



(21) Application No. 201710097646.X

(22) Application Date: February 22, 2017

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(51) Int. Cl.

A61B 5/0402 (2006.01)

H04L 29/08 (2006.01)

G08C 17/02 (2006.01)

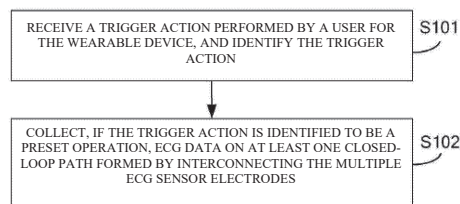
Claims: 4 pages; Description: 10 pages; Drawings: 5 pages

(54) Title of the Invention:

Method, Apparatus, And Wearable Device For Collecting Electrocardiogram (ECG) Data

(57) Abstract:

The present application provides a method, an apparatus, and a wearable device for collecting electrocardiogram (ECG) data, wherein the method for collecting ECG data is applied to the wearable device, the wearable device comprises multiple ECG sensor electrodes, and the method comprises: receiving a trigger action performed by a user for the wearable device, and identifying the trigger action; and collecting, if the trigger action is identified to be a preset operation, ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes. In embodiments of the present application, by identifying a received trigger action and collecting ECG data when the trigger action is identified to be a preset operation, the above-described trigger method is simple, direct, and quick, so that a user can trigger the collection of ECG data when not feeling well. As a result, when a user experiences occasional or paroxysmal heart diseases and symptoms, ECG data can be conveniently and quickly collected, thereby providing support for diagnosis of heart diseases.



1. A method for collecting electrocardiogram (ECG) data, characterized in that the method is applied to a wearable device, the wearable device comprises multiple ECG sensor electrodes, and the method comprises:

receiving a trigger action performed by a user for the wearable device, and identifying the trigger action; and

collecting, if the trigger action is identified to be a preset operation, ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes.

2. The method according to claim 1, characterized in that the wearable device further comprises a button, and the button multiplexes one of the multiple ECG sensor electrodes.

3. The method according to claim 1, characterized in that the receiving a trigger action performed by a user for the wearable device comprises:

receiving the trigger action performed by the user on the button of the wearable device.

4. The method according to claim 1, characterized in that the wearable device further comprises a microelectromechanical system (MEMS) sensor, and the identifying the trigger action comprises:

identifying the trigger action via the MEMS sensor, the trigger action at least comprising one of double-click, triple-click, and continuous double-click.

5. The method according to claim 1, characterized in that during the collecting ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes, the method further comprises:

counting a collecting duration;

determining whether the collecting duration reaches a preset threshold;

if the collecting duration does not reach the preset threshold, then detecting whether the current ECG data is valid ECG data; if the current ECG data is invalid ECG data, then stopping collecting the current ECG data, and storing the collected ECG data; if the current ECG data is valid ECG data, then collecting the current ECG data, and continuing the operation of counting the collecting duration; and

if the collecting duration reaches the preset threshold, then stopping collecting the ECG data, and storing the collected ECG data.

6. The method according to claim 5, characterized in that the detecting whether the current ECG data is valid ECG data comprises:

detecting states of ECG sensor electrodes corresponding to the current ECG data; if the state of any one of the ECG sensor electrodes is a detached state, then determining that the current ECG data is invalid ECG data, and if the states of all the corresponding ECG sensor electrodes are a normal state, then determining that the current ECG data is valid ECG data; and/or

calculating, according to the collected ECG data, a heart rate; if the heart rate is within a preset range, then determining that the current ECG data is valid ECG data, and if the heart rate is not within the preset range, then determining that the current ECG data is invalid ECG data; and/or

detecting, according to the collected ECG data, a waveform similarity between a current R wave and a preset R wave; if the waveform similarity is greater than or equal to a preset value, then determining that the current ECG data is valid ECG data, and if the waveform similarity is smaller than the preset value, then determining that the current ECG data is invalid ECG data.

7. The method according to claim 1, characterized in that if the wearable device comprises a screen, then during the collecting ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes, the method further comprises:

displaying a preset icon via the screen or controlling the wearable device to vibrate, so as to prompt the user that collecting the ECG data has been started; and/or

displaying a progress of collecting the ECG data via the screen.

8. The method according to claim 1, characterized in that if the wearable device does not comprise a screen, then during the collecting ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes, the method further comprises:

controlling the wearable device to vibrate, so as to prompt the user that collecting the ECG data has been started.

9. The method according to claim 1, characterized in that the trigger action at least comprises one of long press, double-click, triple-click, and continuous double-click.

10. An apparatus for collecting ECG data, characterized in that the apparatus is applied to a wearable device, the wearable device comprises multiple ECG sensor electrodes, and the apparatus comprises:

a receiving and identifying module configured to receive a trigger action performed by a user for the wearable device, and identify the trigger action; and

a collecting module configured to collect, if the receiving and identifying module identifies the trigger action to be a preset operation, ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes.

11. The apparatus according to claim 10, characterized in that the wearable device further comprises a button, and the button multiplexes one of the multiple ECG sensor electrodes.

12. The apparatus according to claim 10, characterized in that the receiving and identifying module is specifically configured to:

receive the trigger action performed by the user on the button of the wearable device.

13. The apparatus according to claim 10, characterized in that the wearable device further comprises a microelectromechanical system (MEMS) sensor, and the receiving and identifying module is specifically configured to:

identify the trigger action via the MEMS sensor, the trigger action at least comprising one of double-click, triple-click, and continuous double-click.

14. The apparatus according to claim 10, characterized in that the apparatus further comprises:

a counting module configured to count a collecting duration when the collecting module collects ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes;

a determining module configured to determine whether the collecting duration counted by the counting module reaches a preset threshold;

a first processing module configured to, if the determining module determines that the collecting duration does not reach the preset threshold, detect whether the current ECG data is valid ECG data; if the current ECG data is invalid ECG data, stop collecting the current ECG data, and store the collected ECG data; if the current ECG data is valid ECG data, collect the current ECG data, and continue counting the collecting duration via the counting module; and

a second processing module configured to, if the determining module determines that the collecting duration reaches the preset threshold, stop collecting the ECG data, and store the collected ECG data.

15. The apparatus according to claim 14, characterized in that the first processing module comprises:

a first detection sub-module configured to detect states of ECG sensor electrodes corresponding to the current ECG data; if the state of any one of the ECG sensor electrodes is a detached state,

determine that the current ECG data is invalid ECG data, and if the states of all the corresponding ECG sensor electrodes are a normal state, determine that the current ECG data is valid ECG data; and/or

a calculating sub-module configured to calculate, according to the collected ECG data, a heart rate; if the heart rate is within a preset range, determine that the current ECG data is valid ECG data, and if the heart rate is not within the preset range, determine that the current ECG data is invalid ECG data; and/or

a second detection sub-module configured to detect, according to the collected ECG data, a waveform similarity between a current R wave and a preset R wave; if the waveform similarity is greater than or equal to a preset value, determine that the current ECG data is valid ECG data, and if the waveform similarity is smaller than the preset value, determine that the current ECG data is invalid ECG data.

16. The apparatus according to claim 10, characterized in that if the wearable device comprises a screen, then the apparatus further comprises:

a display and control module configured to, when the collecting module collects ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes, display a preset icon via the screen or control the wearable device to vibrate, so as to prompt the user that collecting the ECG data has been started; and/or

display a progress of collecting the ECG data via the screen.

17. The apparatus according to claim 10, characterized in that if the wearable device does not comprise a screen, then the apparatus further comprises:

a control module configured to, when the collecting module collects ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes, control the wearable device to vibrate, so as to prompt the user that collecting the ECG data has been started.

18. The apparatus according to claim 10, characterized in that the trigger action at least comprises one of long press, double-click, triple-click, and continuous double-click.

19. A wearable device, characterized in that the wearable device comprises:

a processor; and a memory for storing instructions executable by the processor;

wherein the processor is configured to execute the method according to any one of the preceding claims 1-9.

METHOD, APPARATUS, AND WEARABLE DEVICE FOR COLLECTING ELECTROCARDIOGRAM (ECG) DATA

Field of the Invention

[0001] The present application relates to a technical field of wearable devices, and in particular, to a method, an apparatus, and a wearable device for collecting ECG data.

Description of the Related Art

[0002] According to the statistics from the World Health Organization (WHO), cardiovascular diseases are the number one killer across the world. Latent cardiovascular diseases typically don't have symptoms, and a heart attack or stroke may be an early warning for latent cardiovascular diseases. Symptoms of heart attacks include: pain or discomfort in mid chest, and pain or discomfort in arms, left shoulder, elbows, jaw, or back. In addition, patients may even have symptoms such as difficulties in breathing or shortness of breath, nausea or vomiting, dizziness or fainting, cold sweat, and pale complexion.

[0003] The occurrence of many cardiovascular diseases is accompanied by abnormal electrocardiogram, such as various arrhythmia. However, in the early phase of cardiovascular diseases, the diseases are occasional, making it very difficult to detect them at hospital by using conventional ECG devices, and very difficult to catch corresponding ECG signals. A conventional method is using a Holter device to monitor ECG signals, but a Holter device can only be used for a limited period of time and has a high price, which will not be bought by regular users. As a result, it is very difficult to diagnose and confirm this type of diseases.

[0004] With the progress of technology and the rise of wearable devices, wearable ECG monitoring products are becoming increasingly popular, which greatly helps the detection of early and occasional heart diseases.

[0005] At present, wearable ECG monitoring mostly starts ECG monitoring by mobile APPs. That is, a user wears a wearable ECG collecting device, opens a mobile APP, connects the APP with the wearable ECG collecting device, clicks the internal online collection mode of the APP, and starts the automatic collection of ECG data. However, this method for starting ECG data collection via an APP is not direct and quick.

Summary of the Invention

[0006] In view of this, the present application provides a novel technical solution that makes the ECG data trigger method simple, direct, and quick.

[0007] To achieve the above objective, the present application provides the following technical solution:

[0008] According to a first aspect of the present application, a method for collecting ECG data is proposed, which is applied to a wearable device, the wearable device comprises multiple ECG sensor electrodes, and the method comprises:

[0009] receiving a trigger action performed by a user for the wearable device, and identifying the trigger action; and

[0010] collecting, if the trigger action is identified to be a preset operation, ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes.

[0011] According to a second aspect of the present application, an apparatus for collecting ECG data is proposed, which is applied to a wearable device, the wearable device comprises multiple ECG sensor electrodes, and the apparatus comprises:

[0012] a receiving and identifying module configured to receive a trigger action performed by a user for the wearable device, and identify the trigger action; and

[0013] a collecting module configured to collect, if the receiving and identifying module identifies the trigger action to be a preset operation, ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes.

[0014] According to a third aspect of the present application, a wearable device is proposed, and the wearable device comprises:

[0015] a processor; and a memory for storing instructions executable by the processor;

[0016] wherein the processor is configured to execute the above-described method for collecting ECG data.

[0017] As can be seen from the above technical solution, by identifying a received trigger action and collecting ECG data when the trigger action is identified to be a preset operation, the above-described trigger method is simple, direct, and quick, so that a user can trigger the collection of ECG data when not feeling well. As a result, when a user experiences occasional or paroxysmal heart diseases and symptoms, ECG data can be conveniently and quickly collected, thereby providing support for diagnosis of heart diseases.

#### Brief Description of the Drawings

[0018] FIG. 1 is a flow chart of a method for collecting ECG data according to an exemplary embodiment of the present invention;

[0019] FIG. 2A is a first schematic structural view of a wearable device according to an exemplary embodiment of the present invention;

[0020] FIG. 2B is a second schematic structural view of a wearable device according to an exemplary embodiment of the present invention;

[0021] FIG. 3 is a flow chart of a method for collecting ECG data according to another exemplary embodiment of the present invention;

[0022] FIG. 4 is a flow chart of a method for collecting ECG data according to another exemplary embodiment of the present invention;

[0023] FIG. 5 is a schematic structural view of an apparatus for collecting ECG data according to an exemplary embodiment of the present invention;

[0024] FIG. 6 is a schematic structural view of an apparatus for collecting ECG data according to another exemplary embodiment of the present invention;

[0025] FIG. 7 is a schematic structural view of an apparatus for collecting ECG data according to yet another exemplary embodiment of the present invention; and

[0026] FIG. 8 is a schematic structural view of an apparatus for collecting ECG data according to yet another exemplary embodiment of the present invention.

#### Detailed Description of the Specific Embodiments

[0027] The exemplary embodiments will be described in detail here, and the examples thereof are shown in the accompanying drawings. When the description below involves the accompanying drawings, the same numbers in different figures represent the same or similar elements, unless otherwise indicated. The implementation manners described in the following exemplary embodiments do not represent all implementation manners consistent with the present application. On the contrary, they are merely examples of apparatuses and methods that are consistent with some aspects of the present application as described in detail in the appended claims.

[0028] Terms used in the present application are merely for the purpose of describing particular embodiments, instead of aiming to limit the present application. “One,” “the,” and “said” in the singular form as used in the present application and the appended claims are intended to also include the plural forms, unless otherwise indicated clearly in the context. It should also be understood that the term “and/or” used herein refers to further including any or all possible combinations of one or more associated listed items.

[0029] It should be understood that although terms first, second, and third may be used in the present application to describe various information, such information should not be limited to these terms. These terms are only used to differentiate information of the same type. For example, without departing from the scope of the present application, first information may also be referred to as second information, and similarly, second information may also be referred to as first information. Depending on the context, the term “if” as used herein may be interpreted as “at a time when...” or “when...” or “responding to determining.”

[0030] FIG. 1 is a flow chart of a method for collecting ECG data according to an exemplary embodiment of the present invention, the method is applied to a wearable device, the wearable device may include, but is not limited to, devices such as a smart bracelet, a smart watch, and the like, the wearable device may comprise multiple ECG sensor electrodes, and as shown in FIG. 1, the method for collecting ECG comprises the following steps:

[0031] Step S101, receive a trigger action performed by a user for the wearable device, and identify the trigger action.

[0032] Here, the wearable device may comprise a button, and the button may multiplex one of the multiple ECG sensor electrodes. Preferably, the multiplexed ECG sensor electrode may be located at a position that can be easily touched by the user wearing the wearable device, so as to facilitate the user to operate. The above button may be a mechanic button, such as a metal dome button, or may be a capacitive touch button, an inductive touch button, a magnetically triggered button, or a photoelectrically triggered button.

[0033] In this embodiment, the receiving a trigger action performed by a user for the wearable device may comprise: receiving the trigger action performed by the user on the button, wherein the trigger action may include, but is not limited to, long press, double-click, triple-click, and continuous double-click operations. It should be noted that the trigger action performed on the button needs to be differentiated from the operation of touching the multiplexed electrode.

[0034] To more clearly describe this solution, an exemplary description will be provided below in combination with FIG. 2A and FIG. 2B. As shown in FIG. 2A and FIG. 2B, the wearable device comprises a body portion 11 and a wristband portion 12, a first ECG sensor electrode 131 is provided on the inner side of the front face of the body portion 11, and the first ECG sensor electrode 131 may be multiplexed with a button, such as a touch capacitive button. A second ECG sensor electrode 132 and a third ECG sensor electrode 133 are provided on the outer side of the front face of the body portion 11, a fourth ECG sensor electrode 134 is provided on the outer side of the wristband portion 12, and the fourth ECG sensor electrode 134 is connected with the body portion 11 via a wire (not shown) inside the wristband.

[0035] It should be noted that FIG. 2A and FIG. 2B only show a circumstance in which there are four ECG sensor electrodes and the button with one ECG sensor electrode. In practical applications, a wearable device may comprise other numbers of ECG sensor electrodes, for example, comprise two or three ECG sensor electrodes.

[0036] In addition, the receiving a trigger action performed by a user for the wearable device may also comprise: receiving the trigger action performed by the user on the non-button portion of the wearable device, wherein the trigger action may include, but is not limited to, double-click, triple-click, and continuous double-click operations, for example, performing a double-click operation on the wristband portion of the bracelet. It should be noted that a trigger action performed by the user on the button of the wearable device may also be received, the button is not limited to the button multiplexing an ECG sensor electrode, and moreover, the trigger action performed on the button may also include, but is not limited to, double-click, triple-click, and continuous double-click operations. Furthermore, the wearable device may also comprise a microelectromechanical system (MEMS) sensor. In this embodiment, the above trigger action, such as double-click, triple-click, and continuous double-click, may be identified via the MEMS sensor.

[0037] Step S102, collect, if the trigger action is identified to be a preset operation, ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes.

[0038] In this embodiment, an operation may be preset for the button or non-button portion of the wearable device, for example, the duration of pressing the button reaching 3 s, double-click operation, and the like. When the trigger

action currently performed by a user is identified to be a preset operation, the ECG sensor inside the wearable device may be used to collect ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes. When the number of ECG sensor electrodes is greater than two, the ECG sensor electrodes can collect single-lead ECG data and can also collect multi-lead ECG data.

[0039] Optionally, if the wearable device comprises a screen, then when collecting ECG data, the wearable device may display a preset icon via the screen or control the wearable device to vibrate, so as to prompt the user that collecting the ECG data has been started, or may display a progress of collecting the ECG data via the screen. In addition, if the wearable device does not comprise a screen, then when collecting ECG data, the wearable device may control the wearable device to vibrate, so as to prompt the user that collecting the ECG data has been started. By means of the above prompt manner, a user is enabled to learn whether his/her operations are correct, and promptly correct his/her mistakes during incorrect operations, for example, re-touching the electrode.

[0040] In the above embodiment, by identifying a received trigger action and collecting ECG data when the trigger action is identified to be a preset operation, the above-described trigger method is simple, direct, and quick, so that a user can trigger the collection of ECG data when not feeling well. As a result, when a user experiences occasional or paroxysmal heart diseases and symptoms, ECG data can be conveniently and quickly collected, thereby providing support for diagnosis of heart diseases.

[0041] FIG. 3 is a flow chart of a method for collecting ECG data according to another exemplary embodiment of the present invention. As shown in FIG. 3, when performing the above step S102, the method may further comprise the following steps:

[0042] Step S301, count a collecting duration.

[0043] Step S302, determine whether the collecting duration reaches a preset threshold. If the collecting duration does not reach the preset threshold, then perform Step S303; and if the collecting duration reaches the preset threshold, then perform Step S304.

[0044] Here, the preset threshold may be 30 s.

[0045] Step S303, detect whether the current ECG data is valid ECG data. If the current ECG data is invalid ECG data, then perform Step S304, but if the current ECG data is valid ECG data, then perform Step S305.

[0046] Here, a variety of methods may be used to detect whether the current ECG data is valid ECG data. For example, any one or several of the following methods may be used to detect whether the current ECG data is valid ECG data,

[0047] The first method comprises detecting states of ECG sensor electrodes corresponding to the current ECG data; if the state of any one of the ECG sensor electrodes is a detached state, then determining that the current ECG data is invalid ECG data, and if the states of all the corresponding ECG sensor electrodes are a normal state, then determining that the current ECG data is valid ECG data.

[0048] In the embodiment, each ECG sensor electrode corresponds to a detection voltage. If a detection voltage is a preset value, for example, a high level, then the corresponding ECG sensor electrode is in the detached state.

[0049] The second method comprises calculating, according to the collected ECG data, a heart rate; if the heart rate is within a preset range, then determining that the current ECG data is valid ECG data, and if the heart rate is not within the preset range, then determining that the current ECG data is invalid ECG data.

[0050] Here, the preset range may be 30 to 300 times/min.

[0051] The third method comprises detecting, according to the collected ECG data, a waveform similarity between a current R wave and a preset R wave; if the waveform similarity is greater than or equal to a preset value, then determining that the current ECG data is valid ECG data, and if the waveform similarity is smaller than the preset value, then determining that the current ECG data is invalid ECG data.

[0052] Here, the preset value may be 70%, 80%, or the like.

[0053] Step S304, stop collecting the current ECG data, store the collected ECG data, and end the operation.

[0054] Step S305, collect the current ECG data, and proceed to perform Step S301.

[0055] Optionally, after collecting the current ECG data, the ECG data may be transmitted to a mobile terminal, and the ECG data may be displayed on the mobile terminal. Moreover, the ECG data may be transmitted to a server via the mobile terminal, so as to facilitate a doctor to obtain the ECG data from the server and perform diagnostic analysis according to the ECG data.

[0056] In the above embodiment, by counting a collecting duration, continuing to collect ECG data when the collecting duration does not reach the preset threshold, and stopping collecting ECG data when the collecting duration reaches the preset threshold, the objective of obtaining a desired amount of ECG data without wasting the wearable device resources is thus achieved.

[0057] FIG. 4 is a flow chart of a method for collecting ECG data according to another exemplary embodiment of the present invention. As shown in FIG. 4, the method may comprise the following steps:

[0058] Step S401, receive a trigger action performed by a user for the wristband portion of a wearable device, and identify the trigger action via a MEMS sensor.

[0059] In the embodiment, when a user feels symptoms such as palpitation, chest pain, or breathing difficulties, the user may tap the wristband to trigger the collection of ECG data.

[0060] Step S402, collect, if the trigger action is identified to be a continuous double-click operation, ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes.

[0061] Step S403, count a collecting duration, stop collecting ECG data if detecting that the collecting duration reaches a preset threshold, and store the collected ECG data.

[0062] Here, if the user's finger leaves the ECG sensor electrode during the process of collecting ECG data, no closed-loop path will be formed between the ECG sensor electrodes. At this moment, the collection of ECG data is stopped, and the collected ECG data is stored.

[0063] Step S404, transmit the ECG data to a mobile terminal in a wireless manner, and display the ECG data on the mobile terminal.

[0064] Here, the wireless manner may include, but is not limited to, WiFi, Bluetooth, or low-power wireless network standard (ANT). The mobile terminal may include, but is not limited to, a cellphone, a tablet computer (PAD), and the like. In addition, the mobile terminal may transmit ECG data to a server. In this way, a professional doctor may obtain ECG data from the server and reach conclusions by analyzing the ECG data.

[0065] In the above embodiment, the wearable device may be used as a health device, which not only is easy to carry, but also facilitates regular consumers to proactively operate and use, such that a user can immediately trigger the collection of ECG data whenever feeling any discomfort, and the collected ECG data can be subsequently transmitted to a mobile terminal and a server to facilitate a doctor to perform diagnosis and analysis, which is very convenient and fast.

[0066] FIG. 5 is a schematic structural view of an apparatus for collecting ECG data according to an exemplary embodiment of the present invention, the apparatus for collecting ECG data may be applied to a wearable device, the wearable device may comprise multiple ECG sensor electrodes, and the apparatus comprises: a receiving and identifying module 51 and a collecting module 52.

[0067] The receiving and identifying module 51 is configured to receive a trigger action performed by a user for the wearable device, and identify the trigger action.

[0068] The collecting module 52 is configured to collect, if the receiving and identifying module 51 identifies the trigger action to be a preset operation, ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes.

[0069] Here, the wearable device may further comprise a button, and the button multiplexes one of the multiple ECG sensor electrodes.

[0070] The receiving and identifying module 51 may be specifically configured to receive a trigger action performed by a user on the button, and the button is not limited to the button multiplexing an ECG sensor electrode.

[0071] Moreover, the wearable device may also comprise a MEMS sensor. The receiving and identifying module 51 may be specifically configured to identify a trigger action via the MEMS sensor, and the trigger action may include, but is not limited to, at least one of double-click, triple-click, and continuous double-click.

[0072] FIG. 6 is a schematic structural view of an apparatus for collecting ECG data according to another exemplary embodiment of the present invention. As shown in FIG. 6, on the basis of the above embodiment shown in FIG. 5, the apparatus may further comprise: a counting module 53, a determining module 54, a first processing module 55, and a second processing module 56.

[0073] The counting module 53 is configured to count a collecting duration when the collecting module 52 collects ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes.

[0074] The determining module 54 is configured to determine whether the collecting duration counted by the counting module 53 reaches a preset threshold.

[0075] The first processing module 55 is configured to, if the determining module 54 determines that the collecting duration does not reach the preset threshold, detect whether the current ECG data is valid ECG data; if the current ECG data is invalid ECG data, stop collecting the current ECG data, and store the collected ECG data; if the current ECG data is valid ECG data, collect the current ECG data, and continue counting the collecting duration via the counting module 53.

[0076] The second processing module 56 is configured to, if the determining module 54 determines that the collecting duration reaches the preset threshold, stop collecting the ECG data, and store the collected ECG data.

[0077] Here, the first processing module 55 may comprise at least one sub-module of a first detection sub-module 551, a calculating sub-module 552, and a second detection sub-module 553.

[0078] The first detection sub-module 551 is configured to detect states of ECG sensor electrodes corresponding to the current ECG data; if the state of any one of the ECG sensor electrodes is a detached state, determine that the current ECG data is invalid ECG data, and if the states of all the corresponding ECG sensor electrodes are a normal state, determine that the current ECG data is valid ECG data.

[0079] The calculating sub-module 552 is configured to calculate, according to the collected ECG data, a heart rate; if the heart rate is within a preset range, determine that the current ECG data is valid ECG data, and if the heart rate is not within the preset range, determine that the current ECG data is invalid ECG data.

[0080] The second detection sub-module 553 is configured to detect, according to the collected ECG data, a waveform similarity between a current R wave and a preset R wave; if the waveform similarity is greater than or equal to a preset value, determine that the current ECG data is valid ECG data, and if the waveform similarity is smaller than the preset value, determine that the current ECG data is invalid ECG data.

[0081] FIG. 7 is a schematic structural view of an apparatus for collecting ECG data according to yet another exemplary embodiment of the present invention. As shown in FIG. 7, on the basis of the above embodiment shown

in FIG. 5, if the wearable device comprises a screen, then the apparatus may further comprise a display and control module 57.

[0082] The display and control module 57 is configured to, when the collecting module 52 collects ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes, display a preset icon via the screen or control the wearable device to vibrate, so as to prompt the user that collecting the ECG data has been started; and/or display a progress of collecting the ECG data via the screen.

[0083] FIG. 8 is a schematic structural view of an apparatus for collecting ECG data according to yet another exemplary embodiment of the present invention. As shown in FIG. 8, on the basis of the above embodiment shown in FIG. 5, if the wearable device does not comprise a screen, then the apparatus further comprises a control module 58.

[0084] The control module 58 is configured to, when the collecting module 52 collects ECG data on at least one closed-loop path formed by interconnecting the multiple ECG sensor electrodes, control the wearable device to vibrate, so as to prompt the user that collecting the ECG data has been started.

[0085] With regard to the apparatus in the above embodiment, specific manners in which various modules execute operations have been described in detail in the embodiment about the method, and will not be elaborated again herein.

[0086] In the above embodiment, by identifying a received trigger action and collecting ECG data when the trigger action is identified to be a preset operation, the above-described trigger method is simple, direct, and quick, so that a user can trigger the collection of ECG data when not feeling well. As a result, when a user experiences occasional or paroxysmal heart diseases and symptoms, ECG data can be conveniently and quickly collected, thereby providing support for diagnosis of heart diseases.

[0087] After considering the description and practicing the invention disclosed herein, those skilled in the art would easily conceive of other implementation solutions of the present application. The present application is intended to encompass any variations, purposes, or adaptive modifications of the present application, and these variations, purposes, or adaptive modifications follow the generalized principle of the present application and include common general knowledge and customary technical means in the art that are not disclosed in the present application. The description and embodiments are merely seen as exemplary, and the true scope and spirit of the present application shall be defined by the appended claims.

[0088] It should be further noted that terms “comprise,” “include,” or any other variants thereof are intended to cover non-exclusive inclusion, such that a process, a method, a merchandise, or a device comprising a series of elements not only comprises those elements, but also comprises other elements that are not specifically listed, or further comprises elements inherent to such process, method, merchandise, or device. In case of no further limitations, an element defined by the phrase “comprising one...” does not exclude that other identical elements further exist in a process, a method, a merchandise, or a device comprising the elements

[0089] The description above is only preferred embodiments of the present application, which are not used to limit the present application, and any modification, equivalent substitution, and improvement made within the spirit and principle of the present application shall be encompassed within the scope of protection of the present application.

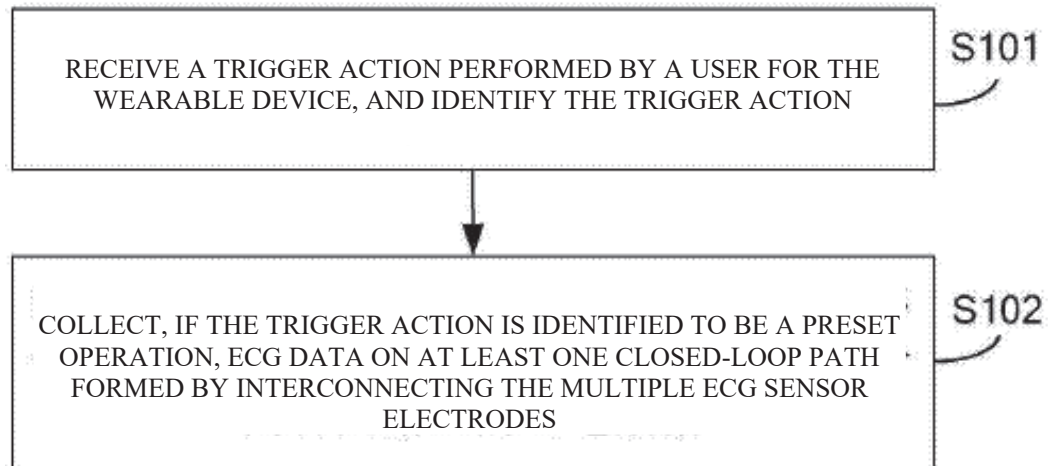


FIG. 1

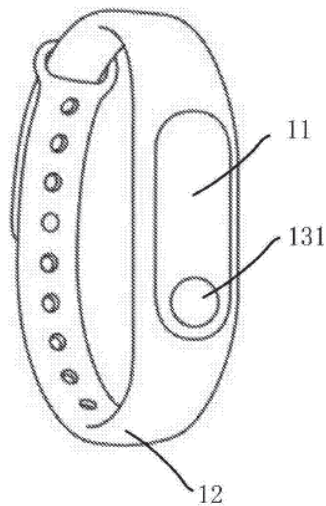


FIG. 2A

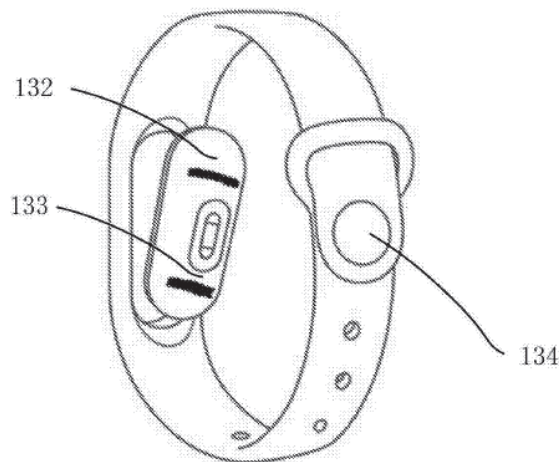


FIG. 2B

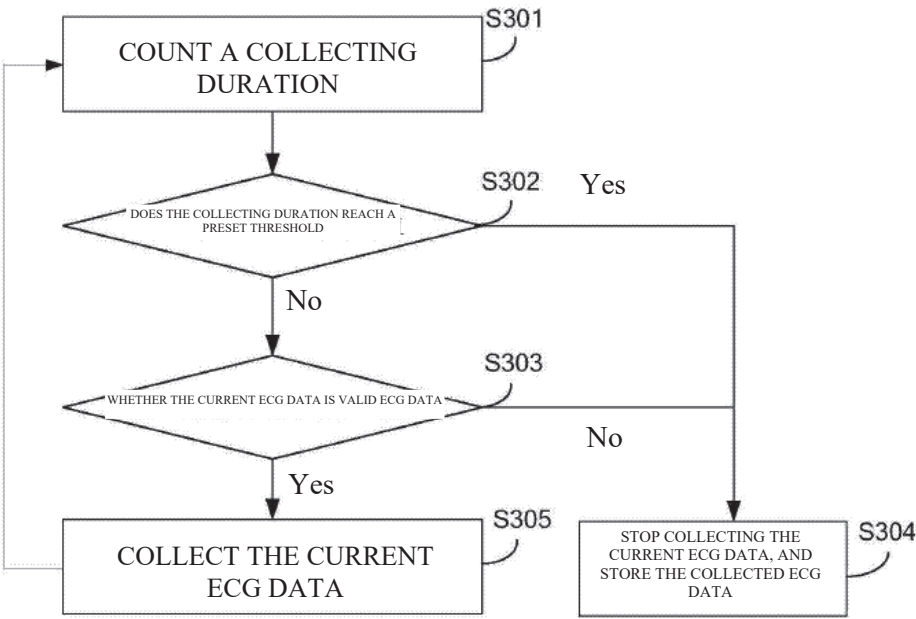


FIG. 3

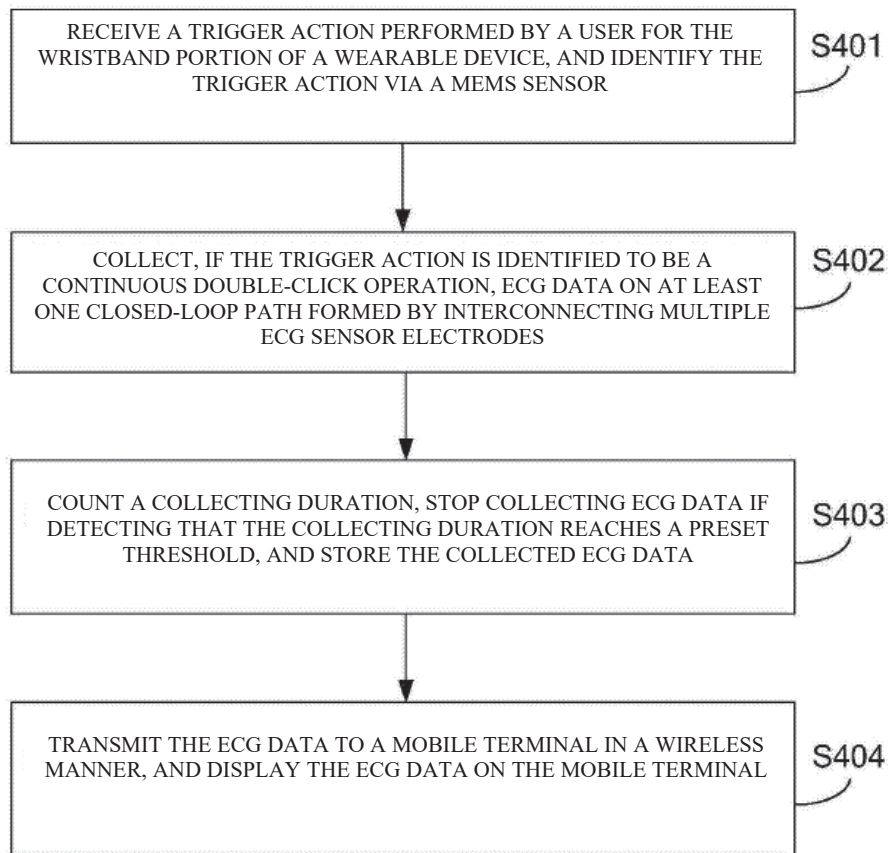


FIG. 4

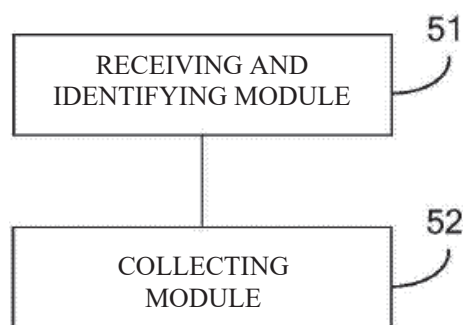


FIG. 5

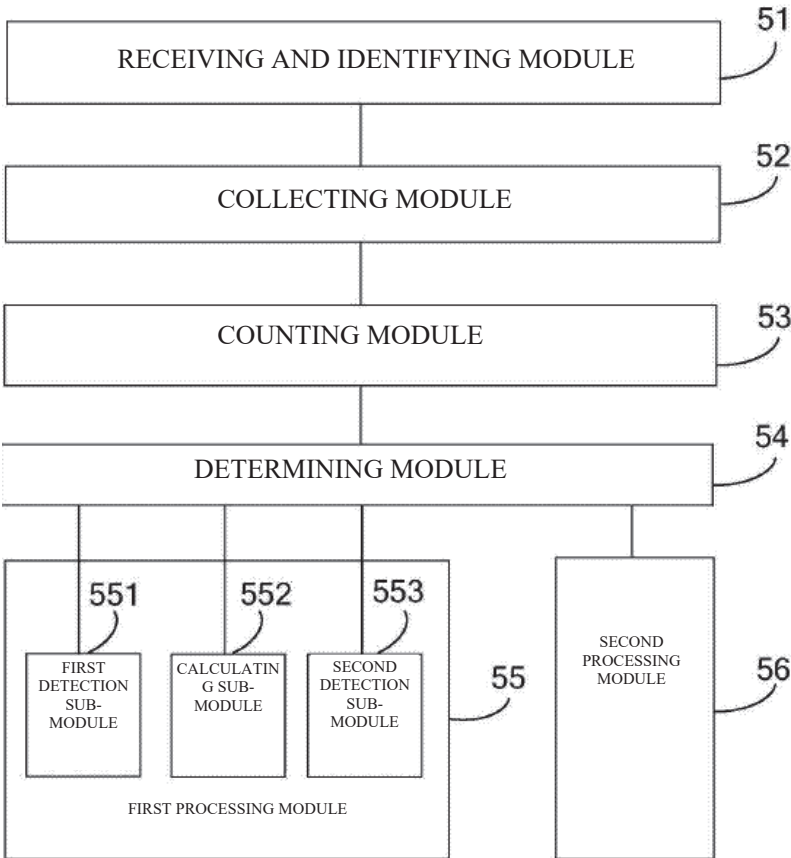


FIG. 6

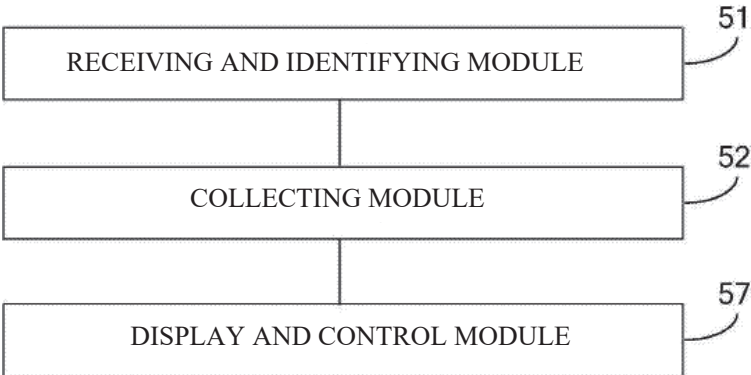


FIG. 7

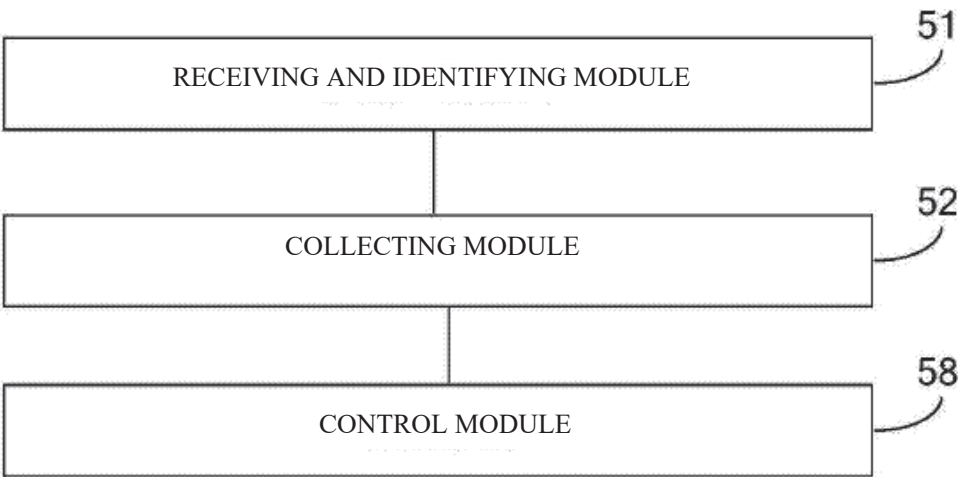


FIG. 5



### **DECLARATION OF TRANSLATOR**

I, Jian Zhang, hereby declare as follows:

1. I personally prepared the attached translation from Chinese into English of the patent that is entitled “CN106901720A - The acquisition method of electrocardiogram (ECG) data, device and wearable device - Google Patents\_AHIT” in Japanese and “CN106901720A\_AHIT\_English.doc” in English (also attached).
2. The attached translation is, to the best of my knowledge, a true, full and accurate translation of the attached Chinese document.
3. I am competent to perform this translation, because I have more than 20 years of experience as a professional Chinese-to-English patent translator.
4. I declare under the penalty of perjury under the laws of the United States that the foregoing is true and correct; and further declare that I am aware that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 1001 of Title 18 of the United States Code.

Dated: August 30, 2023

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