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(54) **BIOSENSOR CONFIGURATION WHICH CAN DETECT AT LEAST TWO PHYSIOLOGICAL FEATURES SIMULTANEOUSLY WITH ONLY TWO CONTACT POSITIONS IN MOBILE DEVICE**

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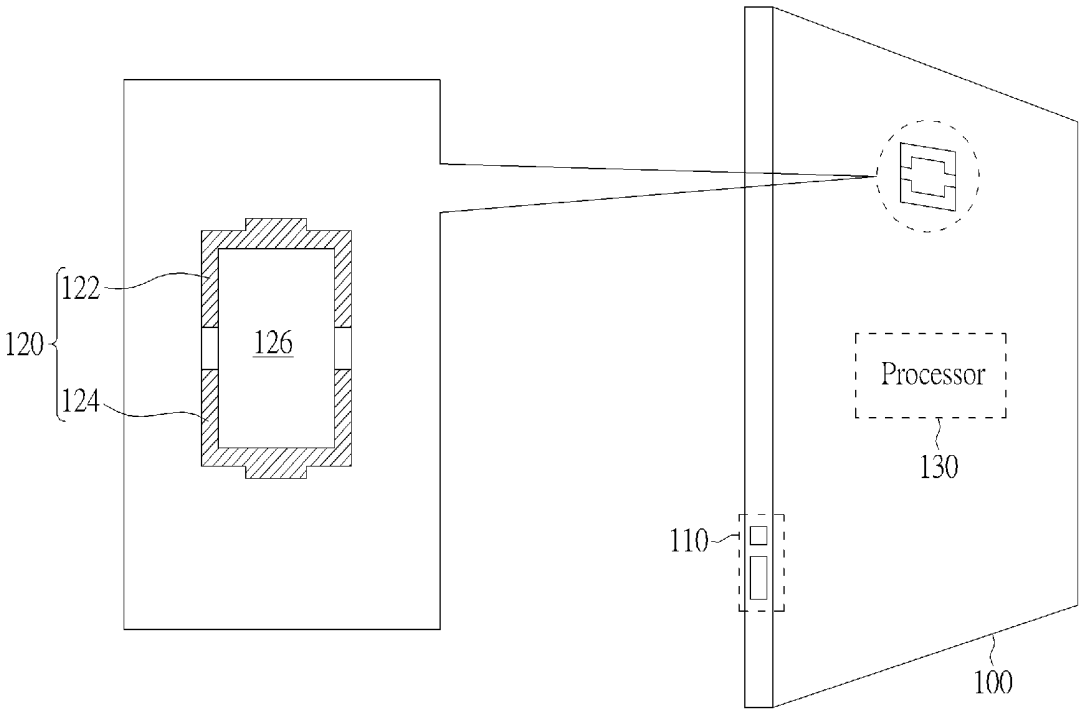
A61B 5/1455	(2006.01)

(52) **U.S. Cl.**

CPC ***A61B 5/0006*** (2013.01); ***A61B 5/0404*** (2013.01); ***A61B 5/14552*** (2013.01); ***A61B 5/0408*** (2013.01); ***A61B 5/0432*** (2013.01)

(57) **ABSTRACT**

The present invention provides an electronic device including a first electrode set and a second electrode set with an optical sensor. The first electrode set is arranged to contact a first position of a human body, and the second electrode set with the optical sensor is arranged contact a second position of the human body, to receive a plurality of physiological signals to determine at least two physiological features simultaneously.



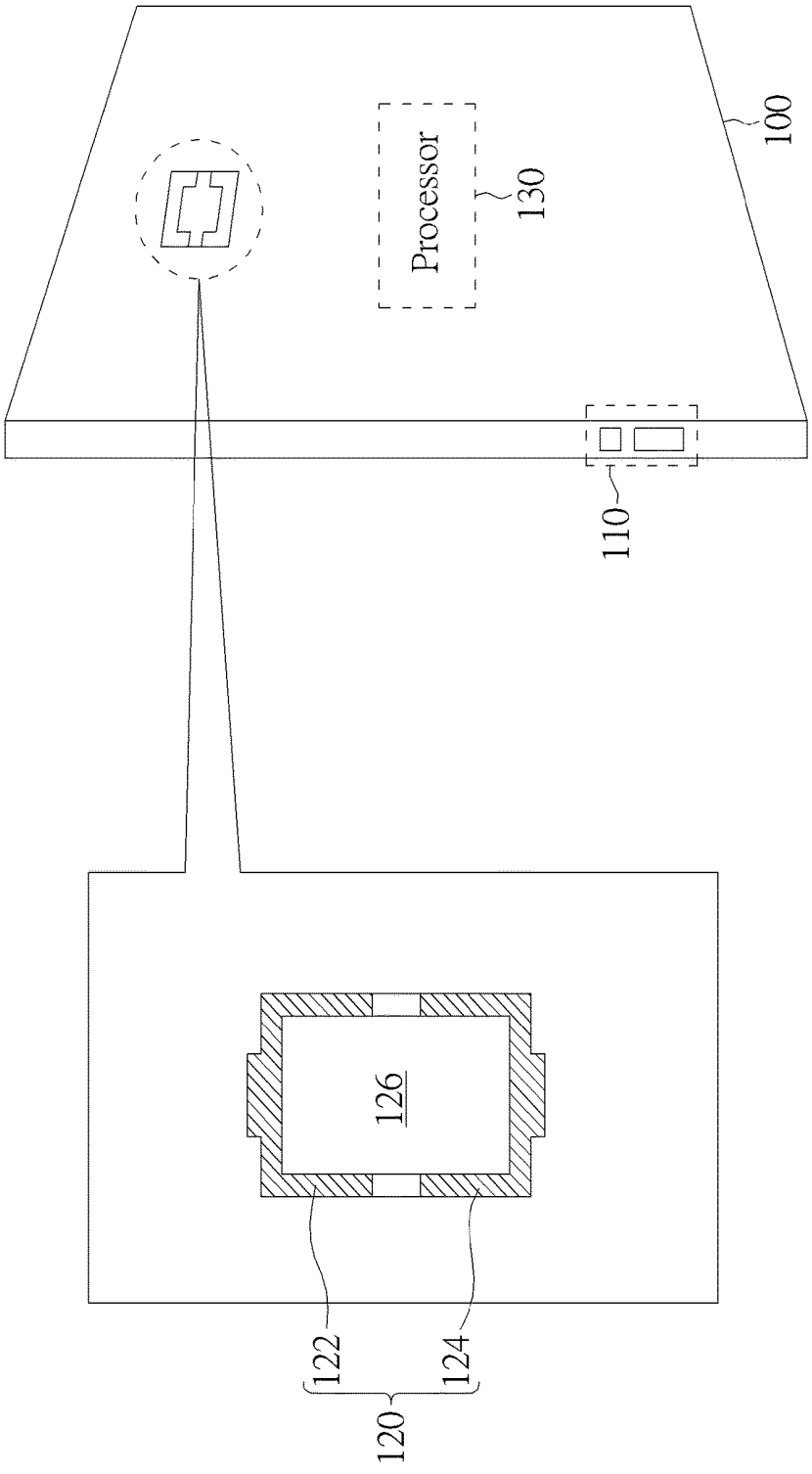


FIG. 1

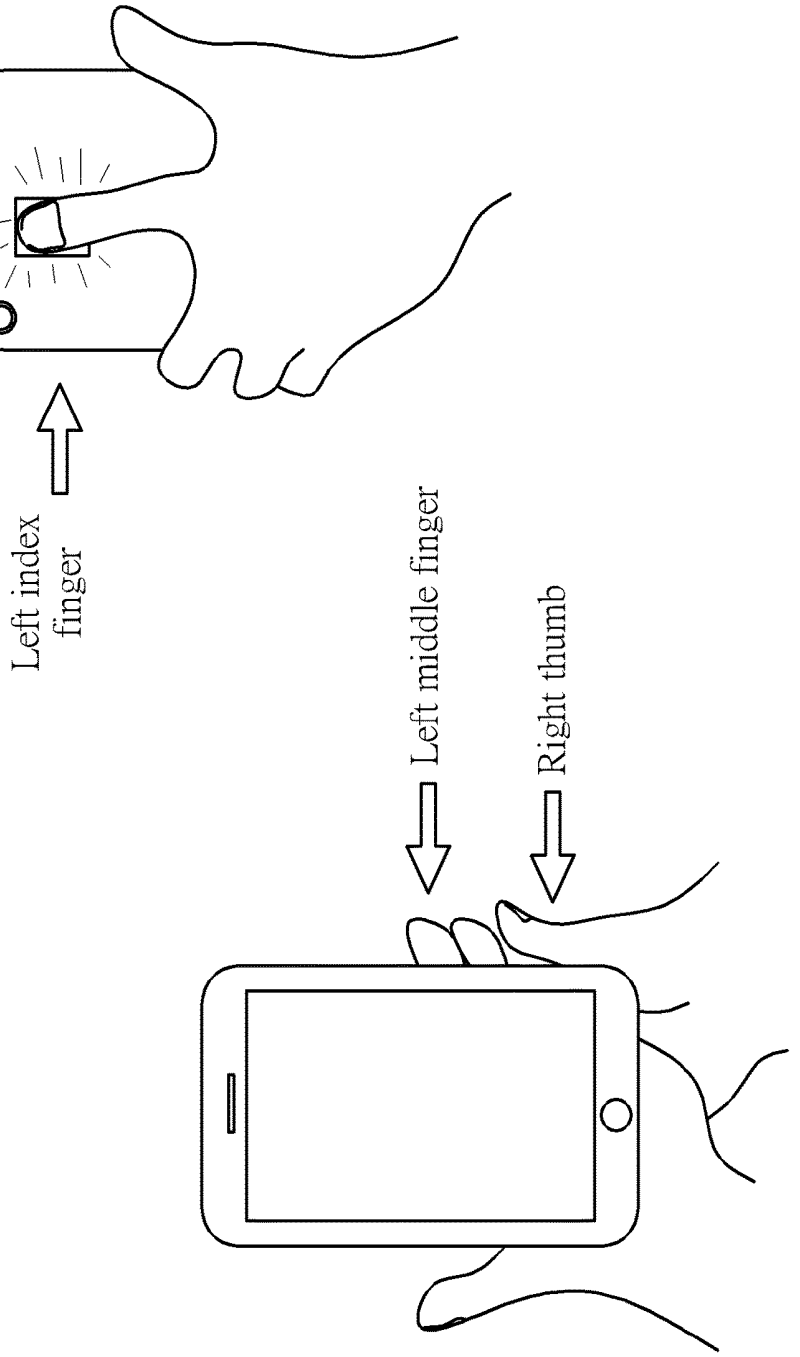


FIG. 2

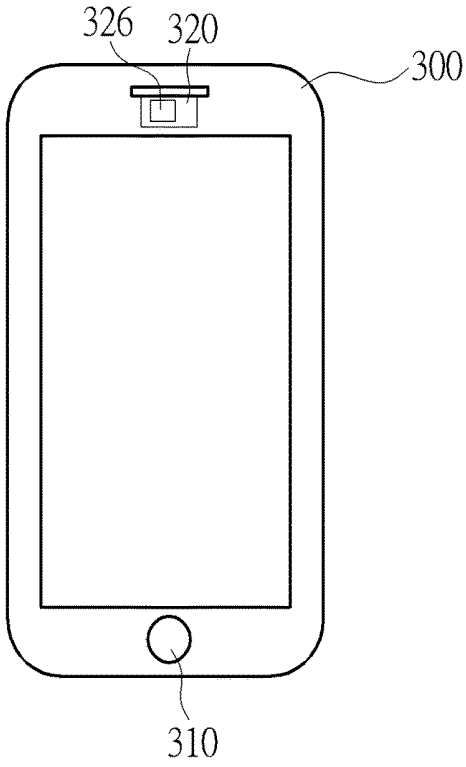


FIG. 3

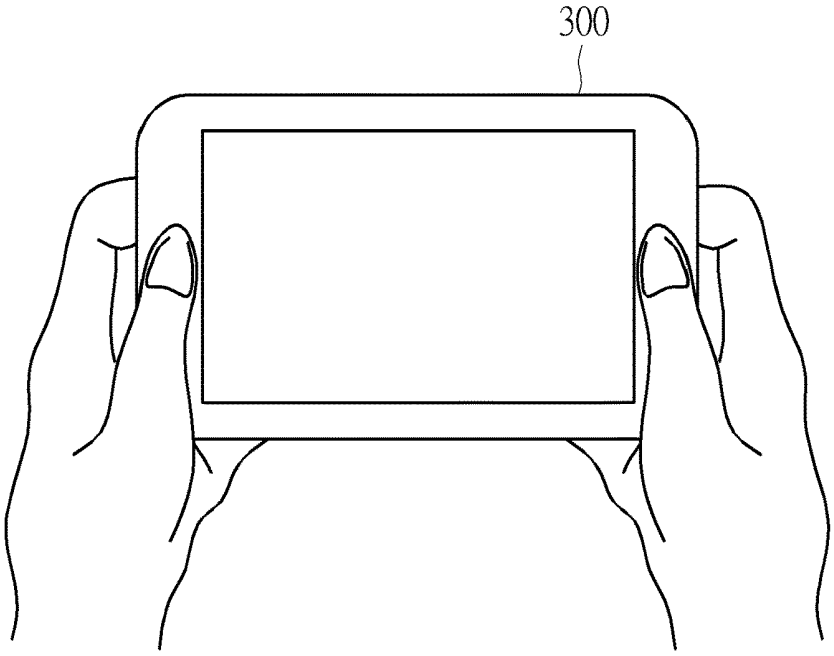


FIG. 4

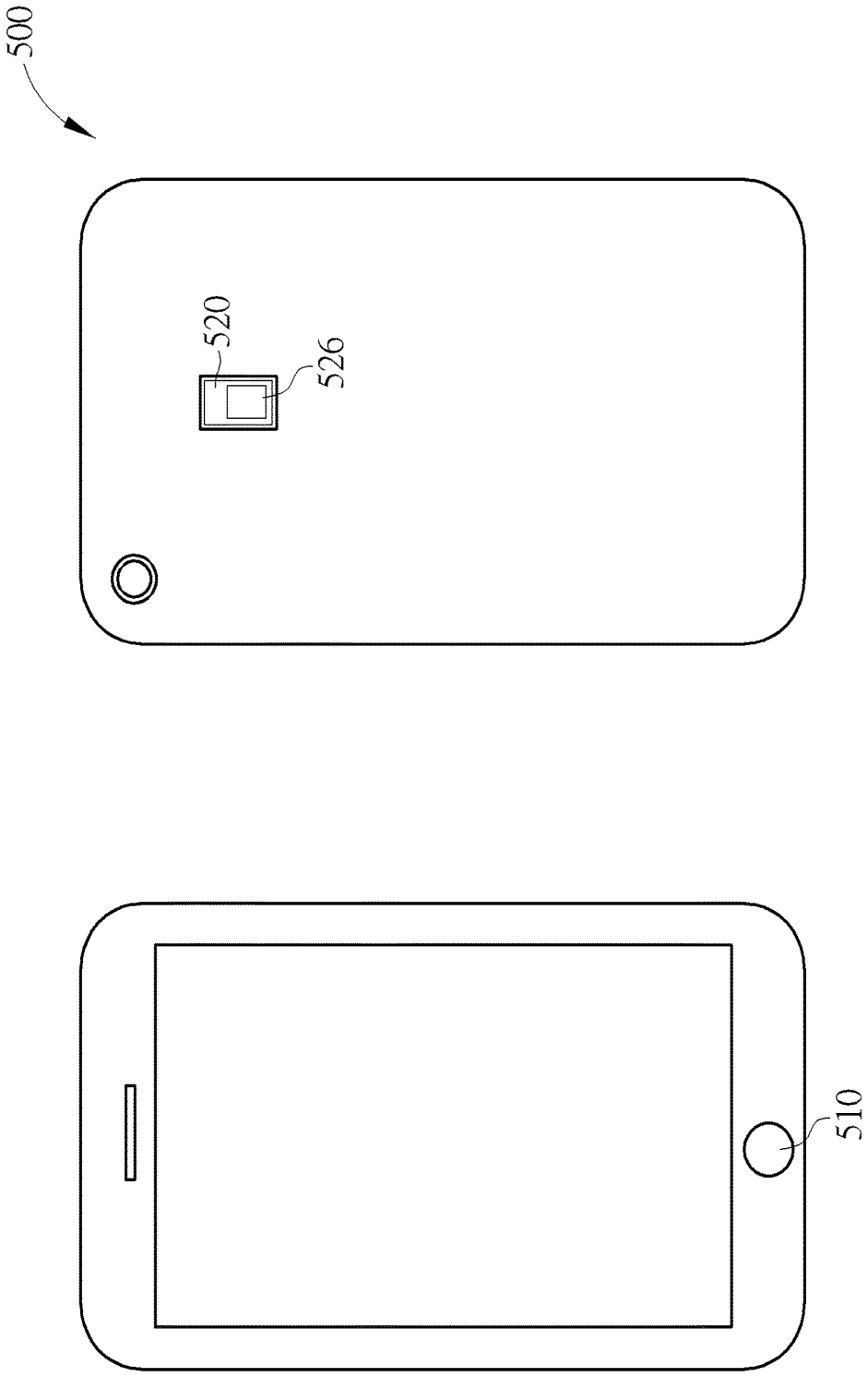


FIG. 5

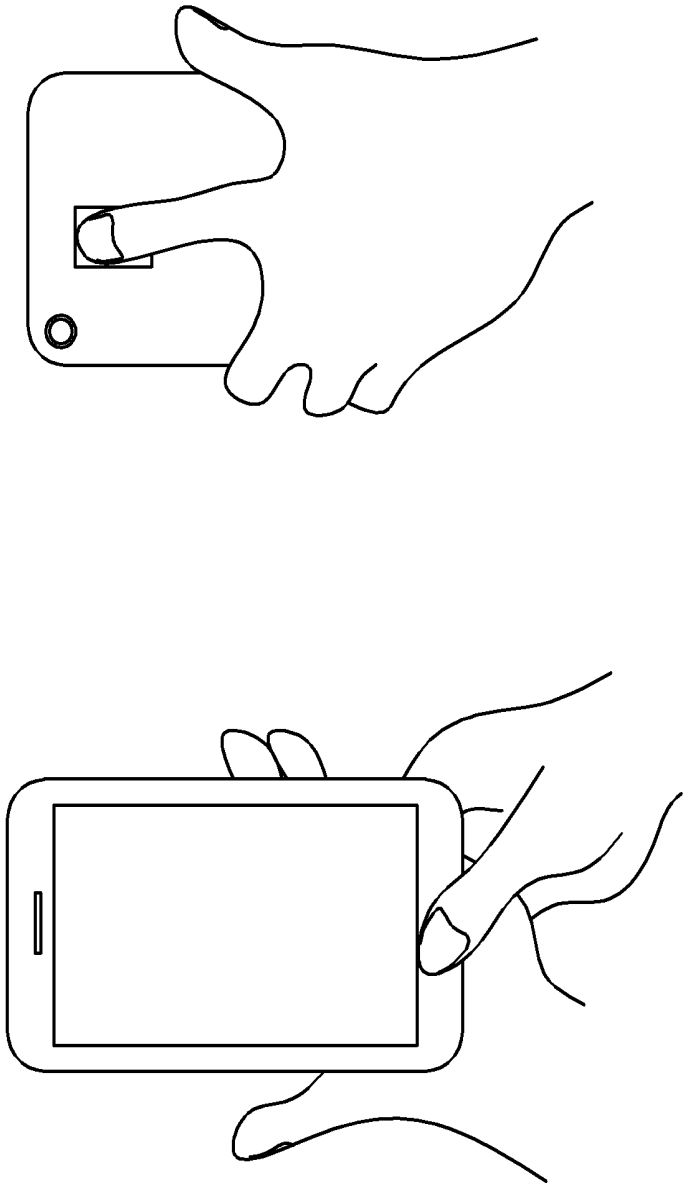


FIG. 6

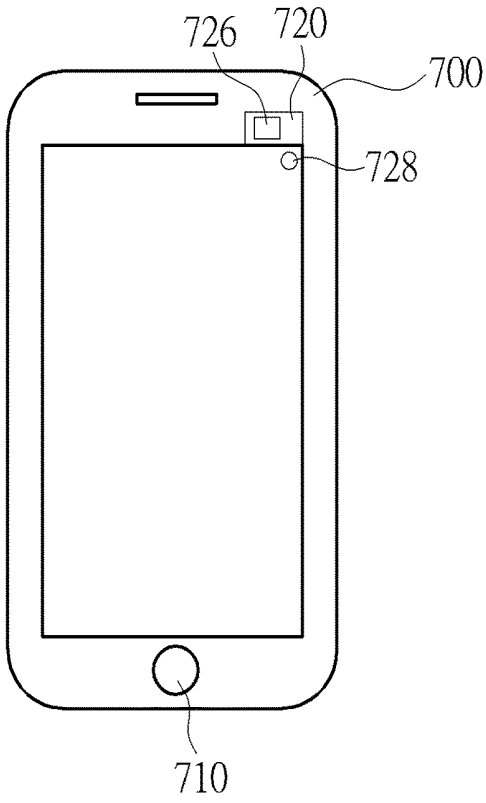


FIG. 7

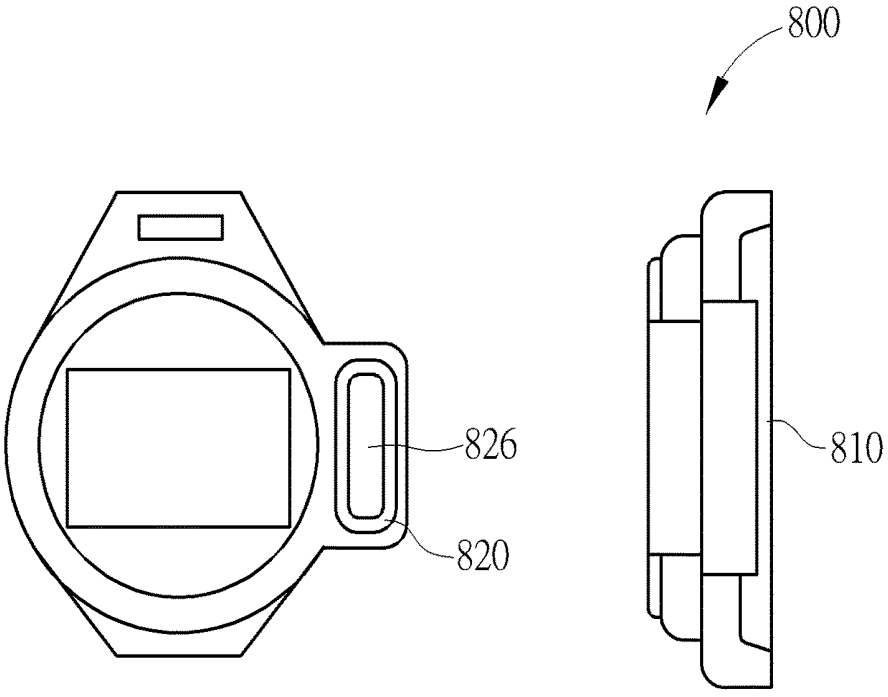


FIG. 8

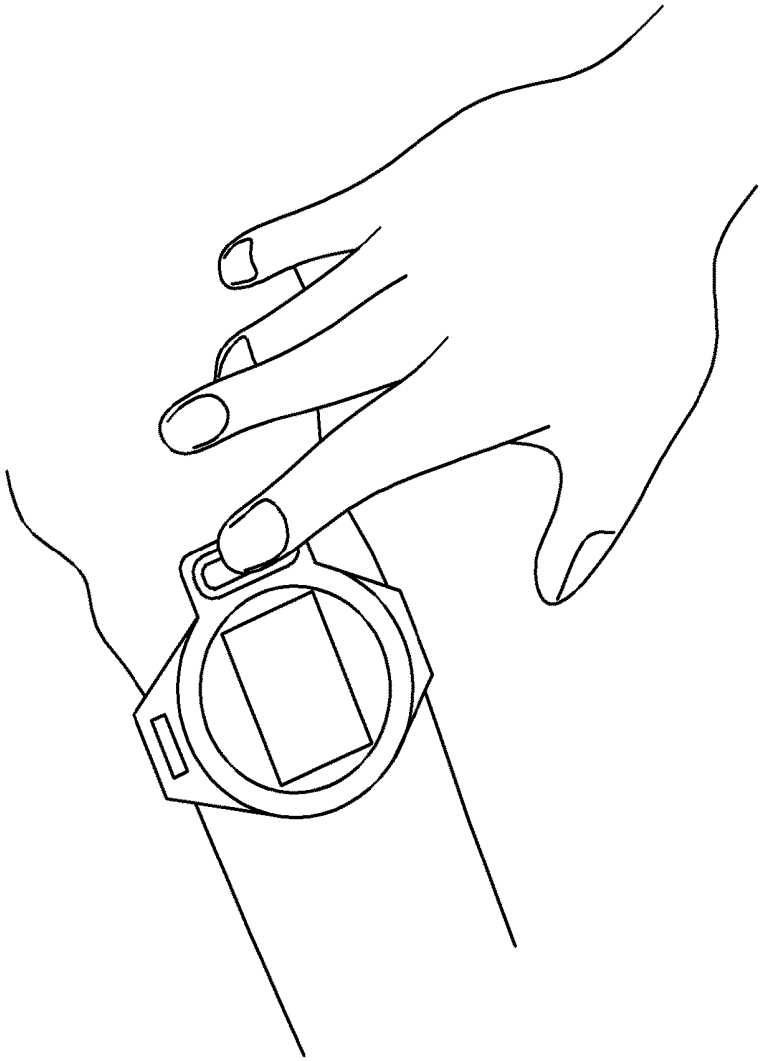


FIG. 9

BIOSENSOR CONFIGURATION WHICH CAN DETECT AT LEAST TWO PHYSIOLOGICAL FEATURES SIMULTANEOUSLY WITH ONLY TWO CONTACT POSITIONS IN MOBILE DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the priority of U.S. Provisional Application No. 62/579,939, filed on Nov. 1, 2017, which is included herein by reference in its entirety.

BACKGROUND

[0002] Recently, personal biosensors become popular for providing physiological information at all time for the reference to the user. However, the current designs of the biosensors may be inconvenient to the user.

SUMMARY

[0003] It is therefore an objective of the present invention to provide a biosensor configuration which can detect at least two physiological features simultaneously upon contacts only with a user's two body positions, to solve the above-mentioned problems.

[0004] According to one embodiment of the present invention, an electronic device is includes a first electrode set and a second electrode set with an optical sensor. The first electrode set is arranged to contact a first position of a human body, and the second electrode set with the optical sensor is arranged contact a second position of the human body, to receive a plurality of physiological signals to determine at least two physiological features simultaneously.

[0005] According to another embodiment of the present invention, a method for generating at least two cardiac health statues is disclosed, and the method comprises the steps of: using a first electrode set to receive a first physiological signal corresponding a first position of a human body; using a second electrode set to receive a second physiological signal corresponding a second position of the human body; using an optical sensor to receive a third physiological signal; and determining the at least two physiological features according to the first physiological signal, the second physiological signal and the third physiological signal.

[0006] These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a diagram illustrating an electronic device according to a first embodiment of the present invention.

[0008] FIG. **2** shows how to use the electronic device shown in FIG. **1** according one embodiment of the present invention.

[0009] FIG. **3** is a diagram illustrating an electronic device according to a second embodiment of the present invention.

[0010] FIG. **4** shows how to use the electronic device shown in FIG. **3** according one embodiment of the present invention.

[0011] FIG. **5** is a diagram illustrating an electronic device according to a third embodiment of the present invention.

[0012] FIG. **6** shows how to use the electronic device shown in FIG. **5** according one embodiment of the present invention.

[0013] FIG. **7** is a diagram illustrating an electronic device according to a fourth embodiment of the present invention.

[0014] FIG. **8** is a diagram illustrating an electronic device according to a fifth embodiment of the present invention.

[0015] FIG. **9** shows how to use the electronic device shown in FIG. **8** according one embodiment of the present invention.

DETAILED DESCRIPTION

[0016] Certain terms are used throughout the following description and claims to refer to particular system components. As one skilled in the art will appreciate, manufacturers may refer to a component by different names. This document does not intend to distinguish between components that differ in name but not function. In the following discussion and in the claims, the terms "including" and "comprising" are used in an open-ended fashion, and thus should be interpreted to mean "including, but not limited to . . . ". The terms "couple" and "couples" are intended to mean either an indirect or a direct electrical connection. Thus, if a first device couples to a second device, that connection may be through a direct electrical connection, or through an indirect electrical connection via other devices and connections.

[0017] FIG. **1** is a diagram illustrating an electronic device **100** according to a first embodiment of the present invention. The electronic device **100** comprises a first electrode set **110**, a second electrode set **120** with an optical sensor **126** and a processor **130**. In this embodiment, the first electrode set **110** comprises two electrodes, the second electrode set **120** comprises two electrodes **122** and **124**, where each of the electrodes **122** and **124** is U-shaped, and the optical sensor **126** is within the second electrodes **122** and **124**. In the embodiment shown in FIG. **1**, the electronic device **100** is a smartphone, the first electrode set **110** is positioned at a side of the smartphone, and the second electrode set **120** with the optical sensor **126** is positioned at a back case of the smartphone.

[0018] It is noted that the shape of the electrodes **122** and **124** shown in FIG. **1** is not a limitation of the present invention. As long as the electrodes **122** and **124** are at a peripheral zone of the optical sensor **126**, the electrodes **122** and **124** may have any other shape, e.g., an O-shaped electrode.

[0019] In the operations of the electronic device **100**, the first electrode set **110** is arranged to contact a first position of a human body (e.g. right half body or right hand), and the second electrode set **120** with the optical sensor **126** is arranged to contact a second position of the human body (e.g. left half body or left hand), to receive a plurality of physiological signals to determine at least two physiological features simultaneously. Taking FIG. **2** as an example, a user may put a left index finger on the second electrode set **120** with the optical sensor **126**, and put a right thumb on the first electrode set **110**, where the right hand holds on the left hand to avoid flexing the muscles. In the embodiment shown in FIG. **1** and FIG. **2**, the first electrode set **110** and the electrodes **122** and **124** are arranged to provide physiological signals, and the processor **130** generates an electrocar-

diography (ECG) signal (e.g. lead I ECG signal) according to the physiological signals from the first electrode set **110** and the electrodes **122** and **124**; and the optical sensor **126** may comprise at least one light emitter and a photodiode, the light emitter generates light (e.g. visible or infrared light) to the left index finger of the user, and the photodiode receives the reflected light to generate a physiological signal, and the processor **130** generates an photoplethysmography (PPG) signal according to the physiological signal from the optical sensor **126**. By analyzing the ECG signal and the PPG signal, e.g. analyzing the waveforms and periods of the ECG signal and the PPG signal, the at least two physiological features such as cardiac health statues can be obtained simultaneously, and the physiological features can be displayed on a screen of the electronic device **100** for the reference to the user. For example, the at least two physiological features may comprise cardiac health statues like ECG, heart rate, blood oxygen saturation (SpO2), blood pressure, or other information like bio-impedance, body fat, body muscle, temperature, blood content analysis, or tissue content concentrations (StO2, collagen, melanin, water . . . etc).

[0020] In the embodiment shown in FIGS. **1** and **2**, the user can simply put two fingers on the first electrode set **110** and the second electrode set **120** with the optical sensor **126**, respectively, to obtain at least two physiological features simultaneously. Therefore, the biosensor configuration is convenient to the user to obtain many cardiac health statues or other body related information.

[0021] FIG. **3** is a diagram illustrating an electronic device **300** according to a second embodiment of the present invention. The electronic device **300** comprises a first electrode set **310**, a second electrode set **320** with an optical sensor **326**. In this embodiment, the electronic device **300** is a smartphone, the first electrode set **310** is built with a home button of the smartphone, and the second electrode set **320** with the optical sensor **326** is positioned at a face of the smartphone. In addition, the designs of the second electrode set **320** with the optical sensor **326** is similar to the second electrode set **120** with the optical sensor **126** shown in FIG. **1**, that is the electrodes of the second electrode set **320** may be at a peripheral zone of the optical sensor **326**, and the second electrode set **320** may have any suitable shape such as the U-shaped or O-shaped electrode.

[0022] In the operations of the electronic device **300**, the first electrode set **310** is arranged to contact a first position of a human body, and the second electrode set **320** with the optical sensor **326** is arranged contact a second position of the human body, to receive a plurality of physiological signals to determine at least two physiological features (e.g. cardiac health statues) simultaneously. Taking FIG. **4** as an example, a user may put a left thumb on the second electrode set **320** with the optical sensor **326**, and put a right thumb on the first electrode set **310**. In the embodiment shown in FIG. **3** and FIG. **4**, the first electrode set **310** and the second electrode set **320** are arranged to provide physiological signals, and a processor (not shown) within the electronic device **300** generates the ECG signal (e.g. lead I ECG signal) according to the physiological signals from the first electrode set **310** and the second electrode set **320**; and the optical sensor **326** may comprise an light emitter and a photodiode, the light emitter generates light to the left thumb of the user, and the photodiode receives the reflected light to generate a physiological signal, and the processor within the electronic device **300** generates the PPG signal according to the physiological signal from the optical sensor. By analyzing the ECG signal and the PPG signal, e.g. analyzing the waveforms and periods of the ECG signal and the PPG signal, the at least two physiological features can be obtained simultaneously, and the physiological features can be displayed on a screen of the electronic device **300** for the reference to the user. For example, the at least two physiological features may comprise cardiac health statues like ECG, heart rate, blood oxygen saturation (SpO2), blood pressure, or other information like bio-impedance, body fat, body muscle, temperature, blood content analysis, or tissue content concentrations (StO2, collagen, melanin, water . . . etc).

[0023] FIG. **5** is a diagram illustrating an electronic device **500** according to a third embodiment of the present invention. The electronic device **500** comprises a first electrode set **510**, a second electrode set **520** with an optical sensor **526**. In this embodiment, the electronic device **500** is a smartphone, the first electrode set **510** is built with a home button of the smartphone, and the second electrode set **520** with the optical sensor **526** is positioned at a back case of the smartphone. In addition, the designs of the second electrode set **520** with the optical sensor **526** is similar to the second electrode set **120** with the optical sensor **126** shown in FIG. **1**, that is the electrodes of the second electrode set **520** may be at a peripheral zone of the optical sensor **526**, and the second electrode set **520** may have any suitable shape such as have the U-shaped or O-shaped electrode.

[0024] In the operations of the electronic device **500**, the first electrode set **510** is arranged to contact a first position of a human body, and the second electrode set **520** with the optical sensor **526** is arranged contact a second position of the human body, to receive a plurality of physiological signals to determine at least two physiological features simultaneously. Taking FIG. **6** as an example, a user may put the left index finger on the second electrode set **520** with the optical sensor **526**, and put the right thumb on the first electrode set **510**. In the embodiment shown in FIG. **5** and FIG. **6**, the first electrode set **510** and the second electrode set **520** are arranged to provide physiological signals, and a processor (not shown) within the electronic device **500** generates the ECG signal (e.g. lead I ECG signal) according to the physiological signals from the first electrode set **510** and the second electrode set **520**; and the optical sensor **526** may comprise an light emitter and a photodiode, the light emitter generates light to the left index finger of the user, and the photodiode receives the reflected light to generate a physiological signal, and the processor within the electronic device **500** generates the PPG signal according to the physiological signal from the optical sensor. By analyzing the ECG signal and the PPG signal, e.g. analyzing the waveforms and periods of the ECG signal and the PPG signal, the at least two physiological features can be obtained simultaneously, and the physiological features can be displayed on a screen of the electronic device **500** for the reference to the user. For example, the at least two physiological features may comprise cardiac health statues like ECG, heart rate, blood oxygen saturation (SpO2), blood pressure, or other information like bio-impedance, body fat, body muscle, temperature, blood content analysis, or tissue content concentrations (StO2, collagen, melanin, water . . . etc).

[0025] FIG. **7** is a diagram illustrating an electronic device **700** according to a fourth embodiment of the present invention. The electronic device **700** comprises a first electrode set **710**, a second electrode set **720** with an optical sensor **726**. In this embodiment, the electronic device **700** is a smartphone, the first electrode set **710** is built with a home button of the smartphone, and the second electrode set **720** with the optical sensor **726** is positioned at a face of the smartphone. In addition, the designs of the second electrode set **720** with the optical sensor **726** is similar to the second electrode set **120** with the optical sensor **126** shown in FIG. **1**, that is, the electrodes of the second electrode set **720** may be at a peripheral zone of the optical sensor **726**, and the second electrode set **720** may have any suitable shape such as the U-shaped or O-shaped electrode.

[0026] In the operations of the electronic device **700**, the first electrode set **710** is arranged to contact a first position of a human body, and the second electrode set **720** with the optical sensor **726** is arranged contact a second position of the human body, to receive a plurality of physiological signals to determine at least two physiological features simultaneously. Similar to the example shown in FIG. **4**, a user may put the left thumb on the second electrode set **720** with the optical sensor **726**, and put the right thumb on the first electrode set **710**. In the embodiment shown in FIG. **7**, the first electrode set **710** and the second electrode set **720** are arranged to provide physiological signals, and a processor (not shown) within the electronic device **700** generates the ECG signal (e.g. lead I ECG signal) according to the physiological signals from the first electrode set **710** and the second electrode set **720**; and the optical sensor **726** may comprise a photodiode, and an light-emitted diode **728** built in the screen may generate light to the left thumb of the user, and the photodiode receives the reflected light to generate a physiological signal, and the processor within the electronic device **700** generates the PPG signal according to the physiological signal from the optical sensor. By analyzing the ECG signal and the PPG signal, e.g. analyzing the waveforms and periods of the ECG signal and the PPG signal, the at least two physiological features can be obtained simultaneously, and the physiological features can be displayed on a screen of the electronic device **700** for the reference to the user. For example, the at least two physiological features may comprise cardiac health statues like ECG, heart rate, blood oxygen saturation (SpO2), blood pressure, or other information like bio-impedance, body fat, body muscle, temperature, blood content analysis, or tissue content concentrations (StO2, collagen, melanin, water . . . etc).

[0027] FIG. **8** is a diagram illustrating an electronic device **800** according to a fifth embodiment of the present invention. The electronic device **800** comprises a first electrode set **810**, a second electrode set **820** with an optical sensor **826**. In this embodiment, the electronic device **800** is a watch, the first electrode set **810** is built in the inner side of the watch, and the optical sensor **826** is within the second electrode set **820**.

[0028] In the operations of the electronic device **800**, the first electrode set **810** is arranged to contact a first position of a human body, and the second electrode set **820** with the optical sensor **826** is arranged contact a second position of the human body, to receive a plurality of physiological signals to determine at least two physiological features simultaneously. Taking FIG. **9** as an example, a user may put the right index finger on the second electrode set **820** with the optical sensor **826**. In the embodiment shown in FIG. **8** and FIG. **9**, the first electrode set **810** and the second electrode set **820** are arranged to provide physiological signals, and a processor (not shown) within the electronic device **800** generates the ECG signal according to the physiological signals from the first electrode set **810** and the second electrode set **820**; and the optical sensor **826** may comprise a light emitter and a photodiode, the light emitter generates light to the left index finger of the user, and the photodiode receives the reflected light to generate a physiological signal, and the processor within the electronic device **800** generates the PPG signal according to the physiological signal from the optical sensor. By analyzing the ECG signal and the PPG signal, e.g. analyzing the waveforms and periods of the ECG signal and the PPG signal, the at least two physiological features can be obtained simultaneously, and the physiological features can be displayed on a screen of the electronic device **800** for the reference to the user. For example, the at least two physiological features may comprise cardiac health statues like ECG, heart rate, blood oxygen saturation (SpO2), blood pressure, or other information like bio-impedance, body fat, body muscle, temperature, blood content analysis, or tissue content concentrations (StO2, collagen, melanin, water . . . etc).

[0029] Briefly summarized, in the biosensor configuration of the present invention, an optical sensor is built with one electrode set so that the user can simply put two fingers (or any two body positions) on the electronic device to obtain at least two physiological features simultaneously. Therefore, the biosensor configuration is convenient to the user to obtain many physiological features.

[0030] Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

What is claimed is:

1. An electronic device, comprising:

a first electrode set comprising at least one electrode;

a second electrode set with an optical sensor, wherein the second electrode set comprises at least one electrode;

wherein the first electrode set is arranged to contact a first position of a human body, and the second electrode set with the optical sensor is arranged contact a second position of the human body, to receive a plurality of physiological signals.

2. The electronic device of claim **1**, wherein the second electrode set is at a peripheral zone of the optical sensor.

3. The electronic device of claim **2**, wherein the optical sensor is within the second electrode.

4. The electronic device of claim **1**, wherein the first electrode set is arranged to contact one of a right half body and a left half body of the human body, and the second electrode set with the optical sensor is arranged to contact the other one of the right half body and the left half body of the human body.

5. The electronic device of claim **4**, wherein the first electrode set is arranged to contact one of a right hand and a left hand, and the second electrode set with the optical sensor is arranged to contact the other one of the right hand and the left hand.

6. The electronic device of claim 5, wherein the first electrode set is arranged to contact a finger or thumb of one of the right hand and the left hand, and the second electrode set with the optical sensor is arranged to contact a finger or thumb of the other one of the right hand and the left hand.

7. The electronic device of claim 4, further comprising:

a processor, coupled to the first electrode set and the second electrode set with the optical sensor, for generating an electrocardiography (ECG) signal according to the physiological signals from the first electrode set and the second electrode set, and generating an photoplethysmography (PPG) signal according to the physiological signal from the optical sensor.

8. The electronic device of claim 7, wherein the processor analyzing the ECG signal and the PPG signal to obtain at least two physiological features simultaneously.

9. The electronic device of claim 8, wherein the at least two physiological feature comprises ECG, heart rate, blood oxygen saturation (SpO2), blood pressure, bio-impedance, body fat, body muscle, temperature, blood content analysis, or tissue content concentration.

10. The electronic device of claim 1, wherein the electronic device is a smartphone, a pad, a tablet, a watch, an accessory, a wearable device or a patch.

11. The electronic device of claim 1, wherein the electronic device is a smartphone, the first electrode set is positioned at a side of the smartphone, and the second electrode set with the optical sensor are positioned at a back case of the electronic device.

12. The electronic device of claim 1, wherein the electronic device is a smartphone, the first electrode set is positioned at a face of the smartphone, and the second electrode set with the optical sensor are positioned at a back case of the electronic device.

13. The electronic device of claim 1, wherein the electronic device is a smartphone, and the first electrode set and the second electrode set with the optical sensor are positioned at a face of the smartphone.

14. The electronic device of claim 1, wherein the electronic device is a smartphone, and the first electrode set and the second electrode set with the optical sensor are positioned at a back case of the smartphone.

15. A method for generating at least two (bio-signal or physiological feature), comprising:

using a first electrode set to receive a first physiological signal corresponding a first position of a human body;

using a second electrode set to receive a second physiological signal corresponding a second position of the human body;

using an optical sensor to receive a third physiological signal; and

determining the at least two physiological features according to the first physiological signal, the second physiological signal and the third physiological signal.

16. The method of claim 15, wherein the first position is one of a right half body and a left half body of the human body, and the second position is the other one of the right half body and the left half body of the human body.

17. The method of claim 15, wherein the step of determining the at least two physiological features according to the first physiological signal, the second physiological signal and the third physiological signal comprises:

generating an electrocardiography (ECG) signal according to the first physiological signal and the second physiological signal;

generating an photoplethysmography (PPG) signal according to the third physiological signal; and

analyzing the ECG signal and the PPG signal to obtain the at least two physiological features simultaneously

18. The electronic device of claim 17, wherein the at least two physiological features comprises ECG, heart rate, blood oxygen saturation (SpO2), blood pressure, body fat, body muscle, temperature, blood content analysis, or tissue content concentration bio-impedance.

* * * * *

专利名称(译)	生物传感器配置，其可以在移动设备中仅与两个接触位置同时检测至少两个生理特征		
公开(公告)号	US20190125187A1	公开(公告)日	2019-05-02
申请号	US16/150282	申请日	2018-10-03
[标]申请(专利权)人(译)	联发科技股份有限公司		
申请(专利权)人(译)	联发科技股份有限公司.		
当前申请(专利权)人(译)	联发科技股份有限公司.		
[标]发明人	KUO JING LIN ZOU TENG FENG LIN CHIH CHUN CHI CHIA WEI LIN HUNG CHIH CHEN YU WEN		
发明人	KUO, JING-LIN ZOU, TENG-FENG LIN, CHIH-CHUN CHI, CHIA-WEI LIN, HUNG-CHIH CHEN, YU-WEN		
IPC分类号	A61B5/00 A61B5/0404 A61B5/0432 A61B5/0408 A61B5/1455		
CPC分类号	A61B5/0006 A61B5/0404 A61B5/0432 A61B5/0408 A61B5/14552 A61B5/01 A61B5/02 A61B5/02055 A61B5/0402 A61B5/0537 A61B5/1451 A61B5/14542 A61B5/14546 A61B5/02108 A61B5/024 A61B5/02427 A61B5/02438 A61B5/0245 A61B5/14532 A61B5/14535 A61B5/14539 A61B5/1455 A61B5/6898 A61B2560/0468 A61B2562/06		
优先权	62/579939 2017-11-01 US		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种电子装置，包括第一电极组和具有光学传感器的第二电极组。第一电极组布置成接触人体的第一位置，并且具有光学传感器的第二电极组布置成接触人体的第二位置，以接收多个生理信号以确定至少两个生理特征同时。