood flow can be diagnosed.

[140] Arrhythmia and heart rate can be diagnosed through the purse wave, and it is possible to diagnose vein aging, vein elasticity, blood circulation age, artery disorder, and peripheral vascular disorder etc.

[141] The automatic diagnosis method according to various exemplary embodiments of the present invention is described in the following.

[142] FIG. 20 to FIG. 23 are flowcharts of an automatic diagnostic method according to various exemplary embodiment of the present invention.

[143] The automatic diagnosis method according to an exemplary embodiment of the present invention includes the steps of sensing bioacoustics (S2010); sensing noise generated in the bioacoustics sensing process (S2020); and outputting bioacoustics by removing the sensed noise from the sensed bioacoustics (S2030).

[144] The noise sensing step may perform using a microphone.

[145] In addition, the microphone is mounted on the chest piece of the electronic stethoscope apparatus, and the noise removing step may output the sensed bioacoustics by filtering with the frequency of the noised signal sensed through the microphone.

[146] Furthermore, the noise sensing step uses a movement sensor for sensing movement of the electronic stethoscope apparatus to sense the noise, and the noise removing step uses the sensing value which is output from the movement sensor to calculate the noise signal and outputs the sensed bioacoustics by filtering it with the frequency of the noise signal.

[147] The automatic diagnosis method according to other exemplary embodiment of the present invention includes the steps of: sensing bioacoustics (S2110); detecting electrocardiography signal (S2120); and estimating the location of the heart sound from the sensed bioacoustics by using the detected electrocardiography signal and of removing the noise from the sensed bioacoustics (S2130).

[148] At this point, the electrocardiography signal detecting step detects the features of the detected electrocardiography signal, and the noise removing step uses the feature of the detected electrocardiography signal to estimate the location of a heart sound from the sensed bioacoustics.

[149] The automatic diagnosis method according to another exemplary embodiment of the present invention includes the steps of sensing bioacoustics (S2210); detecting a purse wave signal (S2220); and measuring the purse wave transfer velocity by using the

distance and time between the first location of the sensed bioacoustics and the second location of the detected purse wave signal (S2230).

[150] The automatic diagnosis method according to another exemplary embodiment of the present invention includes the steps of sensing bioacoustics (S2310); configuring an ultrasonic image by irradiating an ultrasonic signal onto a body part and sensing the reflected ultrasonic signal (S2320); and diagnosing disease by using the sensed bioacoustics and the configured ultrasonic image (S2330).

[151] Meanwhile, the above mentioned automatic diagnosis method can be stored in nontemporary recording media which is possible to be read on computer as a form of program. The nontemporary readable media is not a media storing data for a brief moment such as a register, cache etc., but a media storing data semipermanently and a media that is readable by electronic devices. For example, CD, DVD, hard drive, Bluray disk, USB, memory card, ROM.

[152] Those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from essential characteristics of the disclosure, and those modifications and additions should not be construed individually from the technical scope or aspects of this disclosure. The scope of this disclosure is represented in the claims, other than the foregoing descriptions, and every difference within the equivalent range should be construed to be included in this disclosure.

[153]

Claims

[Claim 1] An electronic stethoscope apparatus comprising:
a bioacoustics sensing part for sensing bioacoustics;
a noise sensing part for sensing noise generated in the bioacoustics sensing process; and
a noise removing part for removing the sensed noise and outputting the sensed bioacoustics with the removed noise.

[Claim 2] The electronic stethoscope apparatus according to claim 1, wherein the bioacoustics sensing part comprises a microphone.

[Claim 3] The electronic stethoscope apparatus according to claim 1, wherein the noise sensing part comprises a microphone and mounted on a chest piece of the electronic stethoscope; and
the noise sensing part outputs the sensed bioacoustics by filtering with a frequency of a noise signal sensed by the microphone.

[Claim 4] The electronic stethoscope apparatus according to claim 1, wherein the noise sensing part comprises a movement sensor for sensing movement of the electronic stethoscope, and outputs the sensed bioacoustics by filtering with a frequency of the noise signal.

[Claim 5] An electronic stethoscope apparatus comprising:
a bioacoustics sensing part for sensing bioacoustics;
an electrocardiography(ECG) detecting part for extracting an electrocardiography signal; and
a noise removing part for estimating a position of heart sound from the sensed bioacoustics by using the extracted electrocardiography signal and removes corresponding noise from the sensed bioacoustics.

[Claim 6] The electronic stethoscope apparatus according to claim 5, wherein bioacoustics sensing part extracts features of the extracted electrocardiography (ECG) signal;
a noise removing part estimates the position of the heart sound from the sensed bioacoustics by using the features of extracted electrocardiography (ECG) signal.

[Claim 7] An electronic stethoscope apparatus comprising:
a bioacoustics sensing part for sensing bioacoustics;
a purse wave signal detecting part for detecting a purse wave signal; and
a purse wave velocity calculation part for measuring purse wave transfer velocity by using distance and time between a first position of

the sensed bioacoustics and a second position of the detected purse wave signal.

[Claim 8] An automatic diagnosis apparatus comprising:
a bioacoustics sensing part for sensing bioacoustics;
an ultrasonic image configuration part for irradiating ultrasonic signal onto a body part and configuring the ultrasonic image by sensing a reflected ultrasonic signal; and
an automatic diagnosis for diagnosing a disease by using the sensed bioacoustics and the configured ultrasonic image.

[Claim 9] An automatic diagnosis method comprising:
sensing a bioacoustics;
sensing a noise generated in the bioacoustics sensing process; and
removing the sensed noise from the sensed bioacoustics and outputting the sensed bioacoustics with the removed noise.

[Claim 10] The automatic diagnosis method according to claim 9, wherein the noise sensing step is performed by using a microphone.

[Claim 11] The automatic diagnosis method according to claim 10, wherein a microphone is mounted on a chest piece of the electronic stethoscope; and the noise sensing step outputs the sensed bioacoustics by filtering with a frequency of a noise signal sensed by the microphone.

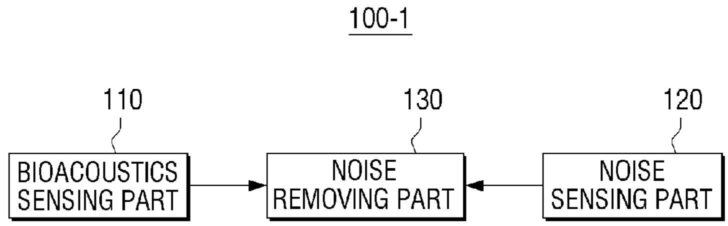
[Claim 12] The automatic diagnosis method according to claim 9, wherein the noise are sensed by a movement sensor for sensing movement of the electronic stethoscope; and
the noise signal is calculated by the sensed value outputted from the movement sensor, the sensed bioacoustics are outputted after filtering with a frequency of the noise signal in the noise removing step.

[Claim 13] The automatic diagnosis method comprising:
sensing bioacoustics;
extracting an electrocardiography signal;
estimating a position of heart sound from the sensed bioacoustics by using the extracted electrocardiography signal and removing corresponding noise from the sensed bioacoustics.

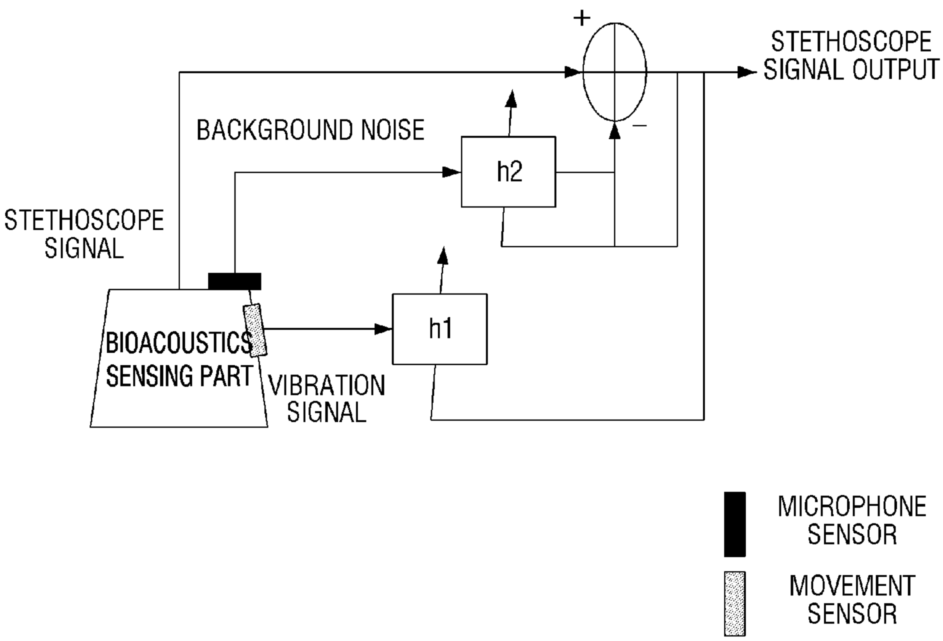
[Claim 14] The automatic diagnosis method according to claim 13, wherein features of the extracted electrocardiography (ECG) signal is detected in the electrocardiography signal extracting step;
the position of the heart sound is estimated from the sensed bioacoustics by using the features of extracted electrocardiography signal in the noise removing step.

[Claim 15] The automatic diagnosis method comprising:
sensing bioacoustics;
detecting a purse wave signal; and
measuring purse wave transfer velocity by using distance and time between a first position of the sensed bioacoustics and a second position of the detected purse wave signal.

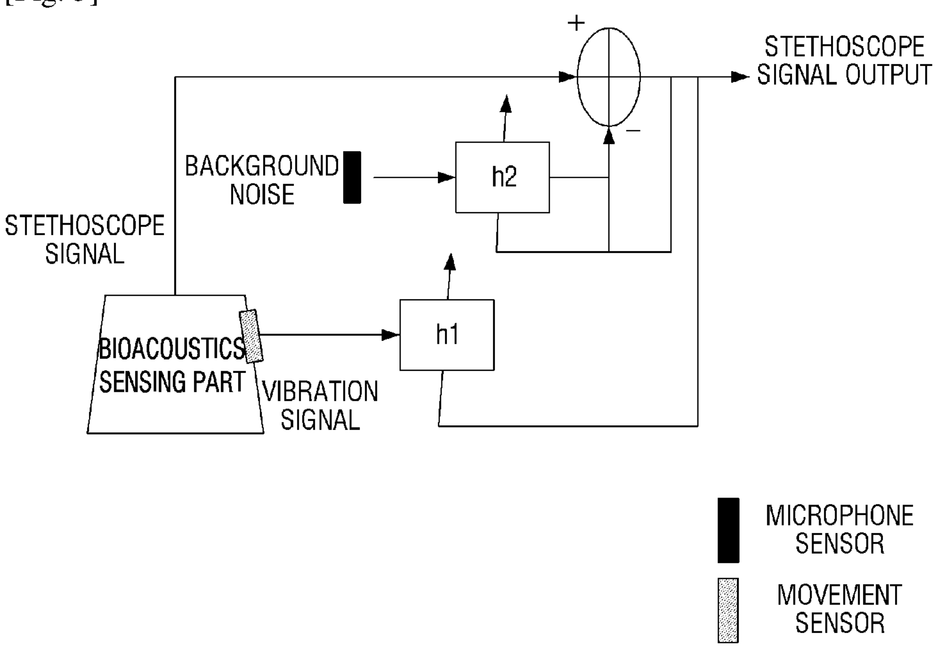
[Fig. 1]



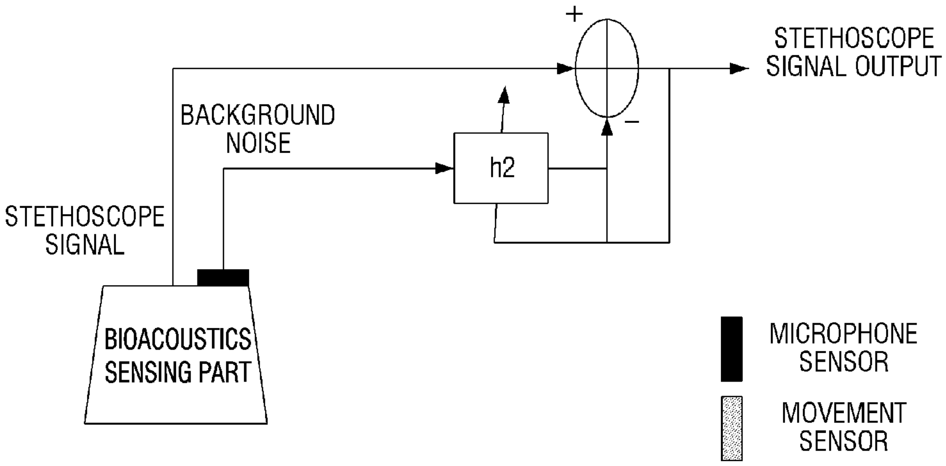
[Fig. 2]



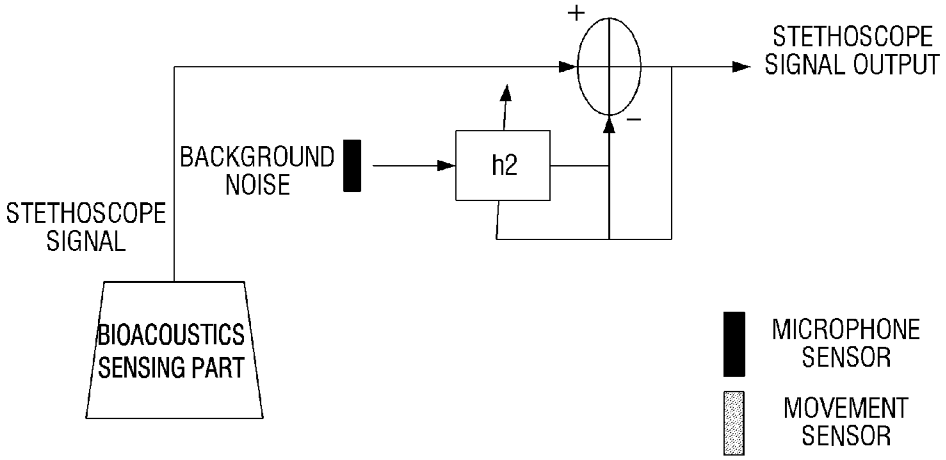
[Fig. 3]



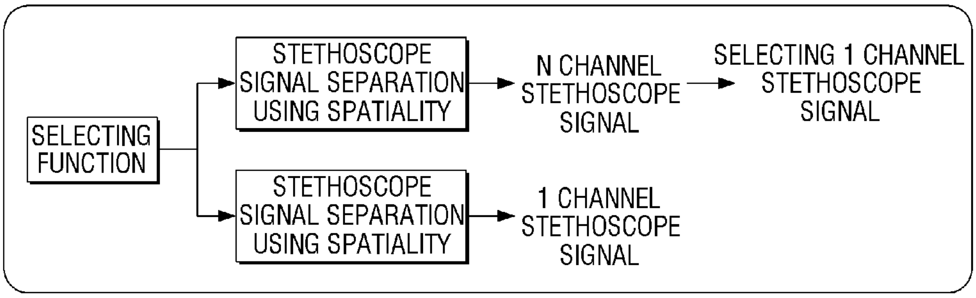
[Fig. 4]



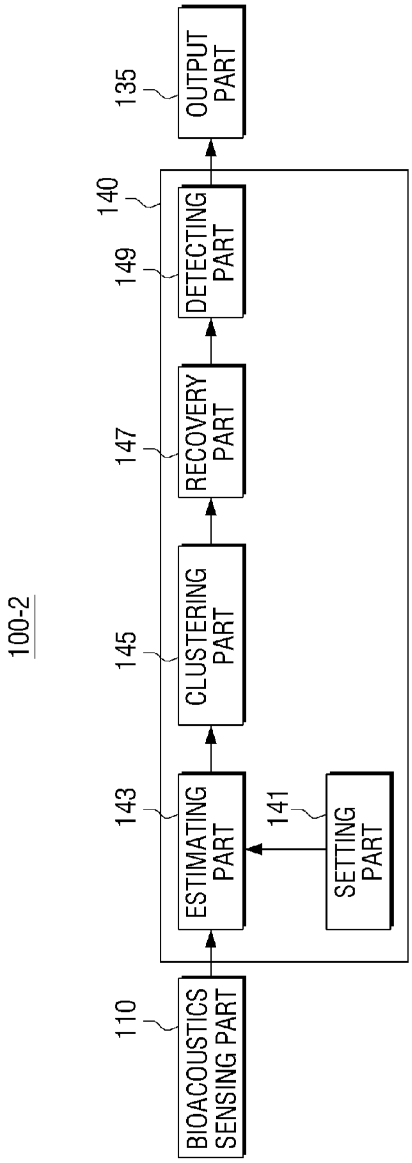
[Fig. 5]



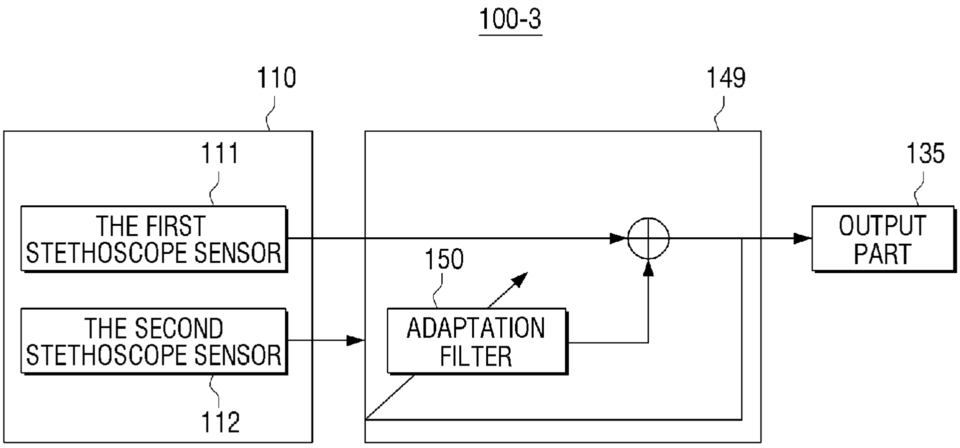
[Fig. 6]



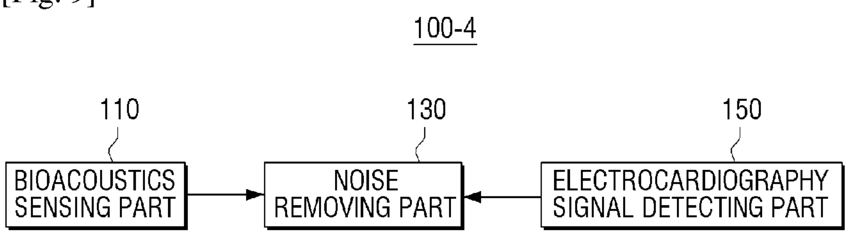
[Fig. 7]



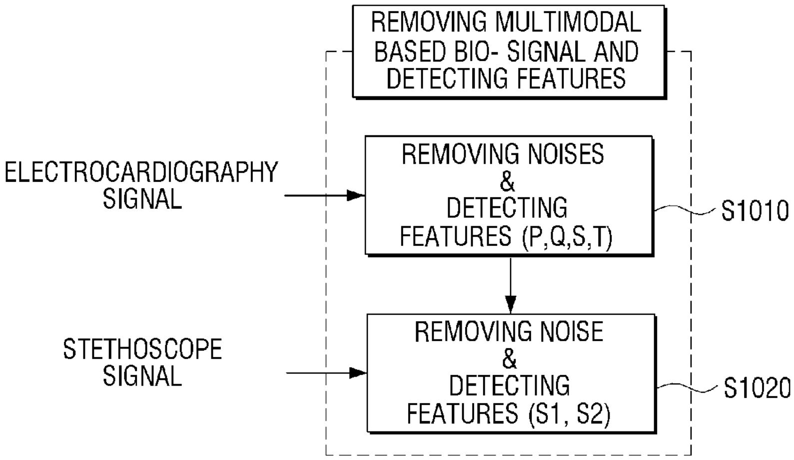
[Fig. 8]



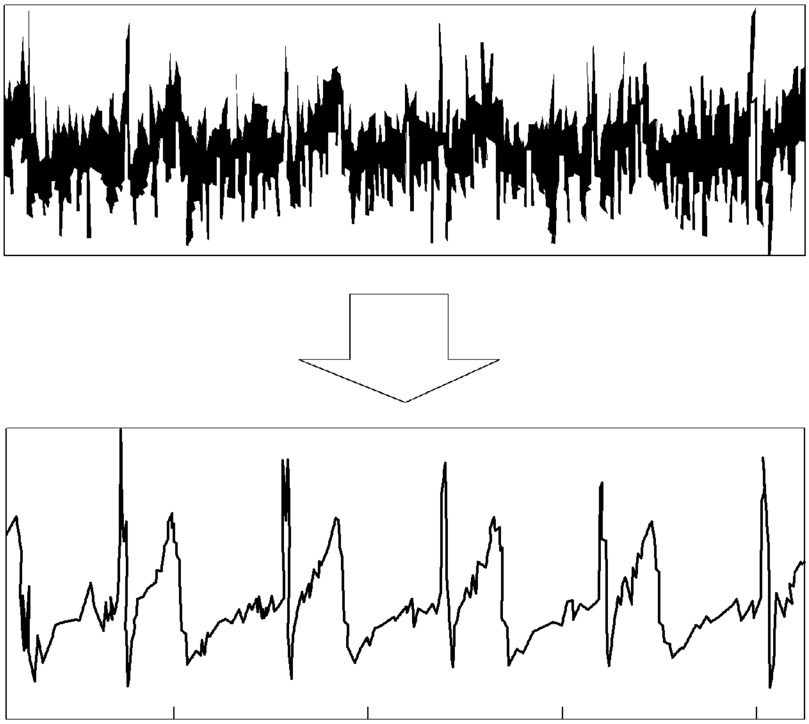
[Fig. 9]



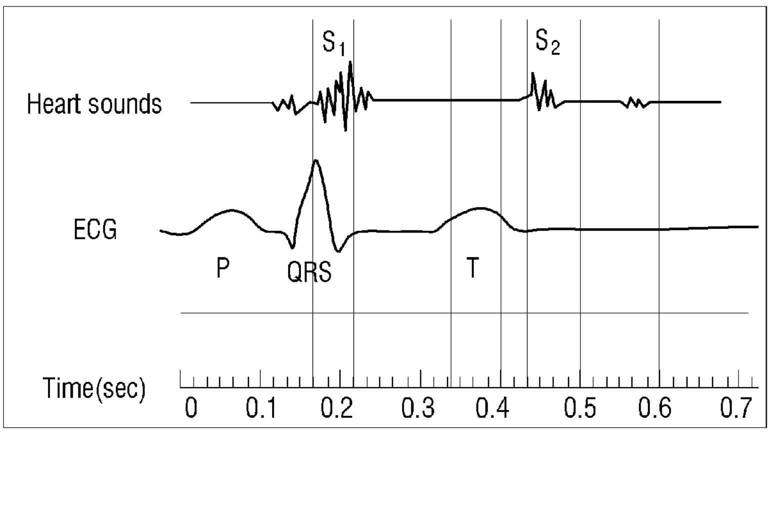
[Fig. 10]



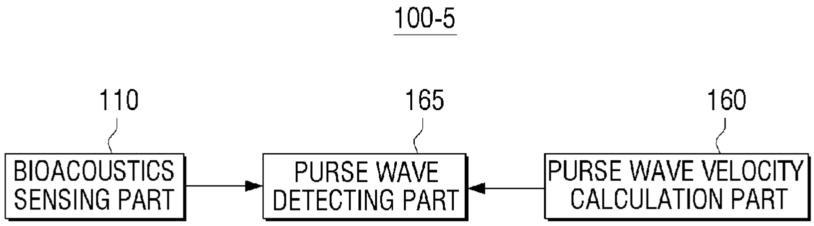
[Fig. 11]



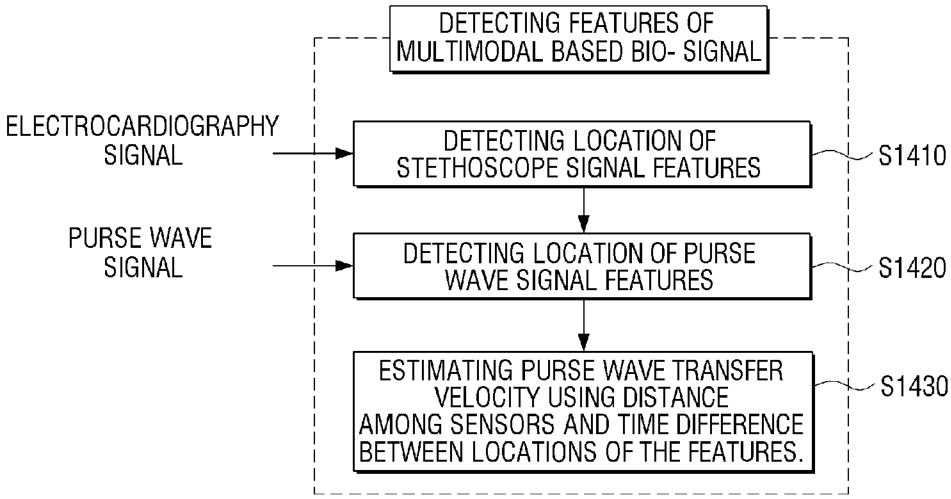
[Fig. 12]



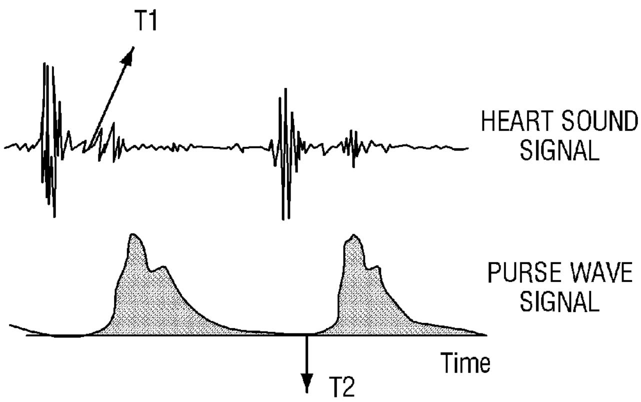
[Fig. 13]



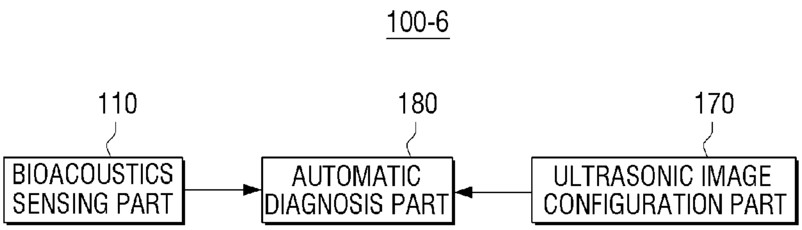
[Fig. 14]



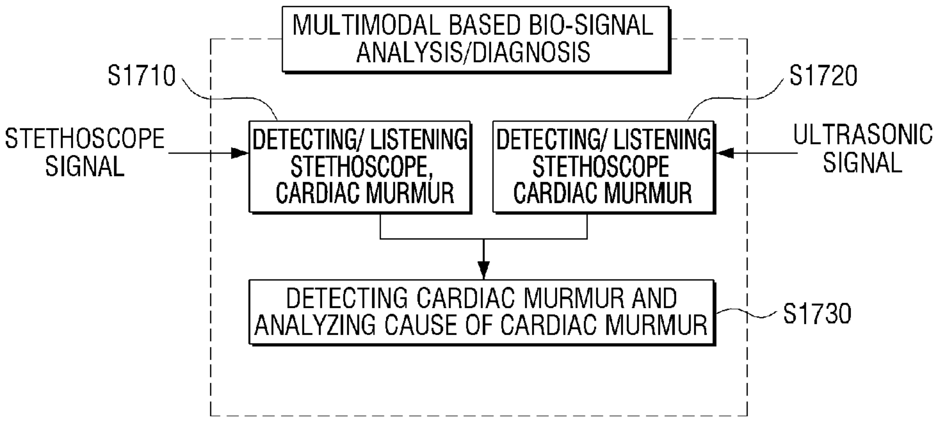
[Fig. 15]



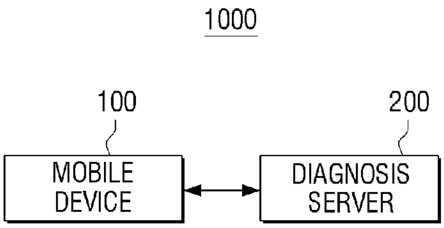
[Fig. 16]



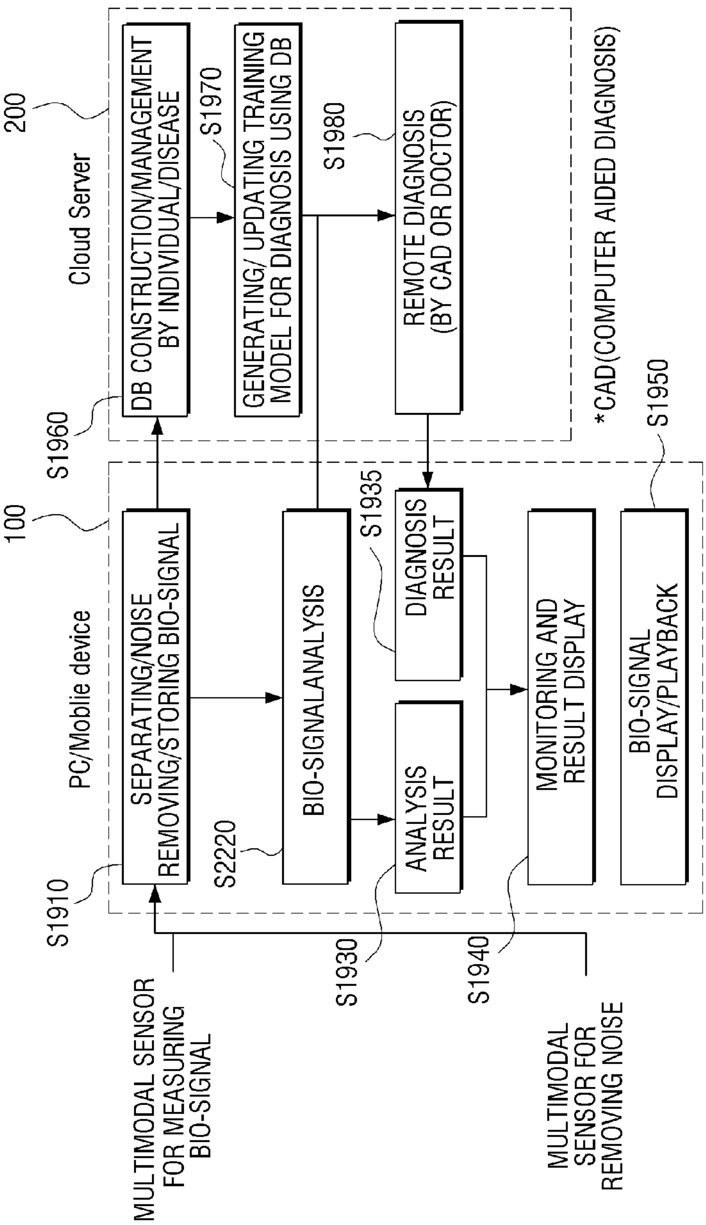
[Fig. 17]


MULTIMODAL BASED BIO-SIGNAL ANALYSIS/DIAGNOSIS
S1710
S1720
STETHOSCOPE SIGNAL
DETECTING/ LISTENING STETHOSCOPE, CARDIAC MURMUR
DETECTING/ LISTENING STETHOSCOPE CARDIAC MURMUR
ULTRASONIC SIGNAL
DETECTING CARDIAC MURMUR AND ANALYZING CAUSE OF CARDIAC MURMUR
S1730

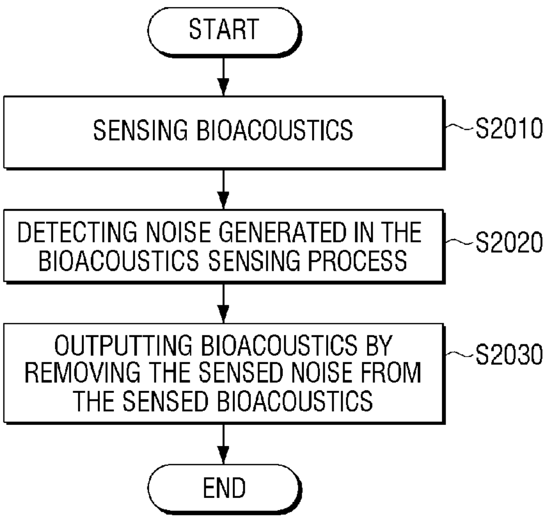
[Fig. 18]


1000
100
200
MOBILE DEVICE
DIAGNOSIS SERVER

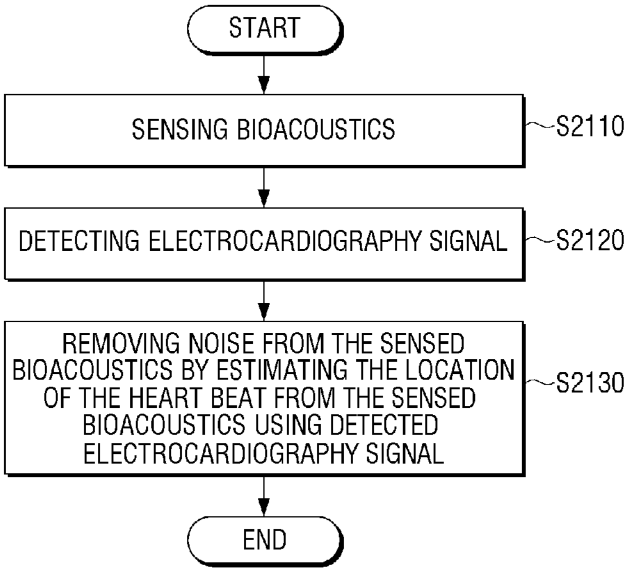
[Fig. 19]


200
Cloud Server
DB CONSTRUCTION/MANAGEMENT BY INDIVIDUAL/DISEASE
S1960
S1970
GENERATING/ UPDATING TRAINING MODEL FOR DIAGNOSIS USING DB
S1980
REMOTE DIAGNOSIS (BY CAD OR DOCTOR)
*CAD(COMPUTER AIDED DIAGNOSIS)
100
PC/Moblie device
SEPARATING/NOISE REMOVING/STORING BIO-SIGNAL
S1910
S2220
BIO-SIGNALANALYSIS
S1935
DIAGNOSIS RESULT
ANALYSIS RESULT
S1930
MONITORING AND RESULT DISPLAY
S1940
BIO-SIGNAL DISPLAY/PLAYBACK
S1950
MULTIMODAL SENSOR FOR MEASURING BIO-SIGNAL
MULTIMODAL SENSOR FOR REMOVING NOISE

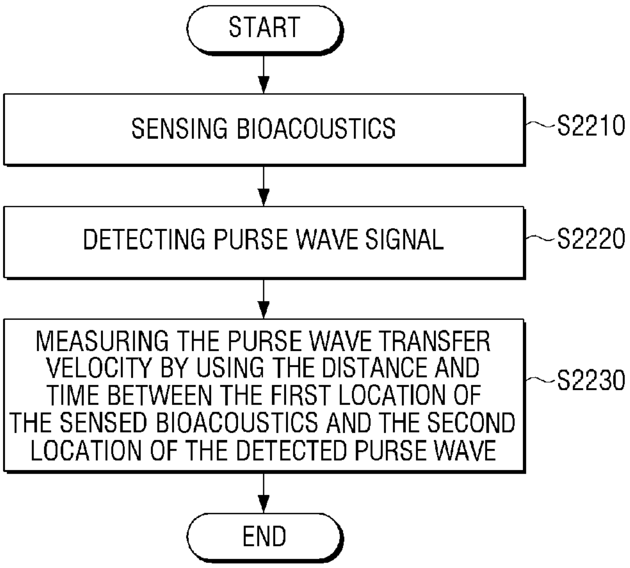
[Fig. 20]


START
SENSING BIOACOUSTICS
S2010
DETECTING NOISE GENERATED IN THE BIOACOUSTICS SENSING PROCESS
S2020
OUTPUTTING BIOACOUSTICS BY REMOVING THE SENSED NOISE FROM THE SENSED BIOACOUSTICS
S2030
END

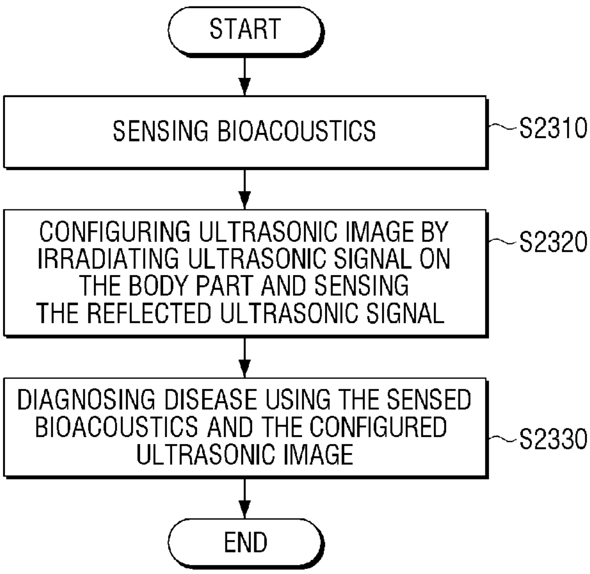
[Fig. 21]



[Fig. 22]



[Fig. 23]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2014/002951

A. CLASSIFICATION OF SUBJECT MATTER

A61B 7/04(2006.01)i, A61B 5/0402(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 7/04; G06F 3/048; A61B 5/02; G01D 11/24; A61B 6/00; A61B 5/00; A61B 5/0402

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: stethoscope, bioacoustics, noise, electrocardiograph, pulse, wave, velocity, ultrasonic

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007-0113649 A1 (VIVEK BHARTI et al.) 24 May 2007 See abstract, paragraphs [0059]-[0082] and figures 1-11.	1,2,5
Y		3,4,6-8
Y	US 2008-0232604 A1 (JOEL R. DUFRESNE et al.) 25 September 2008 See abstract, paragraphs [0046],[0073] and figure 1.	3,4
Y	US 2003-0009108 A1 (KEIZOH KAWAGUCHI) 09 January 2003 See abstract, paragraphs [0024]-[0049] and figures 1-3.	6,7
Y	US 2010-0042003 A1 (SHIIBASHI TAKAO) 18 February 2010 See abstract, paragraphs [0013],[0067] and figures 2-5.	8
A	KR 10-2009-0079006 A (SAMSUNG ELECTRONICS CO., LTD.) 21 July 2009 See abstract, paragraphs [0021]-[0061] and figures 1-3.	1-8

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 July 2014 (03.07.2014)	**07 July 2014 (07.07.2014)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
KIM, Tae Hoon
Telephone No. +82-42-481-8407

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2014/002951

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 9-15
because they relate to subject matter not required to be searched by this Authority, namely:
Claims 9-15 pertain to methods for treatment of the human body by therapy or surgery, as well as diagnostic methods, and thus relate to a subject matter which this International Searching Authority is not required to search under Article 17(2)(a)(i) of the PCT and Rule 39.1(iv) of the Regulations under the PCT.

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2014/002951

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007-0113649 A1	24/05/2007	AU 2006-317089 A1	31/05/2007
		CA 2630777 A1	31/05/2007
		CN 101321497 A	10/12/2008
		CN 101321497 B	09/03/2011
		EP 1951123 A1	06/08/2008
		EP 1951123 A4	17/02/2010
		EP 1951123 B1	26/09/2012
		JP 2009-517127 A	30/04/2009
		JP 2013-172968 A	05/09/2013
		KR 10-1327694 B1	11/11/2013
		KR 10-2008-0069225 A	25/07/2008
		US 8024974 B2	27/09/2011
		WO 2007-061619 A1	31/05/2007
US 2008-0232604 A1	25/09/2008	CN 101652101 A	17/02/2010
		CN 101652101 B	01/08/2012
		EP 2136712 A1	30/12/2009
		JP 2010-522039 A	01/07/2010
		US 8594339 B2	26/11/2013
		WO 2008-118753 A1	02/10/2008
US 2003-0009108 A1	09/01/2003	EP 1273262 A1	08/01/2003
		JP 2001-224564 A	21/08/2001
		US 6845263 B2	18/01/2005
US 2010-0042003 A1	18/02/2010	JP 4992914 B2	08/08/2012
		US 8357097 B2	22/01/2013
		WO 2008-099777 A1	21/08/2008
KR 10-2009-0079006 A	21/07/2009	US 2009-0182240 A1	16/07/2009

patsnap

专利名称(译)	电子听诊器装置，自动诊断装置和方法		
公开(公告)号	[EP2981214A4](EP2981214A4)	公开(公告)日	2017-03-29
申请号	EP2014778643	申请日	2014-04-07
[标]申请(专利权)人(译)	三星电子株式会社		
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当前申请(专利权)人(译)	SAMSUNG ELECTRONICS CO.，LTD.		
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IPC分类号	A61B7/04 A61B5/0402 A61B7/02 A61B5/00 A61B8/08 A61B8/14		
CPC分类号	A61B7/04 A61B5/0402 A61B5/7203 A61B7/02 A61B8/14 A61B8/5207 A61B8/5223		
代理机构(译)	阿普尔亚德LEES		
优先权	61/808699 2013-04-05 US 61/815928 2013-04-25 US 1020140040719 2014-04-04 KR		
其他公开文献	EP2981214A1		
外部链接	Espacenet		

摘要(译)

一种电子听诊器装置，包括：生物声学传感器，被配置为感测生物声学;噪声传感器，被配置为感测所感测的生物声学中的噪声;以及噪声去除器，其被配置为去除所感测的噪声并输出已从中去除噪声的生物声学。