US 20150335274A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2015/0335274 A1**

(43) **Pub. Date: Nov. 26, 2015**

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(54) **PHYSIOLOGICAL SIGNALS DETECTION DEVICE**

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(21) Appl. No.: **14/708,527**

(22) Filed: **May 11, 2015**

Related U.S. Application Data

(60) Provisional application No. 62/002,932, filed on May 26, 2014.

(30) **Foreign Application Priority Data**

Apr. 13, 2015 (TW) 104111745

Publication Classification

(51) **Int. Cl.**

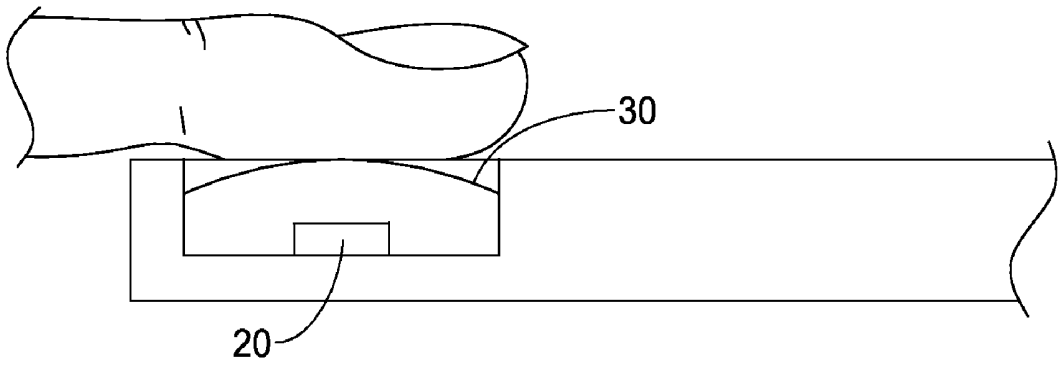
A61B 5/1455 (2006.01)
A61B 5/00 (2006.01)
A61B 5/024 (2006.01)

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

CPC ***A61B 5/14551*** (2013.01); ***A61B 5/02433*** (2013.01); ***A61B 5/7203*** (2013.01); ***A61B 5/6826*** (2013.01)

(57) **ABSTRACT**

A physiological signals detection device has a light source connecting to a control unit, a light detector and a processing unit. The light detector has a pixel sensor array including multiple light sensing elements. The light source emits light through a lens to the human body to generate reflected light. The light detector receives the reflected light to generate a sensing signal. Since the light sensing elements respectively receive different reflected light from different directions, the light sensing elements receiving reflected light from the noise are easily selected and eliminated from calculating the physiology value. Therefore, the calculated physiology value is more accurate.



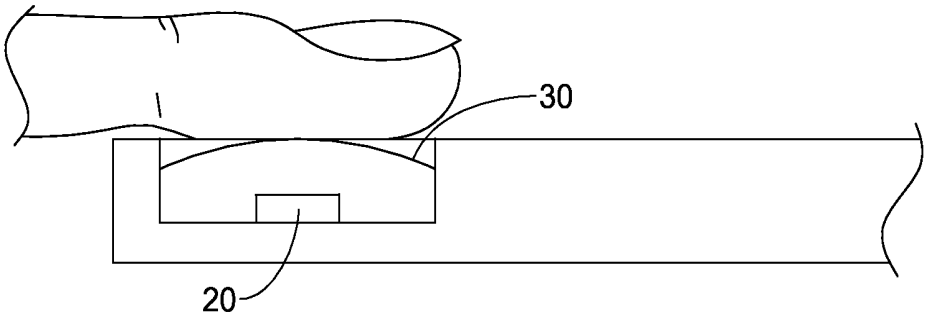
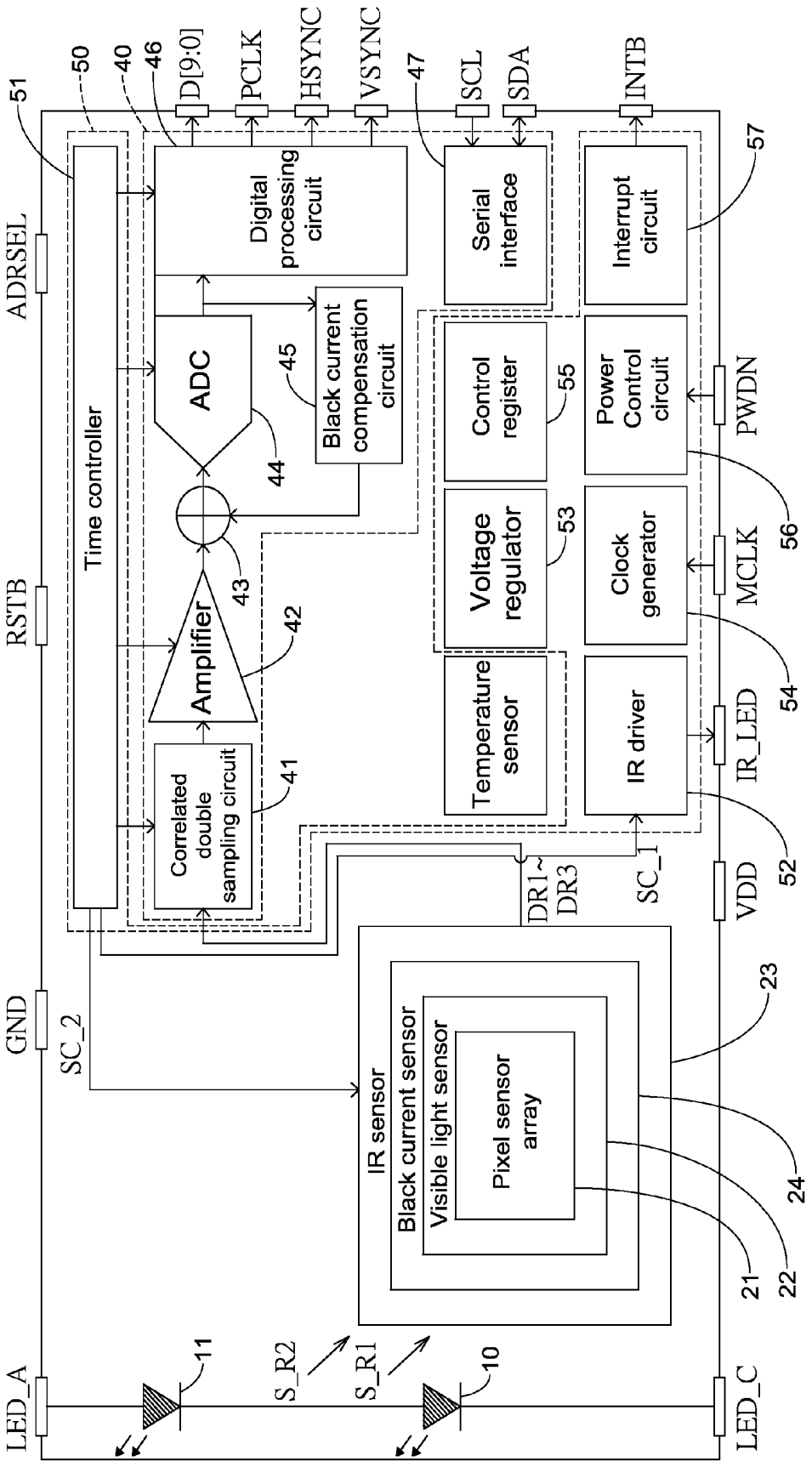


FIG.1


ADRSEL
RSTB
GND
LED_A
LED_C
SC_2
SC_1
DR1~DR3
VDD
IR_LED
MCLK
PWDN
INTB
SDA
SCL
VSYNC
HSYNC
PCLK
D[9:0]
Time controller
Digital processing circuit
Serial interface
Interrupt circuit
ADC
Black current compensation circuit
Control register
Power Control circuit
Amplifier
Voltage regulator
Clock generator
Correlated double sampling circuit
Temperature sensor
IR driver
IR sensor
Black current sensor
Visible light sensor
Pixel sensor array
S_R2
S_R1
11
10
21
22
23
24
41
42
43
44
45
46
47
50
51
52
53
54
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56
57
40

FIG.2

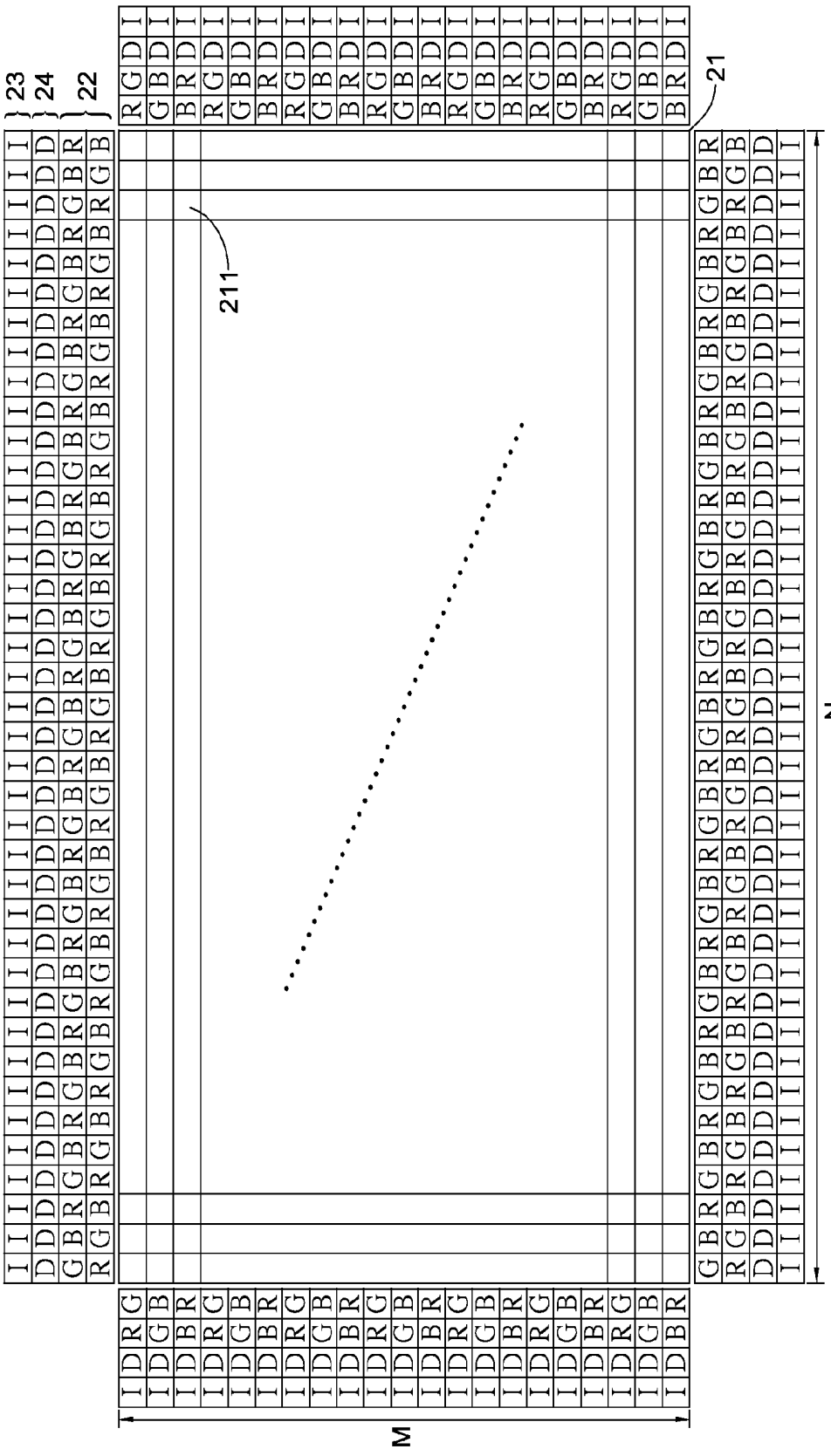

FIG.3

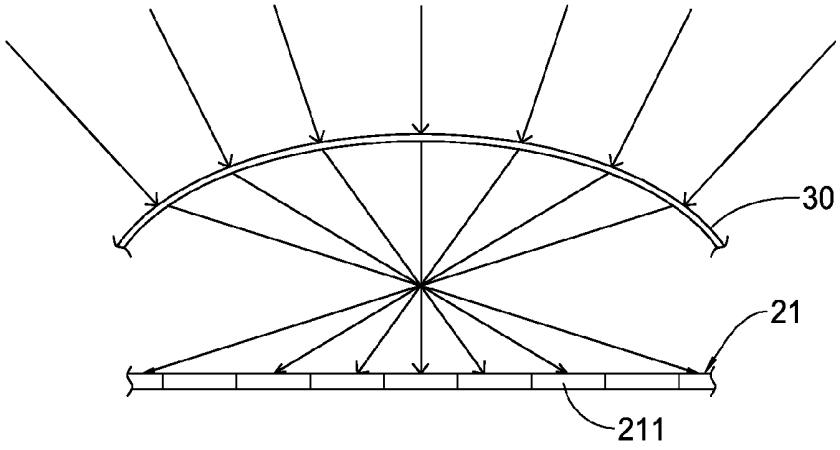

FIG.4

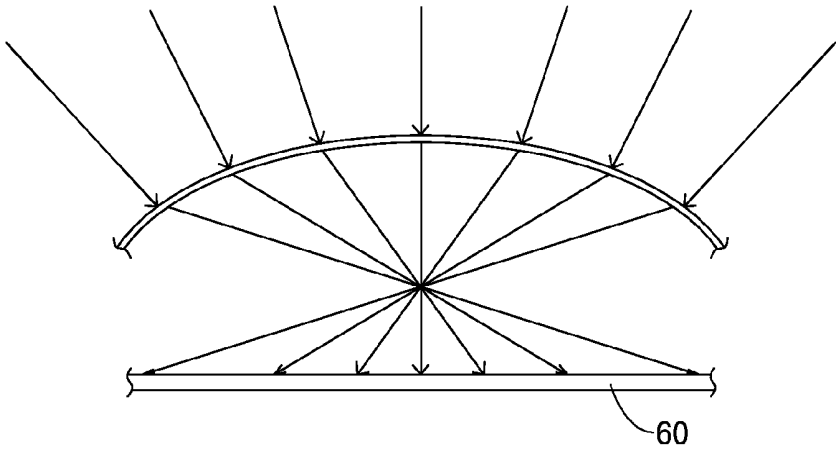

FIG.5
PRIOR ART

PHYSIOLOGICAL SIGNALS DETECTION DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of United States provisional application filed on May 26, 2014 and having application Ser. No. 62/002,932, the entire contents of which are hereby incorporated herein by reference

[0002] This application is based upon and claims priority under 35 U.S.C. 119 from Taiwan Patent Application No. 104111745 filed on Apr. 13, 2015, which is hereby specifically incorporated herein by this reference thereto.

BACKGROUND OF THE INVENTION

[0003] 1. Field of the Invention

[0004] The present invention relates to a physiological signals detection device, especially to a physiological signals detection device using light detectors to detect human bodies' physiological signals.

[0005] 2. Description of the Prior Arts

[0006] With the progress of the technology, more and more functions can be achieved by the light detection. One of the functions is to detect human bodies' physiological signals. Regarding heartbeat rate detection as an example, the heartbeat results in the flow of the blood to further result in the cyclical variation of the blood pressure. The pressure variation of the blood vessel changes the diameter of the blood vessel so that the cyclical variation of the blood pressure causes the diameter of the blood vessel to change continuously. Therefore, using the light detection result of the variation of the diameter of the blood vessel records the light variation of the reflected light from the light source emitting to the blood vessel to further calculate the heartbeat value. Other physiological values such as blood oxygen saturation index, blood pressure and so on can also be further calculated through obtaining the blood vessel signals or the blood signals via light detection.

[0007] The conventional physiological signals detection device includes at least one light source and a light detector. The light source provides light beam emitted through the skin to the blood vessel and then results in a reflected light. The reflected light passes through the skin and is received by the light detector. The light detector converts the reflected light into a sensing signal. Then the processing unit calculates the desired physiological signal value based on the sensing signal.

[0008] However, with referenced to FIG. **5**, the light beam from the light source is also emitted to other objects on the path to the blood vessel, such as epidermal tissue. The light beam emitted to those other objects also results in reflected lights to be received by the light detector **60** together. Since the single light detector **60** receives the reflected lights from all directions, the reflected light resulting from the blood vessel and the reflected light resulting from those other objects are all received by the same light detector **60**. The light detector **60** can only converts the sum of the received reflected light into the sensing signal. Therefore, the sensing signal not only includes the information of the desired blood continuously variation value or the desired blood signal, but also includes other noises. Thus, the physiological signal value calculated by the processing unit based on the sensing signal is also not accurate.

[0009] To overcome the shortcomings, the present invention provides a physiological signals detection device to mitigate or obviate the aforementioned problems.

SUMMARY OF THE INVENTION

[0010] The main objective of the present invention is to provide a physiological signals detection device that excludes the noise from calculation to improve the accuracy of the physiological values.

[0011] The physiological signals detection device comprising:

[0012] a first light source providing a first light beam;

[0013] a light detector having

[0014] a pixel sensor array having multiple first light sensing elements and detecting a reflected light resulted from the first light beam emitted from the first light source to a user's body to generate a first sensing signal;

[0015] a lens covering on the light detector, and the pixel sensor array receiving the reflected light of the first light beam through the lens;

[0016] a processing unit connecting to the light detector and calculating the user's heartbeat value based on the first sensing signal; and

[0017] a control unit connecting to the first light source, the light detector and the processing unit, switching the first light source on and off, controlling the light detector to sense and controlling the processing unit to process signals.

[0018] The physiological signals detection device has following advantages. With the pixel sensor array, different light from different directions are received by different light sensing elements so that the control unit can determine whether the received signals are desired signals or a noises based on the intensity, frequency and so on of the received signals. Then the received signals from the light sensing elements that are determined as receiving noises are excluded. Only the received signals from the light sensing elements that are determined as receiving the desired signals are used to calculate the physiological value. Therefore, the noises are excluded from influencing the physiological value to enhance the accuracy of the physiological value.

[0019] Other objectives, 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

[0020] FIG. **1** is an operational view of a physiological signals detection device in accordance with the present invention, shown a finger being placed on;

[0021] FIG. **2** is a block diagram of a circuit of the physiological signals detection device in FIG. **1**;

[0022] FIG. **3** is an illustrated view of a light detector of the physiological signals detection device in FIG. **1**;

[0023] FIG. **4** is an illustrated view of a light path for receiving a reflected light by the physiological signals detection device in FIG. **1**; and

[0024] FIG. **5** is an illustrated view of a light path for receiving a reflected light by a conventional physiological signals detection device in accordance with the prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] With reference to FIGS. **1** and **2**, a physiological signals detection device in accordance with the present invention comprises a first light source **10**, a light detector **20**, a lens **30**, a processing unit **40** and a control unit **50**.

[0026] The first light source **10** provides a first light beam. The first light beam may be infrared (IR) light. The physiological signals detection device further comprises a second light source **11** to provide a second light beam. The wavelength of the second light beam is different with the wavelength of the first light beam. The second light beam may be a green light. When the physiological signals detection device as described is applied to detect the heartbeat value or the blood pressure, the physiological signals detection device may only use a single light source such as the first light source **10** or the second light source **11**. When the physiological signals detection device as described is applied to detect the blood oxygen saturation index, the blood oxygen saturation index as described needs to use both the first and second light sources **10**, **11** with different wavelength.

[0027] The light detector **20** has a pixel sensor array **21** with multiple light sensing elements **211**. Each light sensing element **211** detects a reflected light resulting from the first light beam emitted to the user's body and generates a corresponding sensing signal.

[0028] With reference to FIG. **3**, in one embodiment, the pixel sensor array **21** may comprises M×N light sensing elements **211**. M and N are positive integer. The pixel sensor array **21** may be an active pixel sensor array. The light sensing elements **211** may comprises multiple first light sensing elements and multiple second sensing elements. The first light sensing elements are used to detect the reflected light of the first light beam. The second light sensing elements are used to detect the reflected light of the second light beam. In one embodiment, the light detector **20** further comprises a visible light sensor **22**, an IR sensor **23** and a black current sensor **24**. The visible light sensor **22** is mounted adjacent to the pixel sensor array **21** to perform ambient light sensing and/or color sensing. The black current sensor **24** is mounted adjacent to the pixel sensor array **21** to generate a reference signal for dark/black current compensation. The IR sensor **23** is mounted adjacent to the pixel sensor array **21** to perform proximity sensing, object position sensing, and/or gesture sensing. In one embodiment, the black current sensor **24** is mounted around the visible light sensor **22**, the IR sensor **23** is mounted around the black current sensor **24**. However, the arrangement is illustrated only and does not limit the present invention. For example, when the IR sensor **23** is mounted between the visible light sensor **22** and the pixel sensor array **21**, the functions of the pixel sensor array **21**, the visible light sensor **22**, the IR sensor **23** and the black current sensor **24** are not influenced.

[0029] The lens **30** covers the light detector **20**. The light detector **20** senses light through the lens **30**.

[0030] The processing unit **40** is connected to the light detector **20** to process the sensing signal of the light detector **20** and to further calculate the desired physiological signal such as the heartbeat value, the blood oxygen saturation index, the blood pressure and so on. In one embodiment, the processing unit **40** comprises, but is not limited to, a correlated double sampling circuit **41**, an amplifier **42**, an adder **43**, an analog-to-digital converter **44**, a black current compensation circuit **45**, a digital processing circuit **46** and a serial interface **47** (serial I/F such as two wire inter-integrated circuit). The signals out from the pixel sensor array **21** are processed by the correlated double sampling configuration with programmable gain settings consisted of the correlated double sampling circuit **41** and the amplifier **42**. The adder **43** adds the output of the amplifier **42** and the output of the black current compensation circuit **45** into an analog signal as an output of the adder **43**. Then the analog-to-digital converter **44** converts the analog signal to a digital signal as an output of the analog-to-digital converter **44**. The output of the black current compensation circuit **45** is generated based on the digital signal. The digital processing circuit **238** performs further operations upon the digital signal (e.g. the threshold comparison, the hysteresis detection and other detection algorithms), and transmits resulting data through the multiple contacts D [9:0], PCLK, HSYNC and VSYNC. The serial interface **47** is used for synchronous serial communication between the chips, and is coupled to a contact SCL corresponding to a serial clock line and a contact SDA corresponding to a serial data line. Since a person skilled in the art should understand the operations of each circuit element included in the processing unit **40**, no detailed discussion is further disclosed.

[0031] The control unit **50** is connected to the first light source **10**, the second light source **11**, the light detector **20** and the processing unit **40**, The control unit **50** switches the first light source **10** and the second light source **11** on and off, controls the light detector **20** to sense, and controls the signal processing of the processing unit **40**. In one embodiment, the control unit **50** comprises, but is not limited to, a timing controller **51**, an IR LED driver **52**, a voltage regulator **53**, a clock generator **54**, a control register **55**, a power control circuit **56** and an interrupt circuit **57**. The timing controller **51** generates the control signal S_C1 to control the IR LED driver **52**, and generates the control signal S_C2 to control the pixel sensor array **21**. The IR LED driver **52** activates and deactivates the first light source **10** according to the control signal S_C1. The clock generator **54** receives an external clock such as a master clock from a contact MCLK. The power control circuit **56** receives a power control signal from a contact PWDN to control a power operation mode. The interrupt circuit **57** receives an interrupt signal from a contact INTB. Since a person skilled in the art should understand the operations of each circuit element included in the control unit **50**, no detailed discussion is further disclosed.

[0032] In one embodiment, when the control unit **50** switches off the pixel sensor array **21**, the control unit **50** may switch on the visible light sensor **22** to perform ambient light sensing and/or color sensing. Similarly, when the control unit **50** switches off the pixel sensor array **21**, the control unit **50** may switch on the IR sensor **23** to perform proximity sensing, object position sensing, and/or gesture sensing. Therefore, when no physiological signals detection is needed, the pixel sensor array **21** may be switched off to save power but the visible light sensor **22** and the IR sensor **23** are still functioned to proceed detection with lower power consumption. Therefore, reducing power consumption is achieved.

[0033] With reference to FIGS. **1** and **2**, when the physiological signals detection device as described is used to detect heartbeat value, the user puts the corresponding part such as finger on the top of the lens **30**. The first light source **10** emits the first light to the finger to generate the reflected light, and then the reflected light pass through the lens **30** to be received by the light detector **20**.

[0034] With reference to FIGS. **2** and **4**, since the pixel sensor array **21** of the light detector **20** has multiple light sensing elements **211**, each light sensing element **211** receives a reflected light from one direction. Different light sensing elements **211** receive the reflected light from different direction. Each light sensing element **211** transmits the sensing signal to the processing unit **40**. The control unit **50** determines each received sensing signal is desired signal or noise based on the character of the reflected light, and controls the signal operation of the processing unit **40**. As to the light sensing elements **211** receive the desired signal, the processing unit **40** calculates the corresponding physiological value based on their sensing signals. As to the light sensing elements **211** receive the noises, the processing unit **40** ignores their sensing signals.

[0035] Therefore, with the pixel sensor array **21** having multiple light sensing elements **211**, the light sensing elements **211** receiving the desired signals are distinguished from the light sensing elements **211** receiving the noises. Thus, the noises are easily excluded from the further calculation to allow the output physiological signals to be more precise.

[0036] Even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and features of the invention, the disclosure is illustrative only. Changes may be made in the details, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A physiological signals detection device comprising:

a first light source providing a first light beam;

a light detector having

a pixel sensor array having multiple first light sensing elements and detecting a reflected light resulted from the first light beam emitted from the first light source to a user's body to generate a first sensing signal;

a lens covering on the light detector, and the pixel sensor array receiving the reflected light of the first light beam through the lens;

a processing unit connecting to the light detector and calculating the user's heartbeat value based on the first sensing signal; and

a control unit connecting to the first light source, the light detector and the processing unit, switching the first light source on and off, controlling the light detector to sense and controlling the processing unit to process signals.

2. The physiological signals detection device as claimed in claim **1** further comprising a second light source, wherein

the control unit connects to and switches the second light source on and off;

the second light source provides a second light beam having a wavelength different from a wavelength of the first light beam;

the pixel sensor array further has multiple second light sensing elements and detects a reflected light resulted from the second light beam emitted from the second light source to a user's body to generate a second sensing signal; and

the processing unit calculates the blood oxygen saturation index based on the first and second sensing signals.

3. The physiological signals detection device as claimed in claim **1**, wherein the first light beam is infrared light.

4. The physiological signals detection device as claimed in claim **2**, wherein the first light beam is an infrared light and the second light beam is a green light.

5. The physiological signals detection device as claimed in claim **1**, wherein

the light detector further has a visible light sensor receiving a visible light, generating a third sensing signal and mounted adjacent to the pixel sensor array;

the control unit connects to and controls the visible light sensor to sense; and

the processing unit calculates an illumination a color contrast of an ambient light based on the third sensing signal.

6. The physiological signals detection device as claimed in claim **2**, wherein

the light detector further has a visible light sensor receiving a visible light, generating a third sensing signal and mounted adjacent to the pixel sensor array;

the control unit connects to and controls the visible light sensor to sense; and

the processing unit calculates an illumination a color contrast of an ambient light based on the third sensing signal.

7. The physiological signals detection device as claimed in claim **5**, wherein when the pixel sensor array is switched off, the control unit actuates the visible light sensing unit.

8. The physiological signals detection device as claimed in claim **6**, wherein when the pixel sensor array is switched off, the control unit actuates the visible light sensing unit.

9. The physiological signals detection device as claimed in claim **1**, wherein

the light detector further has an infrared sensor receiving a reflected light from an infrared light, generating a fourth sensing signal and mounted adjacent to the pixel sensor array;

the control unit connects to and controls the infrared sensor to sense; and

the processing unit calculates whether an object approaches, to determine a position of the object or to determine a gesture based on the fourth signal.

10. The physiological signals detection device as claimed in claim **2**, wherein

the light detector further has an infrared sensor receiving a reflected light from an infrared light, generating a fourth sensing signal and mounted adjacent to the pixel sensor array;

the control unit connects to and controls the infrared sensor to sense; and

the processing unit calculates whether an object approaches, to determine a position of the object or to determine a gesture based on the fourth signal.

11. The physiological signals detection device as claimed in claim **5**, wherein

the light detector further has an infrared sensor receiving a reflected light from an infrared light, generating a fourth sensing signal and mounted adjacent to the pixel sensor array;

the control unit connects to and controls the infrared sensor to sense; and

the processing unit calculates whether an object approaches, to determine a position of the object or to determine a gesture based on the fourth signal.

12. The physiological signals detection device as claimed in claim **9**, wherein when the pixel sensor array is switched off, the control unit actuates the infrared sensor.

13. The physiological signals detection device as claimed in claim **10**, wherein when the pixel sensor array is switched off, the control unit actuates the infrared sensor.

14. The physiological signals detection device as claimed in claim **11**, wherein when the pixel sensor array is switched off, the control unit actuates the infrared sensor.

15. The physiological signals detection device as claimed in claim **1**, wherein the light detector further has an black current sensor mounted adjacent to the pixel sensor array and connecting to the control unit and the processing unit to generate a reference signal for black current compensation.

16. The physiological signals detection device as claimed in claim **2**, wherein the light detector further has an black current sensor mounted adjacent to the pixel sensor array and connecting to the control unit and the processing unit to generate a reference signal for black current compensation.

17. The physiological signals detection device as claimed in claim **5**, wherein the light detector further has an black current sensor mounted adjacent to the pixel sensor array and connecting to the control unit and the processing unit to generate a reference signal for black current compensation.

18. The physiological signals detection device as claimed in claim **9**, wherein the light detector further has an black current sensor mounted adjacent to the pixel sensor array and connecting to the control unit and the processing unit to generate a reference signal for black current compensation.

19. The physiological signals detection device as claimed in claim **11**, wherein the light detector further has an black current sensor mounted adjacent to the pixel sensor array and connecting to the control unit and the processing unit to generate a reference signal for black current compensation.

* * * * *

专利名称(译)	生理信号检测装置		
公开(公告)号	US20150335274A1	公开(公告)日	2015-11-26
申请号	US14/708527	申请日	2015-05-11
[标]申请(专利权)人(译)	义明科技股份有限公司		
申请(专利权)人(译)	英门电子科技股份有限公司.LTD.		
当前申请(专利权)人(译)	英门电子科技股份有限公司.LTD.		
[标]发明人	CHANG TOM WU KAO PIN FANG CHIH JEN HUNG SHANG MING HUANG CHIAO YI LO CHAN PENG KUO TSAI TSENG		
发明人	CHANG, TOM WU, KAO-PIN FANG, CHIH-JEN HUNG, SHANG-MING HUANG, CHIAO-YI LO, CHAN-PENG KUO-TSAI, TSENG		
IPC分类号	A61B5/1455 A61B5/00 A61B5/024		
CPC分类号	A61B5/14551 A61B5/6826 A61B5/7203 A61B5/02433 A61B5/14552		
优先权	104111745 2015-04-13 TW 62/002932 2014-05-26 US		
外部链接	Espacenet USPTO		

摘要(译)

生理信号检测装置具有连接到控制单元的光源，光检测器和处理单元。光检测器具有包括多个光传感元件的像素传感器阵列。光源通过透镜将光发射到人体以产生反射光。光检测器接收反射光以产生感测信号。由于光感测元件分别从不同方向接收不同的反射光，因此容易选择接收来自噪声的反射光的光感测元件并从计算生理值中消除。因此，计算的生理学值更准确。