US 20170020406A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2017/0020406 A1
CHIOUCHANG et al.
(43) Pub. Date: Jan. 26, 2017

(54) **METHOD FOR MEASURING BIOLOGICAL STIMULUS SIGNAL**

(71) Applicant: **UE Technology**, Taichung (TW)

(72) Inventors: **MIN-HUI CHIOUCHANG**, Taichung (TW); **JENG-REN DUANN**, Taichung (TW); **SHENG-CHUAN LIANG**, Taichung (TW); **YUNG-JIUN LIN**, Taichung (TW); **SHIH-CHE LO**, Taichung (TW)

(21) Appl. No.: **15/287,252**

(22) Filed: **Oct. 6, 2016**

Related U.S. Application Data

(63) Continuation-in-part of application No. 13/446,188, filed on Apr. 13, 2012.

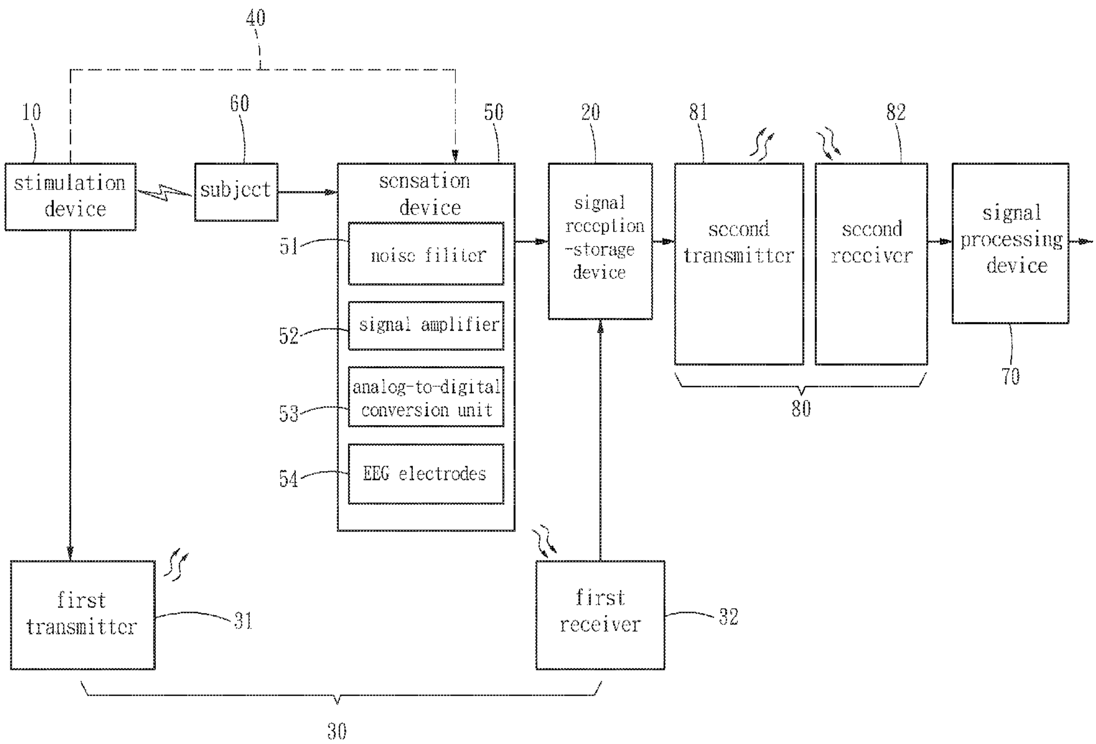
Publication Classification

(51) **Int. Cl.**
A61B 5/0484 (2006.01)
A61B 5/04 (2006.01)
A61B 5/0478 (2006.01)
A61B 5/00 (2006.01)

(52) **U.S. Cl.**
CPC ***A61B 5/0484*** (2013.01); ***A61B 5/0006*** (2013.01); ***A61B 5/04017*** (2013.01); ***A61B 5/0478*** (2013.01); ***A61B 5/7203*** (2013.01); *H04W 4/008* (2013.01)

(57) **ABSTRACT**

The present invention discloses a method for measuring a biological stimulus signal, which replaces the conventional wired synchronized signal transmission technology with a wireless synchronized signal transmission technology to increase convenience in usage, and which compensates the delay time of wireless transmission in a calibration way to achieve a synchronization effect, whereby the stimulus signal can be corresponding to the response signal correctly, and whereby the synchronized integrated data of the subject can be correctly generated.



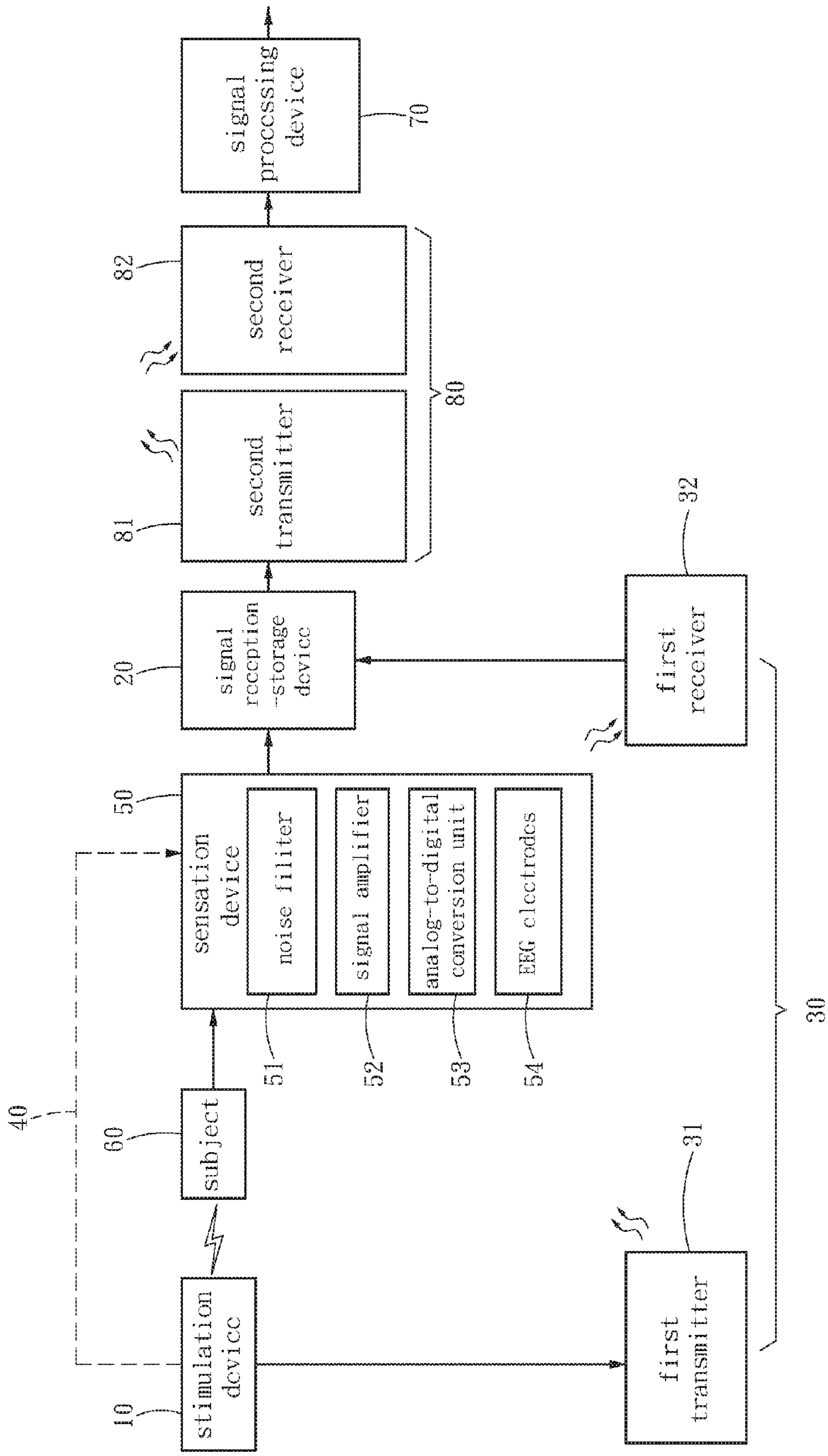

signal processing device
70
82
second receiver
second transmitter
81
80
signal reception -storage device
20
first receiver
32
50
sensation device
noise filiter
signal amplifier
analog-to-digital conversion unit
EEG electrodes
51
52
53
54
30
40
60
subject
31
stimulation device
10
first transmitter

Fig. 1

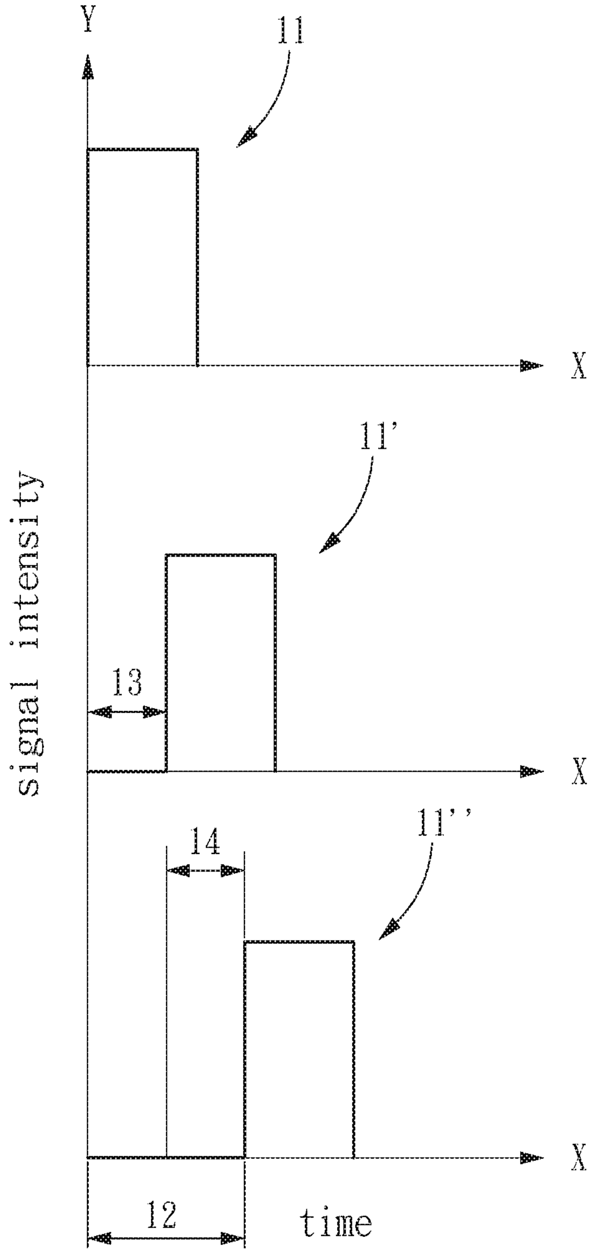


Fig . 2

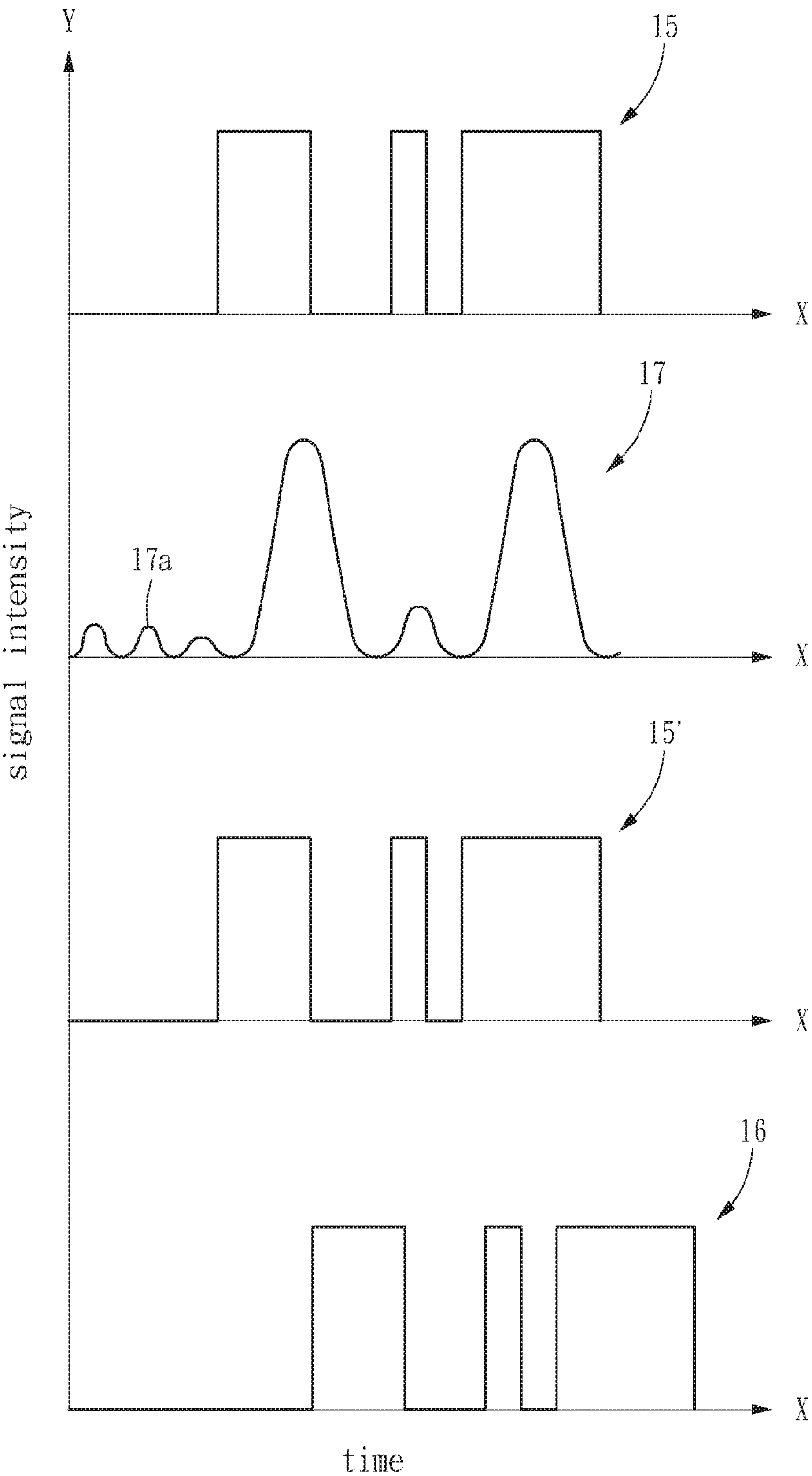


Fig . 3

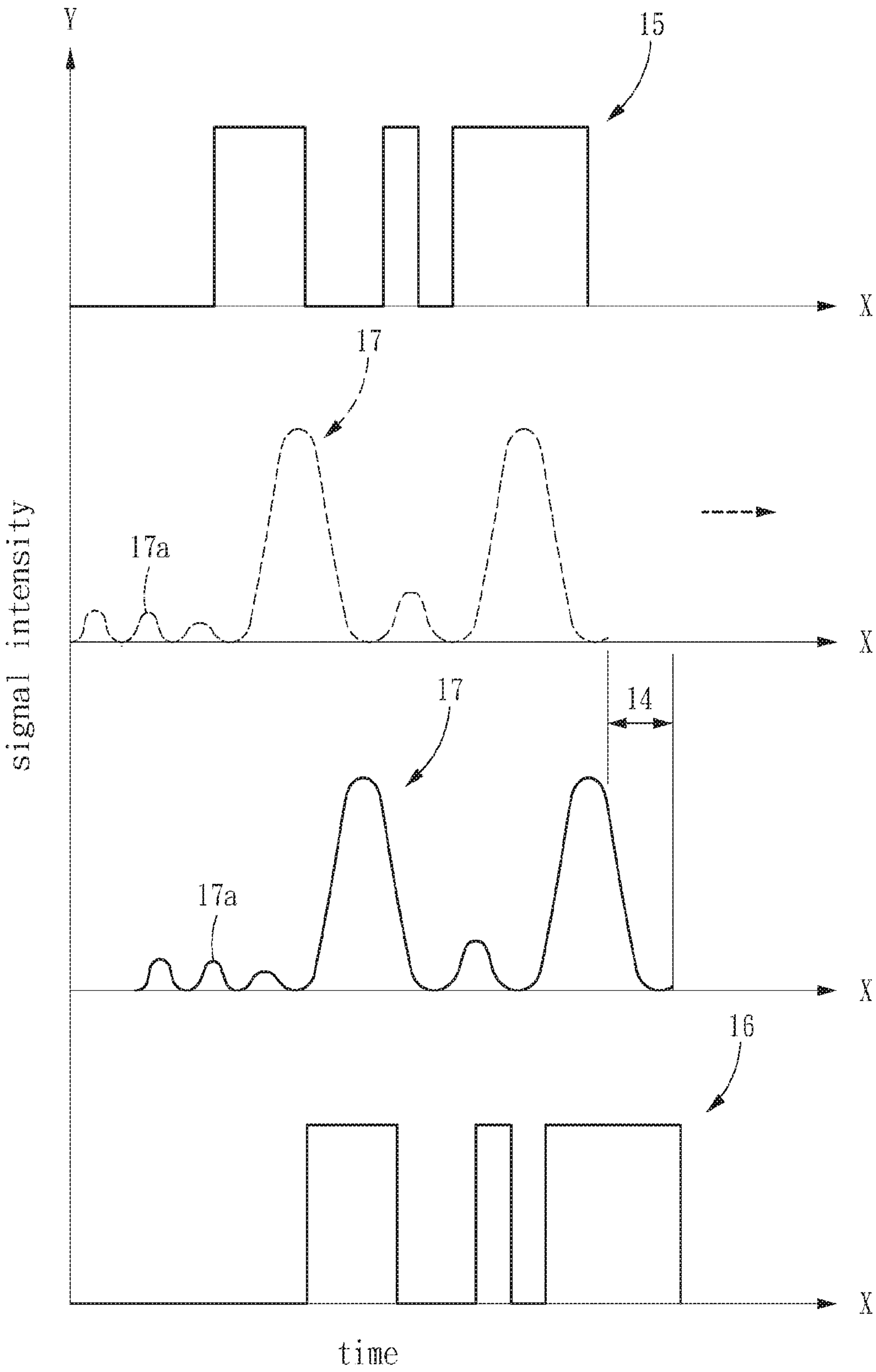


Fig . 4

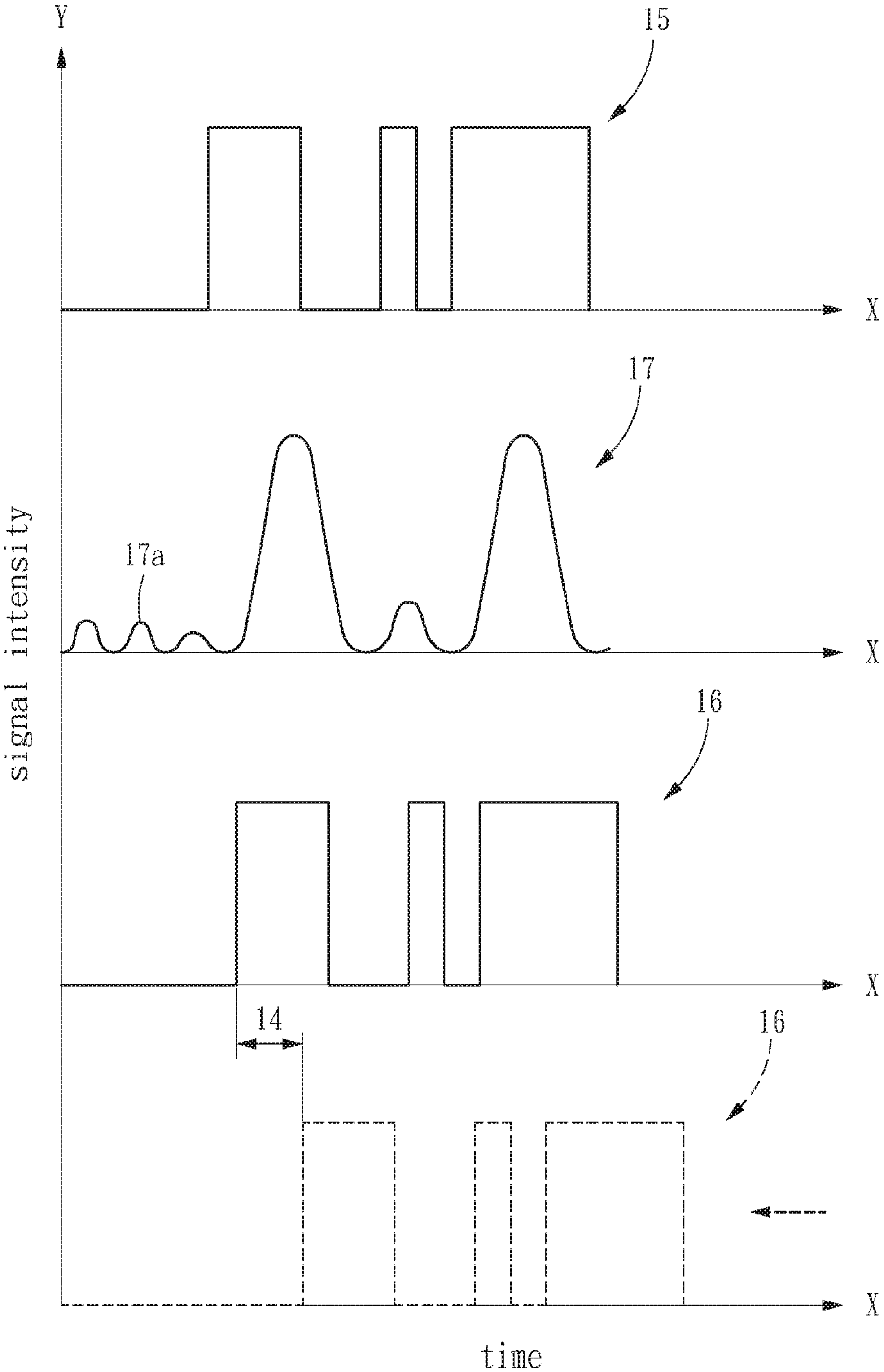


Fig. 5

METHOD FOR MEASURING BIOLOGICAL STIMULUS SIGNAL

[0001] This application is a continuation-in-part, and claims priority, of from U.S. patent application Ser. No. 13/446,188 filed on Apr. 13, 2012, entitled "MEASURING METHOD FOR SYNCHRONIZING BIO-SIGNALS WITH STIMULATIONS", the entire contents of which are hereby incorporated by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to a method for measuring a biological stimulus signal, particularly to a synchronization procession method for measuring a biological stimulus signal.

BACKGROUND OF THE INVENTION

[0003] In the conventional method for measuring a biological stimulus signal, a trigger signal is input into a stimulation device to generate a stimulus signal. The stimulus signal may be a sound or a light beam, stimulating a subject in a special way. Suppose the subject is a human body. If the stimulus signal is a sound, the stimulus signal vibrates the ear drum. If the stimulus signal is a light beam, the stimulus signal stimulates the retina. Receiving a stimulus signal, the human body will generate a physiological response signal. The response signal will be detected by a sensor and directly stored into a signal processing device. The signal processing device is connected with the stimulation device by a transmission line, whereby the signal processing device can acquire the synchronization signal of the stimulation device.

[0004] Via comparing and integrating the response signal and the synchronization signal of the stimulus signal, the related data of the subject is acquired and used to evaluate the response of the subject. However, the conventional technology that uses the transmission lines to connect the stimulation device and the signal processing device limits the configuration of the stimulation device and the signal processing device and constrains the freedom of movement of the subject. While there are a plurality of biological subjects and a plurality of sensors, the wiring will be very complicated, inconvenient for the users and unfavorable to application.

SUMMARY OF THE INVENTION

[0005] The primary objective of the present invention is to disclose a method for measuring a biological stimulus signal, which uses wireless transmission to increase convenience of usage and uses synchronized procession to make the stimulus signal correctly corresponding to the response signal, whereby to generate synchronized integrated data of the subject.

[0006] To achieve the abovementioned objective, the present invention comprises following steps.

[0007] Firstly, in order to acquire a time lag between wireless transmission and wired transmission, let a stimulation device provide a calibration signal and use a wireless transmission path and a wired transmission path to transmit the calibration signal to a signal reception-storage device, wherein the signal reception-storage device receives the calibration signals respectively coining from the wireless transmission path and the wired transmission path and separately delayed by a wireless transmission time and a wired transmission time, and wherein the difference between the wireless transmission time and the wired transmission time is the time lag. After the time lag is acquired, the wired transmission interface is removed.

[0008] Next, let the stimulation device provide a stimulus signal to a subject and simultaneously transmit a synchronization signal to the signal reception-storage device through a first wireless transmission interface, wherein the signal reception-storage device stores the synchronization signal as a comparison signal.

[0009] Next, after the subject receives the stimulus signal and generates a response, let a sensation device detect and converts the response and transmit the response to the signal reception-storage device to store as a response signal

[0010] Next, let a signal processing device, which is connected with the signal reception-storage device, use the time lag to calibrate either of the comparison signal and the response signal. After calibration, the signal processing device integrates the comparison signal and the response signal to generate a synchronized integrated data of the subject.

[0011] Therefore, the present invention is characterized in

[0012] 1. The present invention adopts a wireless transmission technology, exempting the subject from being constrained in the space and distance of movements, applying to more types of tests, and increasing the convenience of usage.

[0013] 2. The present invention uses the time lag to undertake calibration, avoiding the problem caused by the difference between the time of transmitting a signal wirelessly and the time of passing the signal through the sensation device, and acquiring the synchronized integrated data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** is a block diagram schematically showing a system realizing a method for measuring a biological stimulus signal according to one embodiment of the present invention;

[0015] FIG. **2** is a diagram schematically showing a calibration signal according to one embodiment of the present invention;

[0016] FIG. **3** is a diagram schematically showing a stimulus signal and a pre-calibration response signal according to one embodiment of the present invention;

[0017] FIG. **4** is a diagram schematically showing a stimulus signal and a response signal after calibration according to one embodiment of the present invention; and

[0018] FIG. **5** is a diagram schematically showing a stimulus signal and a response signal after calibration according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] The technical contents of the present invention will be described in detail with embodiments. However, it should be understood: these embodiments are only to exemplify the present invention but not to limit the scope of the present invention.

[0020] Refer to FIG. **1** and FIG. **2**. FIG. **1** is a block diagram schematically showing a system realizing a method for measuring a biological stimulus signal according to one embodiment of the present invention. FIG. **2** is a diagram schematically showing a calibration signal according to one embodiment of the present invention. Firstly, a stimulation device **10** provides a calibration signal **11** and uses a wired transmission path and a wireless transmission path to transmit the calibration signal **11** to a signal reception-storage device **20**. In one embodiment, the wireless transmission path is a first wireless transmission interface **30** linking the stimulation device **10** and the signal reception-storage device **20**. In one embodiment, the wired transmission path is a wired transmission interface **40** connecting the stimulation device **10** with a sensation device **50**, and the sensation device **50** is further connected with the signal reception-storage device **20**. The signal reception-storage device **20** receives the calibration signals **11** respectively coining from the wireless transmission path and the wired transmission path and separately delayed by a wireless transmission time **12** and a wired transmission time **13** and then stores the calibration signal **11**. The wireless transmission and the wired transmission respectively consume a wireless transmission time **12** and a wired transmission time **13**. A time lag **14** exists between the wireless transmission time **12** and the wired transmission time **13**.

[0021] Refer to FIG. **2**, wherein the X axis denotes time and the Y axis denotes the signal intensity. In FIG. **2**, the charts from top to bottom respectively show the calibration signal **11** sent out by the stimulation device **10**, the calibration signal **11'** received by the signal reception-storage device **20** through the wired transmission path, and the calibration signal **11"** received by the signal reception-storage device **20** through the wireless transmission path. As shown in FIG. **2**, the difference between the wireless transmission time **12** and the wired transmission time **13** is exactly the time lag **14**. In other words, the time lag **14** is the difference between the time of transmitting a signal through the sensation device **50** and the time of transmitting a signal through the first wireless transmission interface **30**.After the time lag **14** is acquired, the wired transmission interface **40** is removed.

[0022] Refer to FIG. **1** and FIG. **3**. Next, the stimulation device **10** provides a stimulus signal **15** to a subject **60**. At the same time, the stimulation device **10** transmits a synchronization signal **15'** to the signal reception-storage device **20** through the first wireless transmission interface **30**. The signal reception-storage device **20** stores the synchronization signal **15'** as a comparison signal **16**. The synchronization signal **15'** may be completely the same as the stimulus signal **15** (as shown in the drawing). The synchronization signal **15'** may be a pulse signal, which is also used to denote the initial time point of the stimulus signal **15**.

[0023] Next, the subject **60** receives the stimulus signal **15** and generates a response. The sensation device **50** detects and converts the response of the subject **60** and transmits the response to the signal reception-storage device **20**. The signal reception-storage device **20** stores the response as a response signal **17**, as shown in FIG. **3**. The response signal **17** normally has a fundamental wave **17***a*.The fundamental wave **17***a* is a wave normally generated by the subject **60** and unrelated to the stimulus signal **15**. The response signal **17** has the significant wave that is the response of the subject **60** to the stimulus signal **15**.

[0024] Then, let a signal processing device **70**, which is connected with the signal reception-storage device **20**, work out the time lag **14** according to the wireless transmission time **12** and the wired transmission time **13**, and use the time lag **14** to calibrate either of the comparison signal **16** and the response signal **17**. After calibration, the signal processing device **70** integrates the comparison signal **16** and the response signal **17** to generate a synchronized integrated data of the subject **60**.

[0025] Refer to FIG. **4** and FIG. **5**. The present invention calibrates the comparison signal **16** and the response signal **17** in a delay way (shown in FIG. **4**) or a compensation way (shown in FIG. **5**). As shown in FIG. **4**, the signal processing device **70** delays the response signal **17** according to the time lag **14** to calibrate the response signal **17**, wherein the response signal **17** is delayed (displaced rightward) in the time axis (the X axis) by the time lag **14**, wherein the dotted curve denotes the uncalibrated response signal **17**. Thereby, the calibrated response signal **17** is correctly corresponding to the comparison signal **16** in the time domain. After integration, the synchronized integrated data of the subject **60** is generated.

[0026] As shown in FIG. **5**, the signal processing device **70** compensates the comparison signal **16** according to the time lag **14** to calibrate the comparison signal **16**, wherein the comparison signal **16** is compensated (displaced leftward) by the time lag **14** in the time axis (the X axis), and wherein the dotted curve denotes the uncalibrated comparison signal **16**. Thereby, the calibrated comparison signal **16** is correctly corresponding to the response signal **17**. After integration, the synchronized integrated data of the subject **60** is generated.

[0027] In the present invention, the first wireless transmission interface **30** is based on a wireless technology selected from a group including the technologies of WiFi, WiMAX, LTE, UWB, ZigBee, Bluetooth, microwave, infrared, etc. The scope of the present invention also covers the first wireless transmission interface **30** based on other technologies not listed above but able to transmit data wirelessly. The first wireless transmission interface **30** includes a first transmitter **31** connected with the stimulation device **10** and a first receiver **32** connected with the signal reception-storage device **20**.

[0028] In one embodiment, the signal reception-storage device **20** is connected with the signal processing device **70** through a second wireless transmission interface **80**. Similarly, the second wireless transmission interface **80** is based on a wireless technology selected from a group including the technologies of WiFi, WiMAX, LTE, UWB, ZigBee, Bluetooth, microwave, infrared, etc. The second wireless transmission interface **80** includes a second transmitter **81** connected with the signal reception-storage device **20** and a second receiver **82** connected with the signal processing device **70**.

[0029] In one embodiment, the sensation device **50** includes a noise filter **51**, a signal amplifier **52**, an analog-to-digital conversion unit **53**, and an EEG(Electroencephalography) electrodes **54** contacting the head (not shown in the drawings) of the subject **60**. In this embodiment, the response measured by the sensation device **50** is a brain wave from the head. In the sensation device **50**, the EEG electrodes **54** detect the brain wave; the noise filter **51** filters out noise signals; the signal amplifier **52** amplifies the signal; the analog-to-digital conversion unit **53** converts the signal into a digital style to transmit.

[0030] Below is introduced one of the embodiments of the present invention. However, the present invention is not limited by this embodiment.

[0031] In this embodiment, the stimulation device **10** is an audio-video device able to generate specified images or sounds. The sensation device **50** is worn by the subject **60**, using the EEG electrodes **54** thereof to acquire the brain wave signal.

[0032] Firstly, before the subject **60** wears the sensation device **50**, the time lag **14** is acquired from the wireless transmission path and the wired transmission path in advance. In other words, the time lag **14** is the difference of the time that a signal passes through the sensation device **50** and the time that the signal passes through the first wireless transmission interface **30**. The time lag **14** can be applied to the tests for different subjects **60** without re-measurement unless there is variation in the wireless transmission path and/or the wired transmission path.

[0033] After the time lag **14** is acquired, the wired transmission path is removed. Next, let the subject **60** wear the sensation device **50** and let the stimulation device **10** provide the subject **60** with the stimulus signal **15** in form of images or sounds. For example, the stimulation device **10** outputs the stimulus signal **15** to an image display or a speaker to drive the image display or the speaker to generate images or sounds. At the same time, the stimulation device **10** outputs a synchronization signal **15'** through the first wireless transmission interface **30**to the signal reception-storage device **20** as the comparison signal **16**. Then, the sensation device **50** detects the brain wave of the subject **60** and transmits it to the signal reception-storage device **20** to store as the response signal **17**.

[0034] Next, use the time lag **14** to calibrate either of the comparison signal **16** and the response signal **17**. After calibration, the comparison signal **16** and the response signal **17** are integrated to generate the synchronized integrated data of the subject **60**. In the cases that the stimulation device **10** demands the subject **60** to undertake displacements or significant body movements, the design of the first wireless transmission interface **30** and the second wireless transmission interface **80** of the present invention can exempt the displacements or movements of the subject **60** from interference or limitation.

[0035] In comparison with the conventional technology, the present invention has the following advantages:

[0036] 1. The present invention adopts a wireless transmission technology, exempting the subject from being constrained in the space and distance of movements, applying to more types of tests, and increasing the convenience of usage.

[0037] 2. The present invention uses the time lag to undertake calibration, avoiding the problem caused by the difference between the time of transmitting a signal wirelessly and the time of passing the signal through the sensation device, and correctly generating the synchronized integrated data of the subject to satisfy demands in applications.

[0038] 3. The present invention connects the second wireless transmission interface with the signal processing device arranged in a far end, exempting the subject from being constrained by the signal processing device, enabling the subject to move free, and increasing the comfort of the subject.

[0039] 4. The present invention arranges the noise filter, signal amplifier and analog-to-digital conversion unit directly in the sensation device, undertaking wave filtration, amplification, and analog-to-digital conversion, and reducing interference from the external environment.

What is claimed is:

1. A method for measuring a biological stimulus signal, comprising steps:

letting a stimulation device provide a calibration signal and use a wireless transmission path and a wired transmission path to transmit the calibration signal to a signal reception-storage device, wherein the signal reception-storage device receives the calibration signals respectively coining from the wireless transmission path and the wired transmission path and separately delayed by a wireless transmission time and a wired transmission time, and wherein a time lag exists between the wireless transmission time and the wired transmission time;

letting the stimulation device provide a stimulus signal to a subject and simultaneously transmit a synchronization signal to the signal reception-storage device through a first wireless transmission interface, wherein the signal reception-storage device stores the synchronization signal as a comparison signal;

after the subject receives the stimulus signal and generates a response, letting a sensation device detects and converts the response and transmit the response to the signal reception-storage device to store as a response signal; and

letting a signal processing device, which is connected with the signal reception-storage device, use the time lag to calibrate either of the comparison signal and the response signal, and integrate the comparison signal and the response signal after calibration to generate a synchronized integrated data of the subject.

2. The method for measuring a biological stimulus signal according to claim **1**, wherein the signal processing device delays the response signal according to the time lag to calibrate the response signal.

3. The method for measuring a biological stimulus signal according to claim **1**, wherein the signal processing device compensates the comparison signal according to the time lag to calibrate the comparison signal.

4. The method for measuring a biological stimulus signal according to claim **1**, wherein the first wireless transmission interface is based on a wireless technology selected from the group including the technologies of WiFi, WiMAX, LTE, UWB, ZigBee, Bluetooth, microwave, and infrared.

5. The method for measuring a biological stimulus signal according to claim **1**, wherein the first wireless transmission interface includes a first transmitter connected with the stimulation device and a first receiver connected with the signal reception-storage device.

6. The method for measuring a biological stimulus signal according to claim **1**, wherein the signal reception-storage device is connected with the signal processing device through a second wireless transmission interface.

7. The method for measuring a biological stimulus signal according to claim **6**, wherein the second wireless transmission interface is based on a wireless technology selected from the group including the technologies of WiFi, WiMAX, LTE, UWB, ZigBee, Bluetooth, microwave, and infrared.

8. The method for measuring a biological stimulus signal according to claim **6**, wherein the second wireless transmission interface includes a second transmitter connected with the signal reception-storage device and a second receiver connected with the signal processing device.

9. The method for measuring a biological stimulus signal according to claim **1**, wherein the sensation device includes a noise filter, a signal amplifier, and an analog-to-digital conversion unit, and wherein after the sensation device acquires the response from the subject, the noise filter filters out noise signals of the response; the signal amplifier amplifies the signal from the noise filter; the analog-to-digital conversion unit converts the signal from the signal amplifier into a digital response signal.

10. The method for measuring a biological stimulus signal according to claim **9**, wherein the sensation device further includes EEG electrodes contacting the head of the subject, and wherein the response of the subject is a brain wave from the head, and wherein the EEG electrodes detect the brain wave.

11. The method for measuring a biological stimulus signal according to claim **1**, wherein the wireless transmission path includes the first wireless transmission interface linking the stimulation device and the signal reception-storage device, and wherein the wired transmission path includes a wired transmission interface connecting the stimulation device withthe sensation device, and the sensation device is further connected with the signal reception-storage device.

* * * * *

专利名称(译)	测量生物刺激信号的方法		
公开(公告)号	US20170020406A1	公开(公告)日	2017-01-26
申请号	US15/287252	申请日	2016-10-06
[标]申请(专利权)人(译)	UE TECH		
申请(专利权)人(译)	UE科技		
当前申请(专利权)人(译)	UE科技		
[标]发明人	CHIOUCHANG MIN HUI DUANN JENG REN LIANG SHENG CHUAN LIN YUNG JIUN LO SHIH CHE		
发明人	CHIOUCHANG, MIN-HUI DUANN, JENG-REN LIANG, SHENG-CHUAN LIN, YUNG-JIUN LO, SHIH-CHE		
IPC分类号	A61B5/0484 A61B5/04 A61B5/0478 A61B5/00		
CPC分类号	A61B5/0484 A61B5/0006 A61B5/04017 A61B2560/0223 A61B5/7203 H04W4/008 A61B5/0478 A61B5/4884 A61B5/7285 H04W4/80		
外部链接	Espacenet USPTO		

摘要(译)

本发明公开了一种测量生物刺激信号的方法，该方法用无线同步信号传输技术取代传统的有线同步信号传输技术，增加了使用的便利性，并以校准的方式补偿无线传输的延迟时间。同步效果，由此刺激信号可以正确地对应于响应信号，从而可以正确地生成对象的同步的集成数据。