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LIN et al.

(54) **STETHOSCOPE DEVICE**

(71) Applicant: **DailyCare Biomedical Inc**, Taoyuan County (TW)

(72) Inventors: **Kang-Ping LIN**, Taoyuan County (TW); **Bor-Iuan JAN**, Taoyuan County (TW); **Hao-Yu CHAN**, Taoyuan County (TW); **Keng-Hung LIN**, Taoyuan County (TW); **Yu-Hong YAN**, Yunlin County (TW); **Sheng-Kai YANG**, Yilan County (TW)

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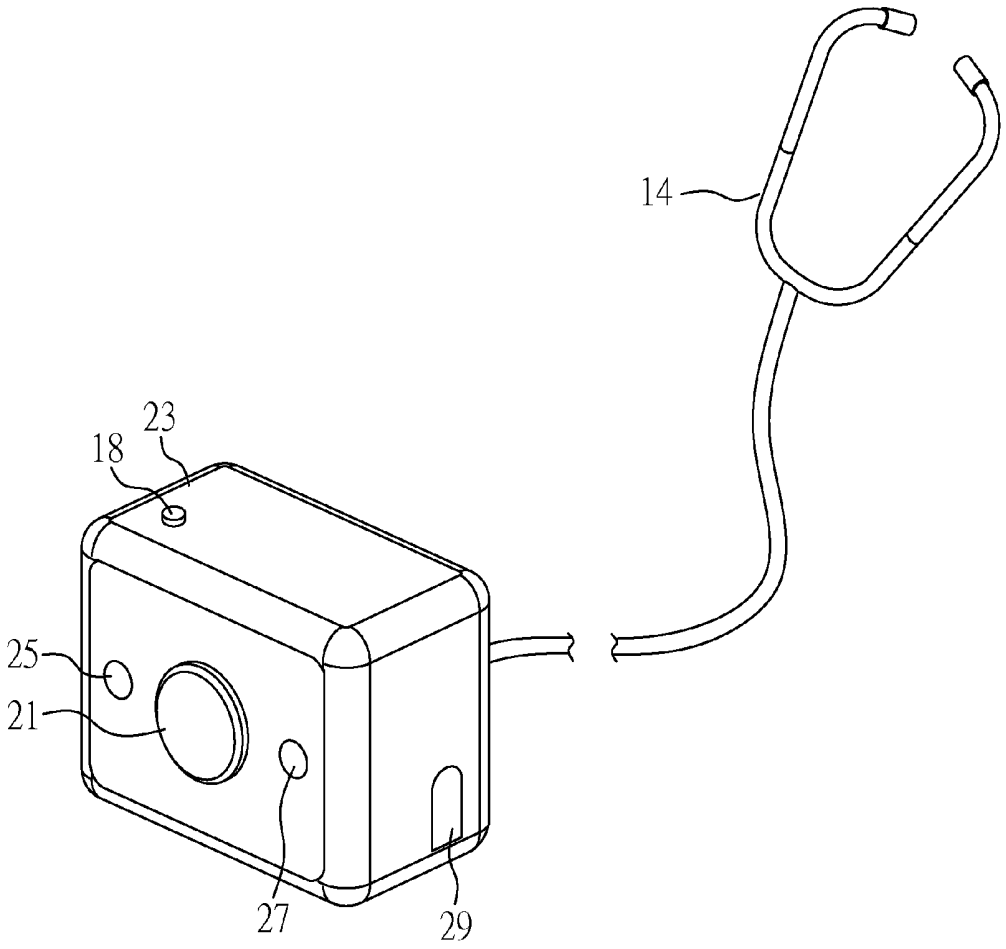
(57) **ABSTRACT**

A stethoscope device is disclosed, which comprises a heart sound sensor comprising a sensing portion to detect a heart sound signal having a periodic first heart sound and a periodic second heart sound; an electrocardiogram sensor comprising two electrodes to detect an electrocardiogram signal having a periodic R wave; a microprocessor for extracting amplitudes of the R wave from the electrocardiogram signal and analyzing appearing positions of the R wave to provide appearing positions of a periodic notification pulse wave to a predetermined reference signal and combine the reference signal with the heart sound signal to form a sound signal; and an output unit to output the sound signal; wherein each pulse of the notification pulse wave of the sound signal provides a notification sound.



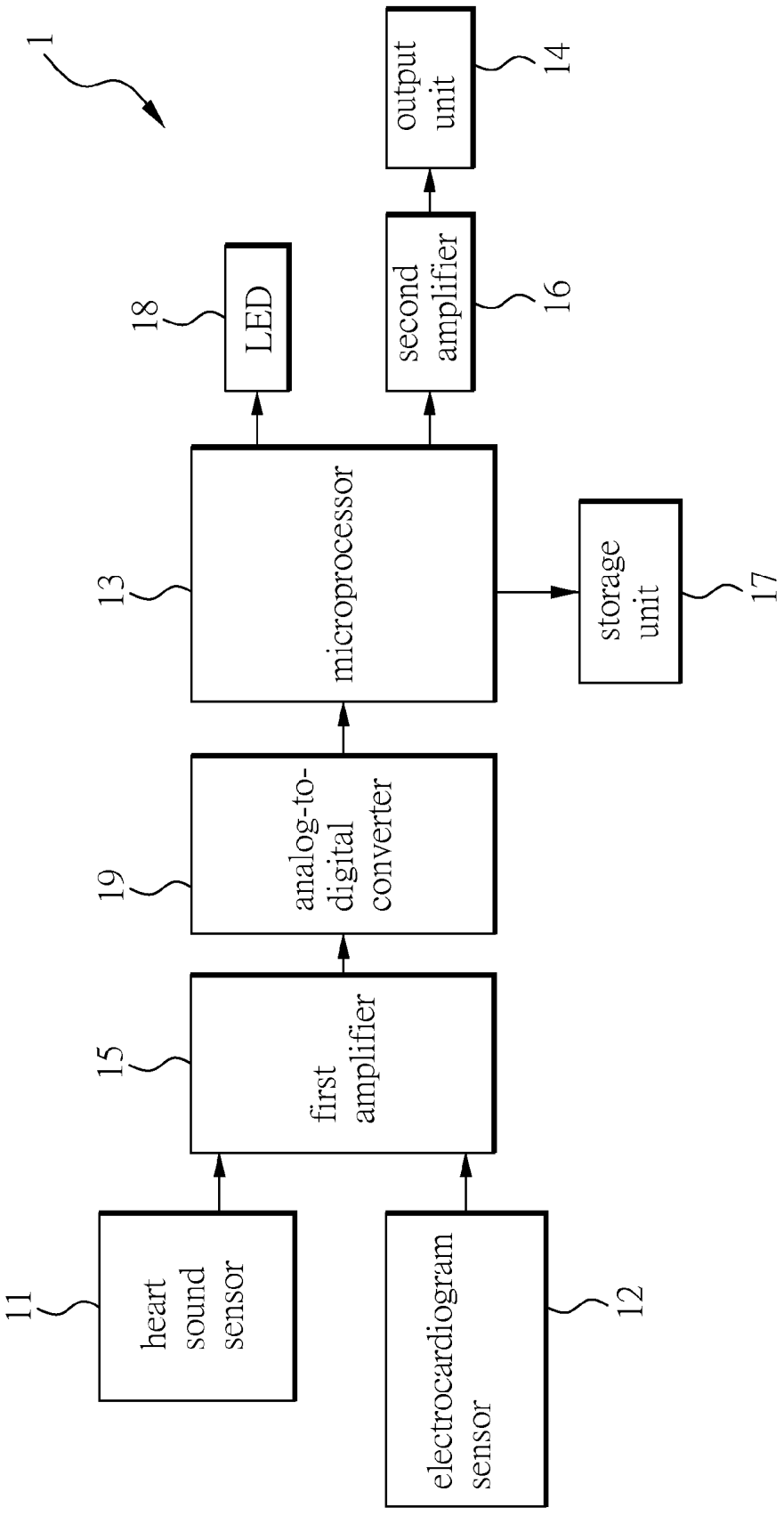

1
output unit
14
second amplifier
16
LED
18
microprocessor
13
storage unit
17
analog-to-digital converter
19
first amplifier
15
heart sound sensor
11
electrocardiogram sensor
12

FIG. 1

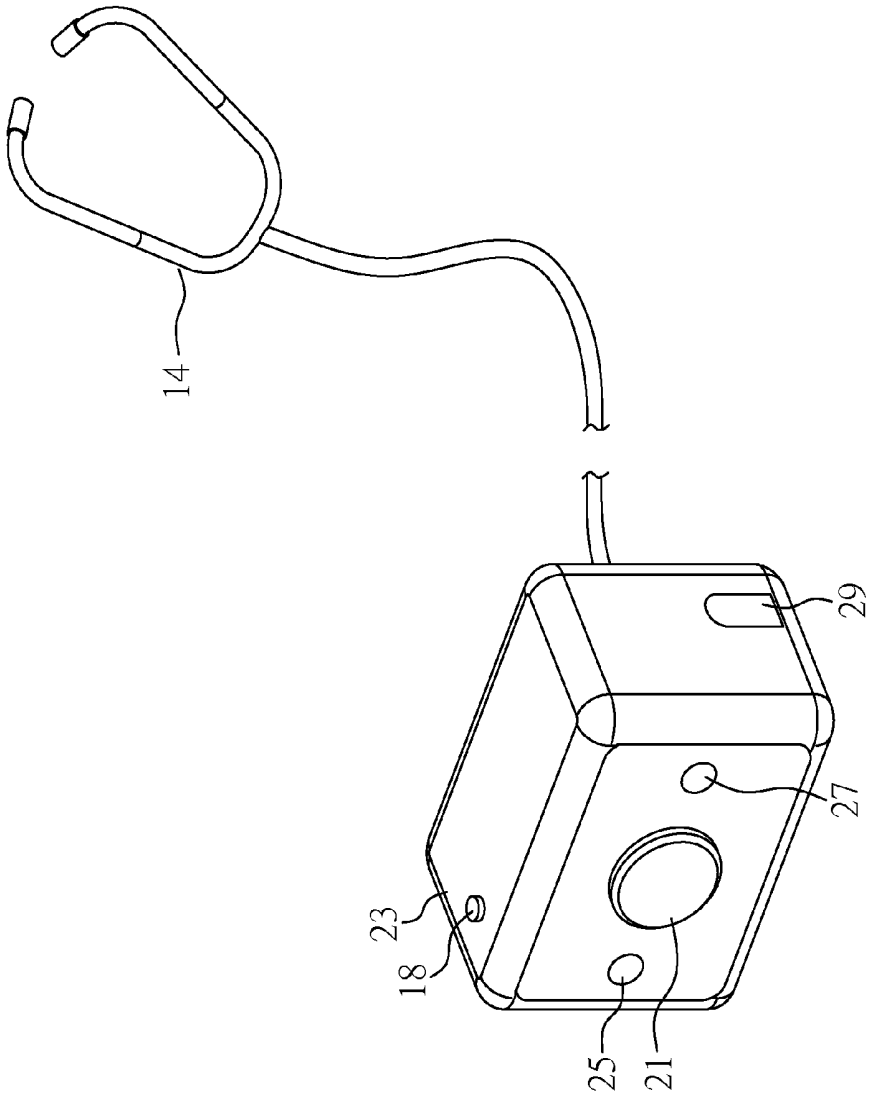


FIG. 2

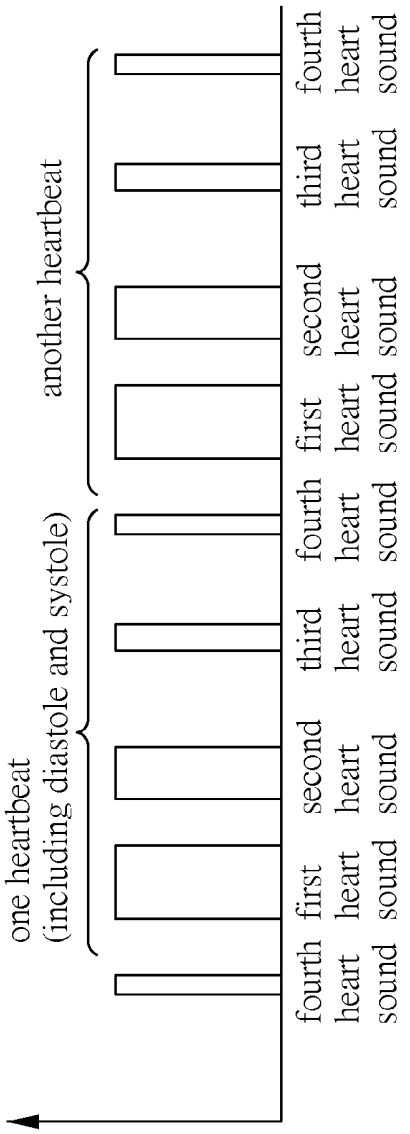

one heartbeat
(including diastole and systole)
another heartbeat
fourth heart sound
first heart sound
second heart sound
third heart sound
fourth heart sound
first heart sound
second heart sound
third heart sound
fourth heart sound

FIG. 3

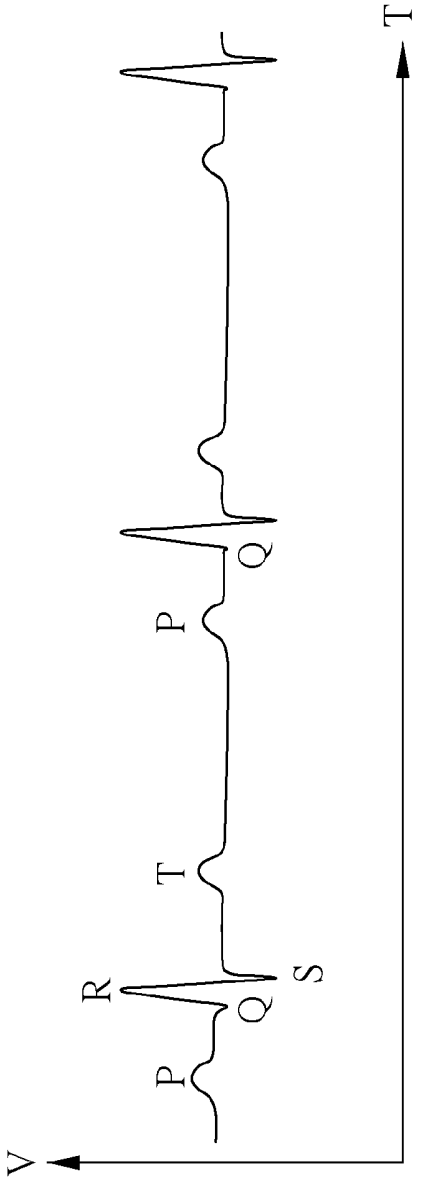

V
T
P
R
Q
S
T
P
Q

FIG. 4

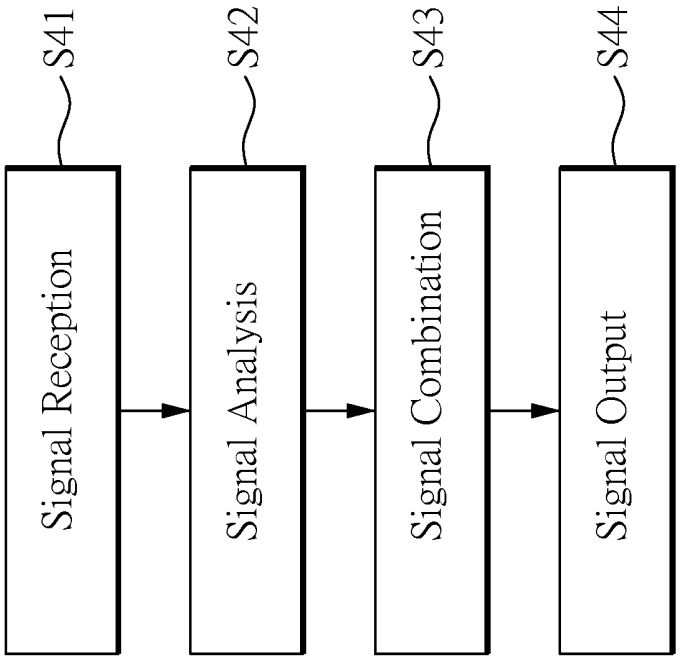

S41
Signal Reception
S42
Signal Analysis
S43
Signal Combination
S44
Signal Output

FIG. 5

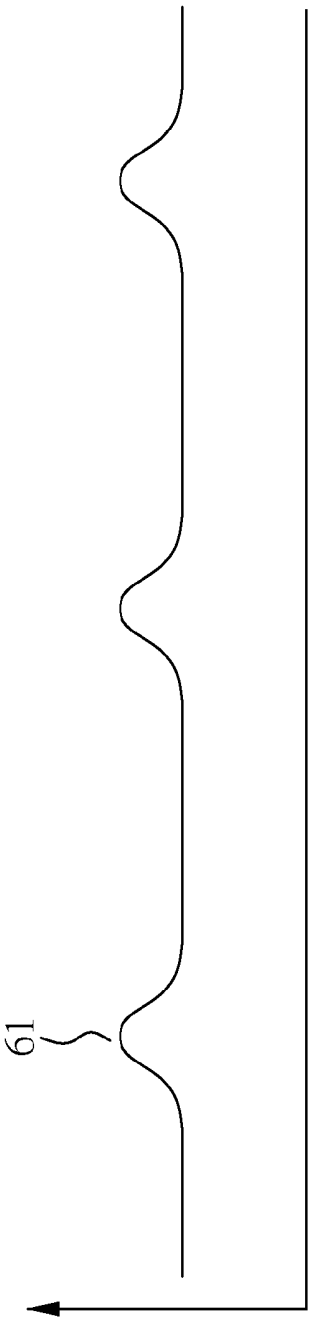

61

FIG. 6

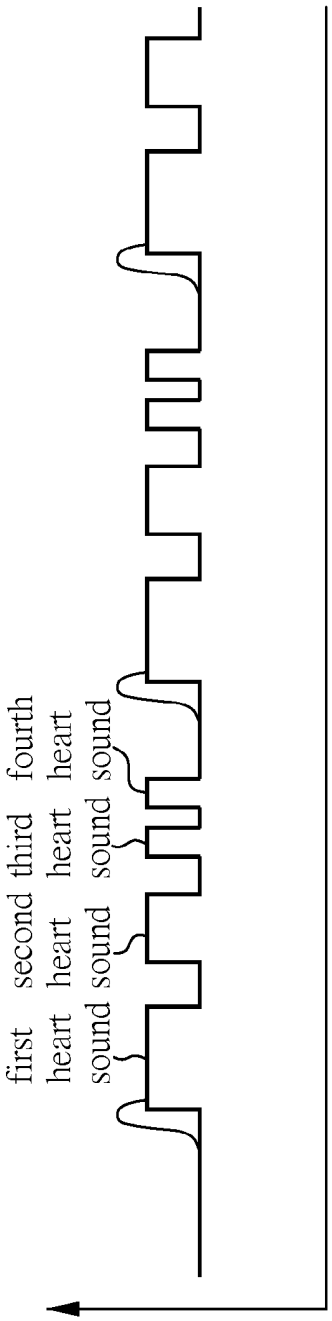

first heart sound
second heart sound
third heart sound
fourth heart sound

FIG. 7

STETHOSCOPE DEVICE

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefits of the Taiwan Patent Application Serial Number 103141364, filed on Nov. 28, 2014, the subject matter of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a stethoscope device, and more particularly, to a stethoscope device with a notification function.

[0004] 2. Description of Related Art

[0005] The stethoscope is a widely used device to determine whether the condition of the heart is normal. Heart sounds are listened by the stethoscope by placing the sensing portion of the stethoscope against the heart. In general, heart sounds can be divided into first heart sound (S1), second heart sound (S2), third heart sound (S3), and fourth heart sound (S4). The first heart sound and the second heart sound can be listened to more easily. The first heart sound is produced by the closing of the atrioventricular valves. The second heart sound is produced by the closing of the semilunar valves. By listening to the intensities, frequencies, and regularities of the first heart sound and the second heart sound, the condition of the heart can be determined.

[0006] Since the frequencies of heartbeats can be fast and slow, it is rather difficult for doctors or beginners to determine when a heart sound has begun when a heart sound is heard. This causes the determination of the condition of the heart to be inaccurate. Thus, there is a need to provide an improved stethoscope device with a notification function to notify when a heart sound will begin.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is to provide a stethoscope device with a notification function, comprising: a heart sound sensor comprising a sensing portion to detect a heart sound signal having a periodic first heart sound and a periodic second heart sound; an electrocardiogram (ECG) sensor comprising two electrodes to detect an electrocardiogram signal having a periodic R wave; a microprocessor with a predetermined reference signal having a periodic notification pulse wave for extracting amplitudes of the R wave from the electrocardiogram signal and analyzing appearing positions of the R wave to provide appearing positions of the notification pulse wave to the reference signal and combine the reference signal with the heart sound signal to form a sound signal; and an output unit to output the sound signal; wherein each pulse of the notification pulse wave of the sound signal provides a notification sound. Since the notification sound will notify when a heart sound will begin; hence, result of auscultation will no longer be inaccurate.

[0008] Other objects, advantages, and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a schematic diagram of a framework of a stethoscope device with a notification function of the present invention;

[0010] FIG. **2** is a schematic diagram of an outer appearance of a stethoscope device with a notification function of the present invention;

[0011] FIG. **3** is a schematic diagram of a heart sound signal of the present invention;

[0012] FIG. **4** is a schematic diagram of an electrocardiogram signal of the present invention;

[0013] FIG. **5** is a flowchart of a procedure performed by the microprocessor of the present invention;

[0014] FIG. **6** is a schematic diagram of a reference signal of the present invention; and

[0015] FIG. **7** is a schematic diagram of a combined sound signal of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] Please refer to FIG. **1**. FIG. **1** is a schematic diagram of a framework of a stethoscope device with a notification function of the present invention. As shown in FIG. **1**, the stethoscope device **1** comprises a heart sound sensor **11**, an electrocardiogram sensor **12**, a microprocessor **13**, and an output unit **14**. The heart sound sensor **11** and the electrocardiogram sensor **12** are coupled to the microprocessor **13** individually. This allows the signals detected by the heart sound sensor **11** and the electrocardiogram sensor **12** to be transmitted to the microprocessor **13**. The microprocessor **13** is coupled to the output unit **14**. This allows the signals processed by the microprocessor **13** to be transmitted to the output unit **14**. A first amplifier **15** and an analog-to-digital converter **19** can be disposed among the heart sound sensor **11**, the electrocardiogram sensor **12**, and the microprocessor **13**. This allows the signals detected by the heart sound sensor **11** and the electrocardiogram sensor **12** to be amplified by the first amplifier **15**. The detected signals can be converted from analog signals to digital signals by the analog-to-digital converter **19**. A second amplifier **16** can be disposed between the microprocessor **13** and the output unit **14**. This allows the signals processed by the microprocessor **13** to be amplified by the second amplifier **16**.

[0017] Please refer to FIG. **2**. FIG. **2** is a schematic diagram of an outer appearance of a stethoscope device with a notification function of the present invention. As shown in FIG. **2**, the heart sound sensor **11**, the electrocardiogram sensor **12**, and the microprocessor **13** are all disposed inside a housing **23**. The output unit **14** is the headphone of the stethoscope device. The heart sound sensor **11** comprises a sensing portion **21** exposed from the housing **23** to detect, receive, and measure a heart sound signal. More specifically, the heart sound signal is obtained by placing the sensing portion **21** against any body parts such as the heart, chest, etc. Preferably, the sensing portion **21** is the sensing portion of a stethoscope. The electrocardiogram sensor **12** comprises two electrodes **25**, **27** exposed from the housing **23** to detect, receive, and measure an electrocardiogram signal. More specifically, the electrocardiogram signal is obtained by placing the two electrodes **25**, **27** against any body parts such as the chest, arms, legs, etc. Preferably, the two electrodes **25**, **27** are disposed at two sides of the sensing portion **21** and at the edges of the housing **23**.

[0018] Please refer to FIG. **3**. FIG. **3** is a schematic diagram of a heart sound signal of the present invention. As shown in FIG. **3**, the heart sound signal is an indirect continuous periodic signal having a periodic first heart sound, a periodic second heart sound, a periodic third heart sound, and a periodic fourth heart sound. Based on the intensities, frequencies, and regularities of the first heart sound and the second heart sound, the condition of the heart can be determined.

[0019] Please refer to FIG. **4**. FIG. **4** is a schematic diagram of an electrocardiogram signal of the present invention. As shown in FIG. **4**, the electrocardiogram signal has a periodic R wave. More specifically, the electrocardiogram signal has a periodic P wave, a periodic QRS complex, and a periodic T wave. The electrocardiogram signal will assist in the determination of the condition of the heart.

[0020] Please refer back to FIGS. **1** and **2**. The microprocessor **13** is preferably a hardware capable of executing a software. The microprocessor **13** comprises an input terminal to input the heart sound signal detected by the heart sound sensor **11** and the electrocardiogram signal detected by the electrocardiogram sensor **12**. The microprocessor **13** performs a procedure including analyzing and processing the heart sound signal and the electrocardiogram signal as well as combining the heart sound signal with a reference signal having a notification sound signal processed beforehand to a single sound signal. The microprocessor **13** also comprises an output terminal to output the sound signal to the output unit **14**.

[0021] The output unit **14** can be any devices used for displaying signals. Preferably, the output unit **14** is a sound output device, such as a headphone, but it is certainly not limited thereto.

[0022] The stethoscope device **1** can further comprise several additional components, such as a storage unit **17**. Preferably, the storage unit **17** is configured to couple to the microprocessor **13** to store signals such as the heart sound signal, the electrocardiogram signal, and the sound signal. The storage unit **17** can be any units with a storage function. Preferably, the storage unit **17** is a memory card such as a SD card, but it is certainly not limited thereto. The stethoscope device **1** can further comprise a slot **29** disposed on the housing **23**. By inserting the storage unit **17** into the slot **29**, the storage unit **17** will couple to the microprocessor **13**.

[0023] The stethoscope device **1** can further comprise a LED **18**. The LED **18** is connected to the microprocessor **13** and disposed on the housing **23**. The LED **18** will emit light or flash light in correspondence to the sound signal to notify a heart sound will begin.

[0024] All of the above-mentioned signals can be amplified by the first amplifier **15** and the second amplifier **16** to ensure the processing and output of the signals to be more accurate and clearer.

[0025] Please refer to FIG. **5**. FIG. **5** is a flowchart of a procedure performed by the microprocessor of the present invention. More specifically, the procedure is a signal processing procedure comprising steps of S**41**, S**42**, S**43**, and S**44**. In step S**41**, the microprocessor **13** receives the heart sound signal and the electrocardiogram signal. These signals can be amplified by the first amplifier **15** before being received by the microprocessor **13** to assure more accurate signal processing. If these signals are analog signals, then the analog-to-digital converter **19** will convert these analog signals to digital signals before being received by the microprocessor **13**.

[0026] In step S**42**, the microprocessor **13** analyzes the heart sound signal and the electrocardiogram signal individually. More specifically, the microprocessor **13** analyzes the amplitudes of the R wave from the electrocardiogram signal and records the time points of the appearing positions of the amplitudes of the R wave. The extraction of information regarding the R wave is a technique known in the art. Since the extraction of information regarding the R wave is not a major subject of the present invention, the extraction of information regarding the R wave will not be described here. Any techniques for extracting information regarding the R wave can be used in the present invention. The results of the signal analyses performed by the microprocessor **13** will be stored in a storage area of the microprocessor **13** or in the storage unit **17**.

[0027] In step S**43**, the microprocessor **13** processes a predetermined reference signal according to the time points of the appearing positions of the R wave. FIG. **6** is a schematic diagram of a reference signal of the present invention. As shown in FIG. **6**, the processed reference signal has a periodic notification pulse wave **61**. Each appearing position of the notification pulse wave **61** is determined by each appearing position of the R wave. The microprocessor **13** combines the processed reference signal having the periodic notification pulse wave **61** with the heart sound signal to form a new signal. Preferably, the new signal is a sound signal and each pulse of the notification pulse wave of the sound signal provides a notification sound. The notification pulse wave **61** of the reference signal delays for a predetermined time compared to the corresponding R wave. The predetermined time is a time after the R wave has appeared and before the T wave appears. Preferably, the predetermined time is in the range of 0.06 seconds to 0.07 seconds. More preferably, the predetermined time is 0.065 seconds. However, the predetermined time is certainly not limited thereto. The time points at which the R wave appears often associate with the first heart sound (the heart sound usually appears slightly later than the R wave). Therefore, the notification sound precedes the first heart sound. The time points at which the notification sound begins are shown in FIG. **7**, which is a schematic diagram of a combined sound signal of the present invention.

[0028] In step S**44**, the microprocessor **13** outputs the sound signal to the output unit **14**. The sound signal can be amplified by the second amplifier **16** to assure that the sound signal outputted by the output device **14** will be clearer.

[0029] The microprocessor **13** can link the notification pulse wave **61** with the LED **18** so that the LED **18** emits light or flashes light when the notification pulse wave **61** appears. Thereby, the flashing of the LED **18** can notify a heart sound will begin together the notification sound.

[0030] Accordingly, the stethoscope device provided by the present invention has a notification function to notify a heart sound will begin. Specifically, the output unit of the stethoscope device will output a sound signal with a notification sound preceding the first heart sound. The notification sound will draw attention to hearing a heart sound that will begin soon. Consequently, the chance of missing listening to a heart sound will be reduced. The whole listening process of heart sounds will be more accurate.

[0031] In addition to the notification function, the stethoscope device provided by the present invention also possesses the ability to measure heart sound signals and electrocardiogram signals at the same time. Moreover, with a storage unit, the stethoscope device provided by the present invention can

store the original heart sound signals and electrocardiogram signals to the storage unit. The storage unit can then output these signals to other units that can display signals.

[0032] Although the present invention has been explained in relation to its preferred embodiment, it is to be understood that many other possible modifications and variations can be made without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. A stethoscope device, comprising:

a heart sound sensor comprising a sensing portion to detect a heart sound signal having a periodic first heart sound and a periodic second heart sound;

an electrocardiogram sensor comprising two electrodes to detect an electrocardiogram signal having a periodic R wave;

a microprocessor for extracting amplitudes of the R wave from the electrocardiogram signal and analyzing appearing positions of the R wave to provide appearing positions of a periodic notification pulse wave to a predetermined reference signal and combine the reference signal with the heart sound signal to form a sound signal; and

an output unit to output the sound signal;

wherein each pulse of the notification pulse wave of the sound signal provides a notification sound.

2. The stethoscope device as claimed in claim **1**, wherein the notification pulse wave of the reference signal delays for a predetermined time compared to the corresponding R wave.

3. The stethoscope device as claimed in claim **2**, wherein the predetermined time is in the range of 0.06 seconds to 0.07 seconds.

4. The stethoscope device as claimed in claim **3**, wherein the predetermined time is 0.065 seconds.

5. The stethoscope device as claimed in claim **2**, wherein the notification sound precedes the first heart sound.

6. The stethoscope device as claimed in claim **2**, further comprising an LED emitting light together with the notification sound.

7. The stethoscope device as claimed in claim **1**, further comprising a storage unit to store the sound signal.

8. The stethoscope device as claimed in claim **7**, wherein the storage unit is a SD card.

9. The stethoscope device as claimed in claim **1**, wherein the output unit is a headphone.

10. The stethoscope device as claimed in claim **1**, further comprising a first amplifier connecting to the heart sound sensor and the electrocardiogram sensor to amplify the heart sound signal and the electrocardiogram signal.

11. The stethoscope device as claimed in claim **10**, further comprising an analog-to-digital converter to convert the amplified heart sound signal and the amplified electrocardiogram signal from analog signals to digital signals to be inputted to the microprocessor.

12. The stethoscope device as claimed in claim **1**, further comprising a second amplifier connecting in between the microprocessor and the output unit to amplify the sound signal to be outputted by the output unit.

* * * * *

专利名称(译)	听诊器设备		
公开(公告)号	US20160151037A1	公开(公告)日	2016-06-02
申请号	US14/953045	申请日	2015-11-27
申请(专利权)人(译)	DAILYCARE生物医学INC		
当前申请(专利权)人(译)	DAILYCARE生物医学INC.		
[标]发明人	LIN KANG PING JAN BOR IUAN CHAN HAO YU LIN KENG HUNG YAN YU HONG YANG SHENG KAI		
发明人	LIN, KANG-PING JAN, BOR-IUAN CHAN, HAO-YU LIN, KENG-HUNG YAN, YU-HONG YANG, SHENG-KAI		
IPC分类号	A61B7/04 A61B5/04 A61B5/00 A61B5/0456		
CPC分类号	A61B7/04 A61B5/0456 A61B5/742 A61B5/7405 A61B5/04012 A61B5/0404 A61B2560/0468		
优先权	103141364 2014-11-28 TW		
外部链接	Espacenet USPTO		

摘要(译)

本发明公开了一种听诊器装置，其包括心音传感器，该心音传感器包括用于检测具有周期性第一心音和周期性第二心音的心音信号的感测部分。一种心电图传感器，包括两个电极，用于检测具有周期性R波的心电图信号;微处理器，用于从心电图信号中提取R波的幅度，并分析R波的出现位置，以将周期性通知脉冲波的出现位置提供给预定的参考信号，并将参考信号与心音信号组合以形成声音信号;输出单元输出声音信号;其中声音信号的通知脉冲波的每个脉冲提供通知声音。