US 20150025395A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2015/0025395 A1**

(43) **Pub. Date: Jan. 22, 2015**

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(54) **BREATHING ANALYSIS METHOD, SYSTEM, AND APPARATUS**

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(21) Appl. No.: **14/253,825**

(22) Filed: **Apr. 15, 2014**

(30) **Foreign Application Priority Data**

Apr. 15, 2013 (TW) 102113370

Publication Classification

(51) **Int. Cl.**

A61B 5/0205	(2006.01)
A61B 5/0432	(2006.01)
A61B 5/044	(2006.01)
A61B 5/00	(2006.01)
A61B 5/0456	(2006.01)
A61B 5/04	(2006.01)

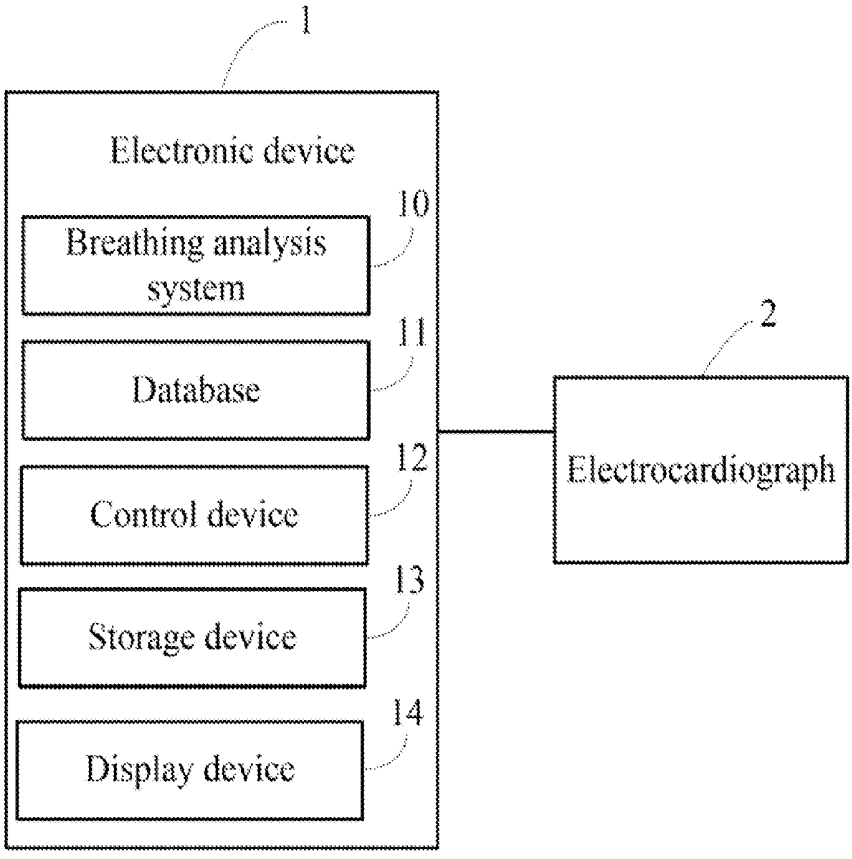
(52) **U.S. Cl.**

CPC ***A61B 5/0205*** (2013.01); ***A61B 5/0456*** (2013.01); ***A61B 5/04012*** (2013.01); ***A61B 5/044*** (2013.01); ***A61B 5/0006*** (2013.01); ***A61B 5/0432*** (2013.01); *A61B 5/0816* (2013.01)

USPC **600/484**

(57) **ABSTRACT**

In a breathing analysis method using an electrocardiogram of a user, a breathing curve is generated according to R waves in the electrocardiogram, and whether the user is currently taking a breathing out action or a breathing in action is detected according to the breathing curve. A duration of the breathing in action or the breathing out action of the user is computed according to the breathing curve, and a ratio of the duration and a standard time of the breathing in action or the breathing out action is computed. A breathing in or out progress is displayed in a progress demonstration bar on the display device according to the ratio.



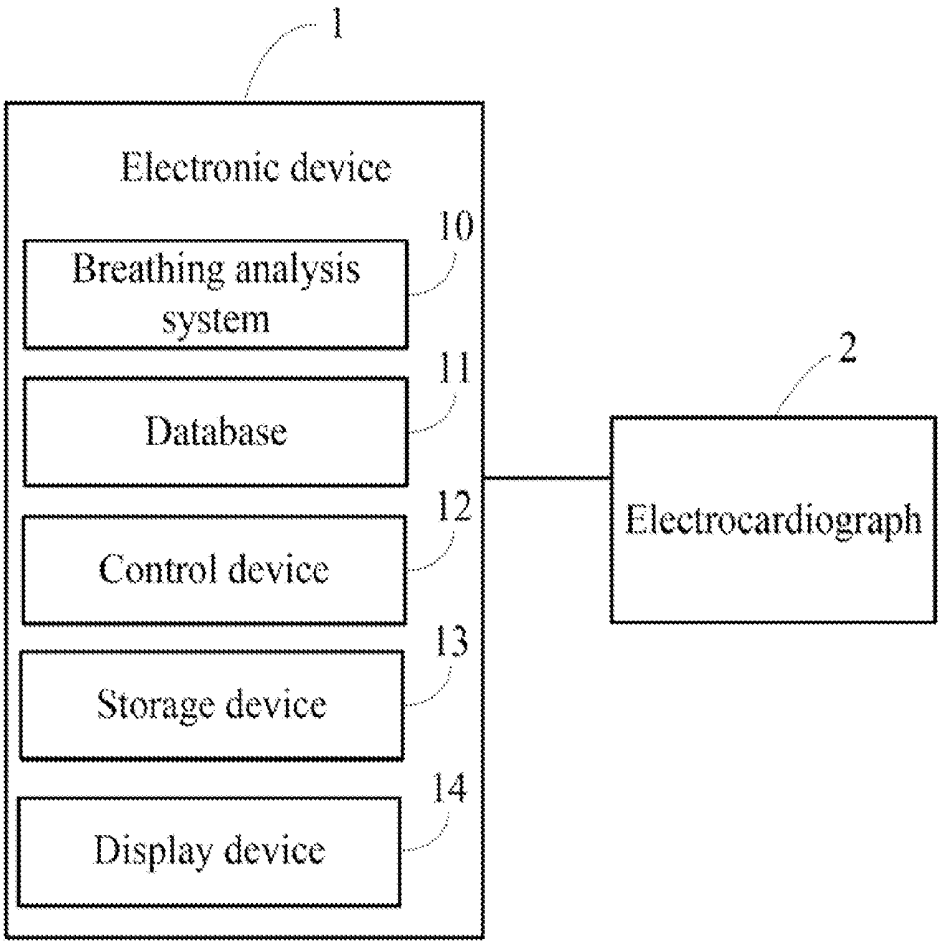

1
Electronic device
10
Breathing analysis system
11
Database
12
Control device
13
Storage device
14
Display device
2
Electrocardiograph

FIG. 1

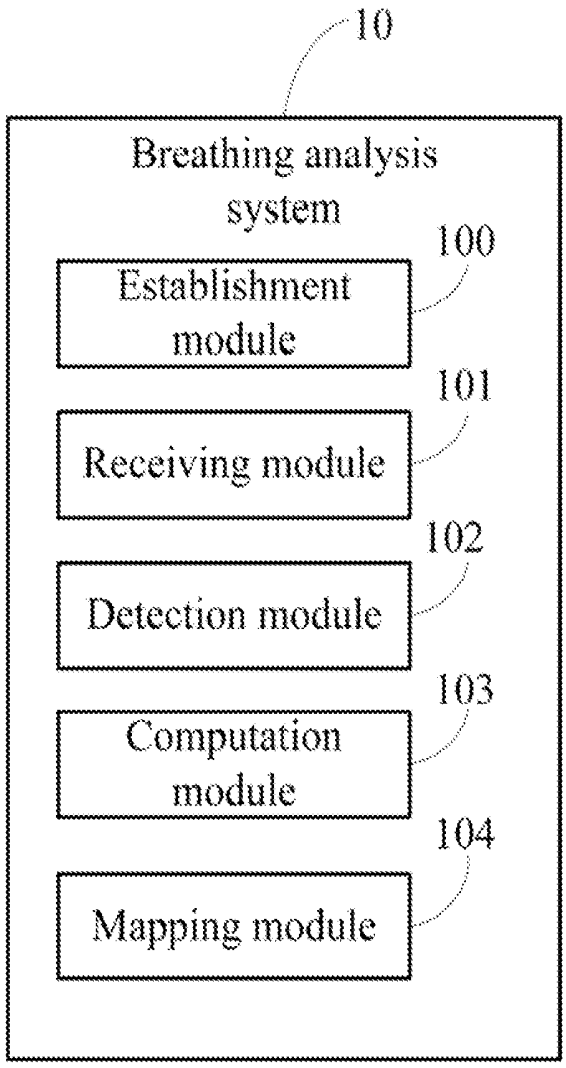

10
Breathing analysis system
100
Establishment module
101
Receiving module
102
Detection module
103
Computation module
104
Mapping module

FIG. 2

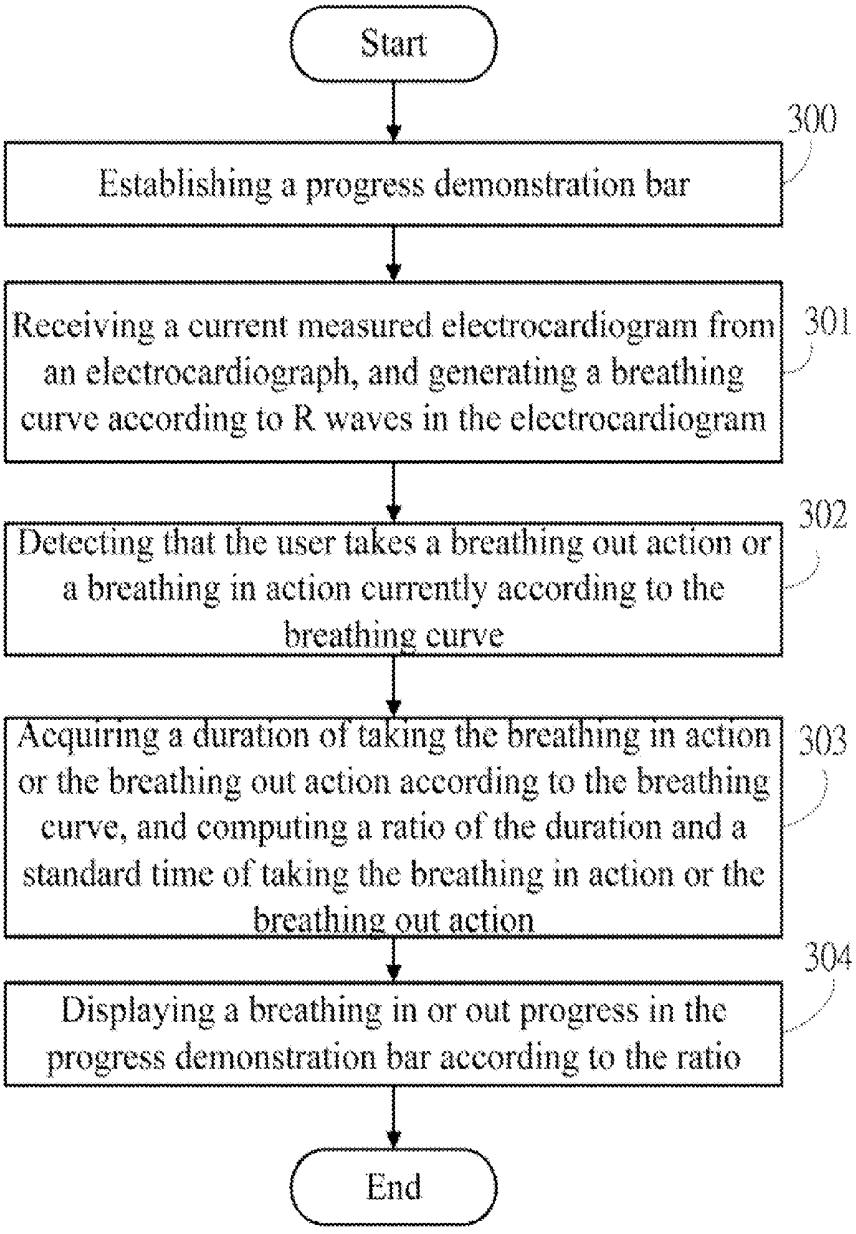

Start
300
Establishing a progress demonstration bar
Receiving a current measured electrocardiogram from an electrocardiograph, and generating a breathing curve according to R waves in the electrocardiogram
301
Detecting that the user takes a breathing out action or a breathing in action currently according to the breathing curve
302
Acquiring a duration of taking the breathing in action or the breathing out action according to the breathing curve, and computing a ratio of the duration and a standard time of taking the breathing in action or the breathing out action
303
Displaying a breathing in or out progress in the progress demonstration bar according to the ratio
304
End

FIG. 3

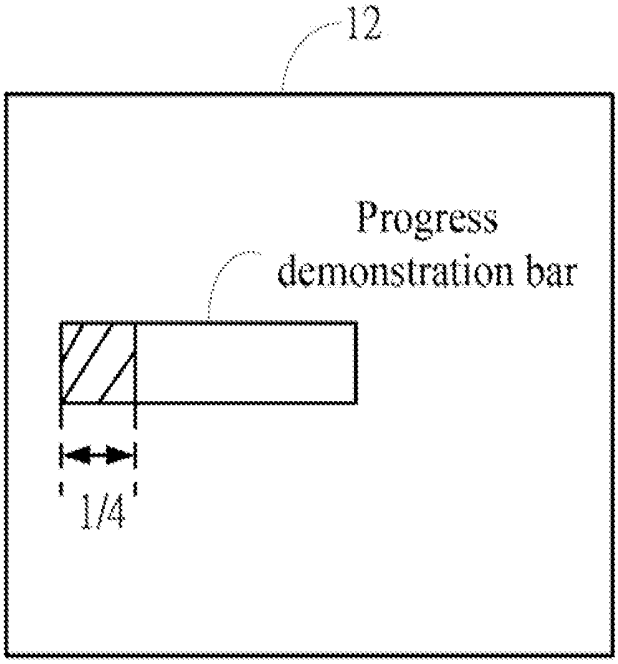


FIG. 4

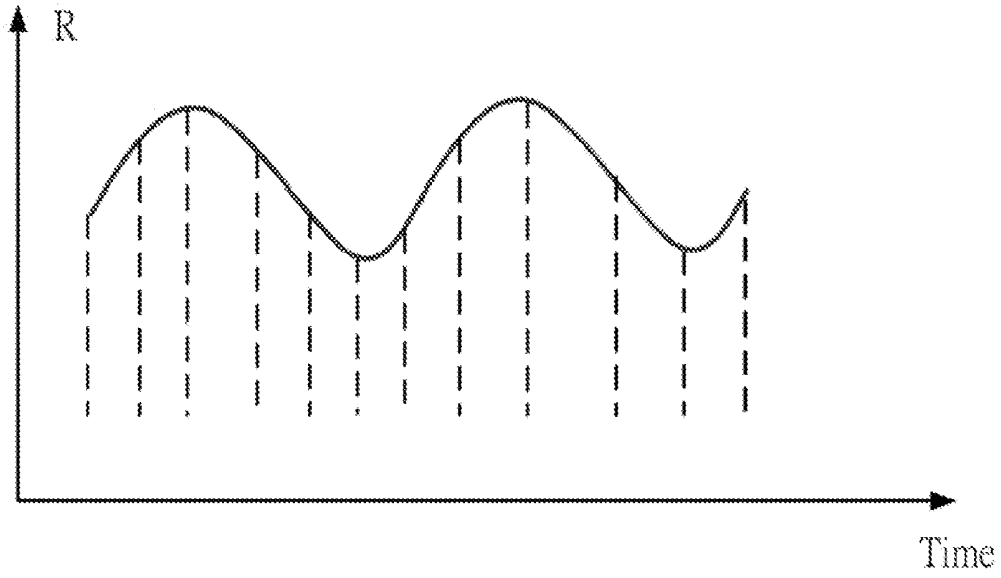


FIG. 5

BREATHING ANALYSIS METHOD, SYSTEM, AND APPARATUS

FIELD

[0001] Embodiments of the present disclosure relate to an electrocardiogram (ECG) analysis technique, and more specifically relates to an apparatus, a method and a system for analyzing breathing of a user according to the user's ECG.

BACKGROUND

[0002] A ECG is used to measure the heart's electrical conduction system. The ECG measures electrical impulses generated by the polarization and depolarization of cardiac tissue and translates the electrical impulses into a wave which is used to measure the rate and regularity of heartbeats. The wave comprises a P wave, a QRS complex, a T wave, and a U wave. The QRS complex includes a plurality of R waves.

[0003] An RR interval, the interval between two adjacent R waves, can be used to measure a heart rate. The heart rate can vary according to the body's physical needs, including the need to absorb oxygen and excrete carbon dioxide.

[0004] Usually, the ECG only can be read by experts, for example medical staff. Thus, it is difficult to realize whether a person is breathing normal according to the ECG for determining whether the user is healthy.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. **1** is a block diagram of one example embodiment of a hardware environment for executing a breathing analysis system.

[0006] FIG. **2** is a block diagram of one example embodiment of function modules of the breathing analysis system in FIG. **1**

[0007] FIG. **3** is a flowchart of one example embodiment of a breathing analysis method.

[0008] FIG. **4** illustrates an example of a breathing curve.

[0009] FIG. **5** illustrates an example of a progress demonstration bar.

DETAILED DESCRIPTION

[0010] In general, the word "module," as used hereinafter, refers to logic embodied in hardware or firmware, or to a collection of software instructions, written in a programming language, for example, Java, C, or assembly. One or more software instructions in the modules may be embedded in firmware. It will be appreciated that modules may comprise connected logic units, such as gates and flip-flops, and may comprise programmable units, such as programmable gate arrays or processors. The modules described herein may be implemented as either software and/or hardware modules and may be stored in any type of non-transitory computer-readable storage medium or other computer storage device.

[0011] FIG. **1** is a block diagram of one example embodiment of a hardware environment for executing a breathing analysis system **10**. The breathing analysis system **10** is installed and running in an electronic device **1**, for example a computer, a smart phone, or a smart TV, for example. The electronic device **1** includes a database **11**, a control device **12**, a storage device **13**, and a display device **14**. In this embodiment, the electronic device **1** connects to an electrocardiograph **2**. The electrocardiograph **2** can read an electrocardiogram of one or more users.

[0012] The breathing analysis system **10** includes a plurality of function modules (shown in FIG. **2**), that analyze and display breathing actions of one or more users according to the users' electrocardiogram (ECG).

[0013] The database **11** can be installed in the electronic device **1**, and also can be externally connected with the electronic device **1**. The database **11** stores standard times of a breathing in action and a breathing out action. The breathing in action can be absorbing oxygen, and the breathing out action can be excreting carbon dioxide. For example, the database **11** may store that the standard time of a breathing in action is N seconds, and the standard time of a breathing out action is M seconds. In other embodiments, the database **11** can also store a proper ratio of a breathing in action and a breathing out action, such as this ratio can be 1:2. The standard times and the ratio stored in the database **11** can be edited by permitted users, for example a medical staff.

[0014] The control device **12** can be a processor, an application-specific integrated circuit (ASIC), or a field programmable gate array (FPGA), for example. The control device **12** can execute computerized codes of the function modules to realize the functions of the breathing analysis system **10**.

[0015] The storage device **13** can include some type(s) of non-transitory computer-readable storage medium, for example a hard disk drive, a compact disc, a digital video disc, or a tape drive. The storage device **13** stores the computerized codes of the function modules of the breathing analysis system **10**.

[0016] FIG. **2** is a block diagram of one example embodiment of function modules of the breathing analysis system **10**. The function modules includes an establishment module **100**, a receiving module **101**, a detection module **102**, a computation module **103**, and a mapping module **104**. The function modules **100-104** can include computerized codes in the form of one or more programs, which provide at least the functions needed to execute the steps illustrated in FIG. **3**.

[0017] FIG. **3** is a flowchart of one example embodiment of a breathing analysis method. In the embodiment, the method is performed by execution of computer-readable software program codes or instructions by at least one processor (i.e., the control device **12**) of the electronic device **1**. Depending on the embodiment, additional steps in FIG. **3** can be added, removed, and the ordering of the steps may be changed.

[0018] In **300**, the establishment module **100** establishes a progress demonstration bar. An example of the progress demonstration bar is shown in FIG. **4**. The progress demonstration bar can prompt the taking of a correct breathing in action or a correct breathing out action.

[0019] In **301**, the receiving module **101** receives a current measured electrocardiogram of a user from the electrocardiograph **2**, and generates a breathing curve according to R waves in the electrocardiogram. In at least one embodiment, the breathing curve is generated according to values of the R waves. One example of the breathing curve is shown in FIG. **5**.

[0020] In **302**, the detection module **102** detects and determines that the user is currently taking a breathing out action or a breathing in action according to the breathing curve. In at least one embodiment, the detection module **102** detects and determines that the user takes a breathing in action or a breathing out action according to slopes of the breathing curve. In at least one embodiment, when detecting that a slope in the breathing curve is a negative value, the detection module **102** determines that the user takes a breathing in action.

When detecting that a slope in breathing curve at one time is a positive value, the detection module **102** determines that the user takes a breathing out action. When detecting that a slope in breathing curve is zero, the detection module **102** determines that the user holds the breath at this time.

[0021] In **303**, the computation module **103** acquires the duration of the breathing in action or the breathing out action according to the breathing curve, and computes a ratio of the duration and a standard time of the breathing in action or the breathing out action. The standard time of the breathing in action or the breathing out action is transmitted from the database **11**. In at least one embodiment, the duration of the breathing in action is from a time that a slope in the breathing curve changes to zero from a positive value. In another embodiment, the duration of a breathing out action is from a time that the slope in the breathing curve changes to zero from a negative value. In at least one embodiment, if the duration of a breathing in action is A seconds, and a standard time of the breathing in action is B seconds, then the computation module **103** computes the ratio of the duration and the standard time is A/B.

[0022] In **304**, the mapping module **104** displays on the display device **14** a breathing in or breathing out progress in the progress demonstration bar according to the ratio, for example, illustrated in FIG. **4**. According to the progress demonstration bar, the user can know he/she needs to continue the breathing in action or the breathing out action until the progress demonstration bar is completed.

[0023] It should be emphasized that the above-described embodiments of the present disclosure, including any particular embodiments, are merely possible examples of implementations, set forth for a clear understanding of the principles of the disclosure. Many variations and modifications may be made to the above-described embodiment(s) of the disclosure without departing substantially from the spirit and principles of the disclosure. All such modifications and variations are intended to be included herein within the scope of this disclosure and protected by the following claims.

What is claimed is:

1. A breathing analysis method being executed by at least one processor of an electronic device, the method comprising:

Receiving, at the electronic device, a current measured electrocardiogram of a user from an electrocardiograph, and generating a breathing curve according to R waves in the electrocardiogram;

Detecting, at the electronic device, whether the user is currently taking a breathing out or a breathing in accordance with the breathing curve;

Acquiring, at the electronic device, a duration of the breathing in action or the breathing out action in accordance with the breathing curve, and computing a ratio of the duration and a standard time of the breathing in action or the breathing out action; and

displaying a breathing in or breathing out progress in a progress demonstration bar according to the ratio on a display device of the electronic device.

2. The method according to claim **1**, wherein the breathing curve is generated according to values of the R waves.

3. The method according to claim **1**, wherein the electronic device determines whether the user is breathing in or breathing out in accordance to slopes of the breathing curve.

4. The method according to claim **3**, wherein the electronic device determines the user is breathing in when a slope in the breathing curve is a negative value, the electronic device determines the user is breathing out when a slope in breathing curve is a positive value, and the electronic device determines the user holds the breath when a slope in breathing curve is zero.

5. The method according to claim **1**, wherein the standard time of the breathing inaction or the breathing out action is transmitted from a database.

6. The method according to claim **1**, wherein the duration of breathing in action is from a time that a slope in the breathing curve changes to zero from a positive value, and the duration of breathing out action is from a time that the slope in the breathing curve changes to zero from a negative value.

7. An apparatus, comprising:

a display device;

a control device; and

a storage device storing one or more programs which when executed by the control device, causes the control device to:

receive a current measured electrocardiogram of a user from an electrocardiograph, and generating a breathing curve according to R waves in the electrocardiogram;

detect whether the user is currently taking a breathing out or a breathing in accordance with the breathing curve;

acquire a duration of the breathing in action or the breathing out action in accordance with the breathing curve, and computing a ratio of the duration and a standard time of the breathing in action or the breathing out action; and

display a breathing in or breathing out progress in a progress demonstration bar according to the ratio on the display device.

8. The apparatus according to claim **7**, wherein the breathing curve is generated according to values of the R waves.

9. The apparatus according to claim **7**, wherein the control device determines whether the user is breathing in or breathing out in accordance to slopes of the breathing curve.

10. The apparatus according to claim **9**, wherein the control device determines the user takes a breathing in action when a slope in the breathing curve is a negative value, the control device determines the user takes a breathing out action when a slope in breathing curve is a positive value, and the control device determines the user holds the breath when a slope in breathing curve is zero.

11. The apparatus according to claim **7**, further comprising a database which stores standard times of the breathing in action or the breathing out action.

12. The apparatus according to claim **7**, wherein the duration of breathing in action is from a time that a slope in the breathing curve changes to zero from a positive value, and the duration of breathing out action is from a time that the slope in the breathing curve changes to zero from a negative value.

13. A non-transitory storage medium having stored thereon instructions that, when executed by a processor of an electronic device, causes the processor to perform a breathing analysis method, wherein the method comprises:

receiving a current measured electrocardiogram of a user from an electrocardiograph, and generating a breathing curve according to R waves in the electrocardiogram;

detecting whether the user is currently taking a breathing out or a breathing in accordance with the breathing curve;

acquiring a duration of the breathing in action or the breathing out action in accordance with the breathing curve,

and computing a ratio of the duration and a standard time of the breathing in action or the breathing out action; and

displaying a breathing in or breathing out progress in a progress demonstration bar according to the ratio on a display device of the electronic device.

14. The non-transitory storage medium according to claim **13**, wherein the breathing curve is generated according to values of the R waves.

15. The non-transitory storage medium according to claim **13**, wherein whether the user takes a breathing in action or a breathing out action is detected according to slopes of the breathing curve.

16. The non-transitory storage medium according to claim **15**, wherein it is determined the user takes a breathing in action when a slope in the breathing curve is a negative value, it is determined the user takes a breathing out action when a slope in breathing curve is a positive value, and it is determined the user holds the breath when a slope in breathing curve is zero.

17. The non-transitory storage medium according to claim **13**, wherein the standard time of the breathing in action or the breathing out action is transmitted from a database.

18. The non-transitory storage medium according to claim **13**, wherein the duration of the breathing in action is from a time that a slope in the breathing curve changes to zero from a positive value, and the duration of a breathing out action is from a time that the slope in the breathing curve changes to zero from a negative value.

* * * * *

专利名称(译)	呼吸分析方法，系统和装置		
公开(公告)号	US20150025395A1	公开(公告)日	2015-01-22
申请号	US14/253825	申请日	2014-04-15
[标]申请(专利权)人(译)	奇美通讯股份有限公司		
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IPC分类号	A61B5/0456 A61B5/0432 A61B5/04 A61B5/00 A61B5/044 A61B5/0205		
CPC分类号	A61B5/0205 A61B5/0456 A61B5/04012 A61B5/0816 A61B5/0006 A61B5/0432 A61B5/044 A61B5/04014		
优先权	102113370 2013-04-15 TW		
外部链接	Espacenet USPTO		

摘要(译)

在使用用户的心电图的呼吸分析方法中，根据心电图中的R波生成呼吸曲线，并且根据呼吸曲线检测用户当前是在采取呼吸动作还是呼吸动作。根据呼吸曲线计算呼吸动作的持续时间或用户的呼出动作，并计算持续时间与呼吸动作或呼出动作的标准时间的比率。根据比率在显示设备上的进度演示条中显示呼吸进出。