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(54) **BIOINFORMATION MEASUREMENT SYSTEM AND BIOINFORMATION MEASUREMENT METHOD**

SYSTEM UND VERFAHREN ZUR MESSUNG BIOLOGISCHER INFORMATIONEN

SYSTÈME DE MESURE D'INFORMATIONS BIOLOGIQUES ET PROCÉDÉ DE MESURE D'INFORMATIONS BIOLOGIQUES

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a biological information measurement system including a biological information measurement section and a biological information output section as specified in claim 1, and an operation method of the biological information measurement system, as specified in claim 12.

2. Description of Related Art

[0002] In a medical field of the related art, a communication cable (wire) for transmitting information measured by a measurement apparatus to an output apparatus is present between the measurement apparatus measuring biological information of a subject such as a patient and the output apparatus outputting the information measured by the measurement apparatus, as exemplary shown in US 2014/0058233 A1.

[0003] The presence of such a communication cable may impede action of a medical worker when the medical worker performs other medical practice while measuring biological information of a subject such as a patient with the measurement apparatus, and there is also concern that medical accident may occur due to entangling of the communication cable.

[0004] On the other hand, a restriction is imposed on a subject such as a patient since the subject is required to maintain a posture thereof to be constant to some degree during measurement of biological information due to the presence of the communication cable, and thus a burden is placed on the subject such as a patient.

[0005] Due to the presence of the communication cable, there is a possibility that a signal of measurement information may be attenuated in the process of transmitting measurement information obtained by the measurement apparatus measuring biological information to the output apparatus, or the influence of disturbance is also pointed out in a case where another communication system apparatus is used around the measurement apparatus measuring biological information.

[0006] For example, Japanese Patent Application Publication No. 2014-64929 (JP2014-64929A) discloses that in which a pulse oxygen measurement sensor is attached to a patient, and a modulated red light and infrared photoplethysmograph signal is transmitted to a universal/upgrading pulse oximeter (UPO) for patient monitoring through a patient cable, and discloses that the UPO computes the patient's oxygen saturation and pulse rate on the basis of the sensor signal and, optionally, displays the patient's oxygen status.

[0007] However, in the universal/upgrading pulse oximeter (UPO) for patient monitoring disclosed in JP2014-64929A, biological information of a patient is monitored without interruption, but a communication system cable is presented between a measurement apparatus measuring biological information and an output apparatus.

[0008] Therefore, in the UPO disclosed in JP2014-64929A, when a medical worker performs measurement of biological information on a subject such as a patient, the medical worker cannot perform smooth medical practice, and a restriction is imposed on a posture of the subject such as a patient during measurement, and thus a burden may be placed on the subject such as a patient.

SUMMARY OF THE INVENTION

[0009] Therefore, the present invention can be realized in light of the circumstances, by wirelessly transmitting measurement information obtained by a biological information measurement section 100 to a biological information output section 200 without using a communication cable between the biological information measurement section 100 and the biological information output section 200. Consequently, an object of the present invention is to provide a biological information measurement system and an operation method of the system, in which, when a medical worker performs measurement of biological information on a subject such as a patient, the medical worker can easily perform smooth medical practice, and a restriction imposed on a posture of the subject such as a patient during measurement can be alleviated.

[0010] In order to solve the problem, according to an aspect of the present invention, there is provided a biological information measurement system applied to a subject requiring cardiopulmonary resuscitation, including a biological information measurement section; and a biological information output section, as specified in claim 1, in which the biological information measurement section includes a light emitting portion that irradiates the head of the subject with near-infrared light, a light receiving portion that receives light as a result of the near-infrared light applied from the light emitting portion propagating inside the head of the subject, a light detection portion that detects the intensity of the light received by the light receiving portion, and a wireless transmission portion that wirelessly transmits information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity detected by the light detection portion, and in which the biological information output section includes a reception portion that receives the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, wirelessly transmitted from the wireless transmission portion of the biological information measurement section, and a determination portion that monitors information regarding a change in a blood flow based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, received by the reception portion, over time, and determines whether or not a rate of the change in a blood flow exceeds a predetermined reference value in a case where there is a change in the information regarding a change in a blood flow according to a timing of chest compressions of the subject.

[0011] In the biological information measurement system according to the aspect of the present invention, the light emitting portion of the biological information measurement section irradiates the head of the subject with near-infrared light having three different wavelengths, and the three different wavelengths are a first wavelength λ_1 (770 nm $\pm$ 20 nm), a second wavelength λ_2 (805 nm $\pm$ 20 nm), and a third wavelength λ_3 (870 nm $\pm$ 20 nm).

[0012] In the biological information measurement system according to the aspect of the present invention, the light emitting portion and the light receiving portion of the biological information measurement section include a light emitting portion (o1) and a light receiving portion (p1) for performing measurement, provided on the left as a pair, and a light emitting portion (o2) and a light receiving portion (p2) for performing measurement, provided on the right as a pair, and the order of eight times of irradiation performed every cycle by using near-infrared light having three different wavelengths is any one of the following orders of A→B→C→D→E→F→G→H, B→C→D→E→F→G→H→A, C→D→E→F→G→H→A→B, D→E→F→G→H→A→B→C→, E→F→G→H→A→B→C→D, F→G→H→A→B→C→D→E→, G→H→A→B→C→D→E→F, and H→A→B→C→D→E→F→G:

A: o1 (left) first wavelength λ_1 (770 nm $\pm$ 20 nm)
B: o1 (left) second wavelength λ_2 (805 nm $\pm$ 20 nm)
C: o1 (left) third wavelength λ_3 (870 nm $\pm$ 20 nm)
D: o2 (right) second wavelength λ_2 (805 nm $\pm$ 20 nm)
E: o2 (right) first wavelength λ_1 (770 nm $\pm$ 20 nm)
F: o1 (left) second wavelength λ_2 (805 nm $\pm$ 20 nm)
G: o2 (right) third wavelength λ_3 (870 nm $\pm$ 20 nm)
H: o2 (right) second wavelength λ_2 (805 nm $\pm$ 20 nm)

[0013] In the biological information measurement system according to the aspect of the present invention, the orders of A: o1 (left) first wavelength λ_1 (770 nm $\pm$ 20 nm) and C: o1 (left) third wavelength λ_3 (870 nm $\pm$ 20 nm) may be replaced with each other, or the orders of E: o2 (right) first wavelength λ_1 (770 nm $\pm$ 20 nm) and G: o2 (right) third wavelength λ_3 (870 nm $\pm$ 20 nm) may be replaced with each other.

[0014] In the biological information measurement system according to the aspect of the present invention, preferably, in a case where irradiation is performed eight times every cycle, irradiation from a first cycle to an eighth cycle is regarded as one set, one or more sets of irradiation is performed, and at least one set of irradiation is performed within one second.

[0015] In the biological information measurement system according to the aspect of the present invention, the light emitting portion and the light receiving portion of the biological information measurement section may include a light emitting portion (o1) and a light receiving portion (p1) for performing measurement, provided on the left as a pair, and a light emitting portion (o2) and a light receiving portion (p2) for performing measurement, provided on the right as a pair, light beams having the three different wavelengths may be applied from the light emitting portions on o1 (left) and o2 (right) in the irradiation order, and the light detection portion may detect the intensities of light beams received by the light receiving portions on p1 (left) and p2 (right) in each cycle, and, in respective pieces of data detected by the light detection portion in each cycle, in a case where differences between pieces of data are all laid in the same direction (for example, all in an increase direction) through comparison between adjacent cycles, whereas differences between pieces of data are all laid in an opposite direction (for example, all in a decrease direction) through comparison between other adjacent cycles, the determination portion may determine that there is a change in a blood flow.

[0016] In the biological information measurement system according to the aspect of the present invention, in the biological information measurement section, a light detection unit including the light emitting portion, the light receiving portion, and the light detection portion may have a first terminal, a wireless transmission unit including the wireless transmission portion may have a second terminal, and the first terminal and the second terminal may be directly connected to each other in an attachable and detachable manner.

[0017] In the biological information measurement system according to the aspect of the present invention, in the biological information measurement section, a light detection unit including the light emitting portion, the light receiving portion, and the light detection portion may have a first terminal, a wireless transmission unit including the wireless transmission portion may have a second terminal, and the first terminal and the second terminal may be connected to each other via a wire.

[0018] In the biological information measurement system according to the aspect of the present invention, the biological information measurement section may further include a display portion that displays display information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, detected by the light detection portion.

[0019] In the biological information measurement system according to the aspect of the present invention, the biological information output section may further include a display portion that displays display information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, received by the reception portion.

[0020] In the biological information measurement system according to the aspect of the present invention, the biological information measurement section may further include a calculation portion that performs a calculation process on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, detected by the light detection portion.

[0021] In the biological information measurement system according to the aspect of the present invention, the biological information output section may further include a calculation portion that performs a calculation process on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, received by the reception portion.

[0022] In the biological information measurement system according to the aspect of the present invention, in a case where the determination portion determines that the predetermined reference value is exceeded, the biological information output section may perform outputting of output information based on notification information for notifying the outside that the predetermined reference value is exceeded.

[0023] In order to solve the problem, according to another aspect of the present invention, there is provided an operation method for a biological information measurement system applied to a subject requiring cardiopulmonary resuscitation, as specified in claim 12, including a biological information measurement step executed in a biological information measurement section; and a biological information output step executed in a biological information output section, in which the biological information measurement step includes a light emission step of irradiating the head of the subject with near-infrared light, a light reception step of receiving light as a result of the near-infrared light applied in the light emission step propagating inside the head of the subject, a light detection step of detecting the intensity of the light received in the light reception step, and a wireless transmission step of wirelessly transmitting information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity detected in the light detection step, and in which the biological information output step includes a reception step of receiving the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, wirelessly transmitted in the wireless transmission step of the biological information measurement step, and a determination step of causing the biological information output section to monitor information regarding a change in a blood flow based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, received in the reception step, over time, and to determine whether or not a rate of the change in a blood flow exceeds a predetermined reference value in a case where there is a change in the information regarding a change in a blood flow according to a timing of chest compressions of the subject.

Advantageous Effects of Invention

[0024] According to the present invention, it is possible to transmit measurement information obtained by a biological information measurement section to a biological information output section without using a communication system cable between the biological information measurement section and the biological information output section.

[0025] Therefore, it is possible to achieve an effect in which, when a medical worker performs measurement of biological information on a subject such as a patient, the medical worker can easily perform smooth medical practice, and a restriction imposed on a posture of the subject such as a patient during measurement can be alleviated.

Brief Description of Drawings

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Fig. 1 is a diagram illustrating an example of an embodiment of a biological information measurement system 300 in which measurement information obtained by a biological information measurement section 100 is wirelessly transmitted to a biological information output section 200 in a state in which the biological information measurement section 100 is attached (adhered) to the head of a subject such as a patient.

Fig. 2 is a block diagram illustrating examples of principal portion configurations of the biological information measurement section 100 and the biological information output section 200 forming the biological information measurement system 300.

Fig. 3 is a diagram illustrating a first embodiment of the biological information measurement section 100 according to the present invention.

Fig. 4 is a diagram illustrating the order of applying near-infrared light having three different wavelengths (a first wavelength λ_1, a second wavelength λ_2, and a third wavelength λ_3) eight times every cycle in a time series.

Fig. 5 is a diagram illustrating the order of applying near-infrared light having three different wavelengths (the first wavelength λ_1, the second wavelength λ_2, and the third wavelength λ_3) six times every cycle in a time series.

Fig. 6 is a diagram in which a state in which the biological information measurement section 100 according to the first embodiment is attached (adhered) to the head of a subject such as a patient is viewed from the side.

Fig. 7 is a diagram illustrating a second embodiment of the biological information measurement section 100 according to the present invention.

Fig. 8 is a diagram in which a state in which the biological information measurement section 100 according to the second embodiment is attached (adhered) to the head of a subject such as a patient is viewed from the side.

Fig. 9 is a flowchart illustrating an example of a process performed by the biological information measurement system 300 including the biological information measurement section 100 and the biological information output section 200.

DETAILED DESCRIPTION OF EMBODIMENTS

[0027] With reference to Figs. 1 to 9, embodiments of the present invention will be described.

(Summary of Biological Information Measurement System 300 including Biological Information Measurement Section 100 and Biological Information Output Section 200)

[0028] Fig. 1 is a diagram illustrating an example of an embodiment of a biological information measurement system 300 in which measurement information obtained by a biological information measurement section 100 is wirelessly transmitted to a biological information output section 200 in a state in which the biological information measurement section 100 is attached (adhered) to the head of a subject such as a patient.

[0029] The biological information measurement system 300 provided by the present invention includes the biological information measurement section 100 and the biological information output section 200.

[0030] The biological information measurement section 100 includes a light emitting portion which irradiates the head of a subject with near-infrared light; a light receiving portion which receives light as a result of the near-infrared light applied from the light emitting portion propagating inside the head of the subject; a light detection portion which detects the intensity of the light received by the light receiving portion; and a wireless transmission portion which wirelessly transmits information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood on the basis of the light intensity detected by the light detection portion.

[0031] On the other hand, the biological information output section 200 includes a reception portion which receives information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, wirelessly transmitted from the wireless transmission portion of the biological information measurement section, and an output portion which outputs output information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, received by the reception portion.

[0032] As illustrated in Fig. 1, the biological information measurement system 300 according to the present invention is realized by wirelessly transmitting measurement information obtained by the biological information measurement section 100 to the biological information output section 200 without using a communication cable between the biological information measurement section 100 and the biological information output section 200.

[0033] In the biological information measurement system 300 according to the present invention, when a medical worker performs measurement of biological information on a subject such as a patient, the medical worker can perform smooth medical practice, and a restriction imposed on a posture of the subject such as a patient during measurement can be alleviated.

[0034] The biological information measurement section 100 of the biological information measurement system 300 according to the present invention measures the intensity of light as a result of near-infrared light applied to the head of a subject such as a patient propagating inside the head without being absorbed in the head, that is, the intensity (intensity of transmitted light) of light transmitted inside the head.

[0035] If blood flows (a blood flow changes) in a living body, it is known that the concentration or the amount of hemoglobin in blood changes. Conversely, if the concentration or the amount of hemoglobin in blood changes, it may be regarded that blood flows (a blood flow changes) in a living body.

[0036] The present invention focuses on the fact that, when the light emitting portion irradiates the head of a subject with near-infrared light, and the concentration or the amount of hemoglobin in blood increases, an amount (absorption amount) of the applied light in the near-infrared region absorbed in the head increases so that an amount (transmission amount) of the light in the near-infrared region transmitted inside the head is reduced, and an amount (reception amount) of light received by the light receiving portion is reduced due to the reduction in the transmission amount, and the fact that, when the concentration or the amount of hemoglobin in blood is reduced, an amount (absorption amount) of the applied light in the near-infrared region absorbed in the head is reduced so that an amount (transmission amount) of the light in the near-infrared region transmitted inside the head increases, and an amount (reception amount) of light received by the light receiving portion increases due to the increase in the transmission amount.

[0037] In the present invention, a configuration may be designed in which a current is output from the light receiving portion according to an amount (reception amount) of light received by the light receiving portion such as a photodiode (PD).

[0038] In the present invention, a flow of blood (a change in a blood flow) can be understood in real time by measuring the intensity (intensity of transmitted light) of light transmitted without being absorbed in the head by using the fact that an amount (transmission amount) of light in the near-infrared region transmitted inside the head differs depending on an increase or a decrease in the concentration or the amount of hemoglobin in blood of the head of a subject.

[0039] For example, in a case where the biological information measurement system 300 of the present invention is applied to a subject such as a patient requiring cardiopulmonary resuscitation, a medical worker can accurately adjust a position where cardiac massage (sternum pressing) is performed or massage force while checking a flow of blood (a change in a blood flow), and thus it is possible to improve a success probability of cardiopulmonary resuscitation.

(Configuration of Biological Information Measurement System 300)

[0040] Fig. 2 is a block diagram illustrating examples of principal portion configurations of the biological information measurement section 100 and the biological information output section 200 forming the biological information measurement system 300.

[0041] The biological information measurement system 300 provided by the present invention includes the biological information measurement section 100 and the biological information output section 200 as exemplified in Fig. 1.

[0042] The biological information measurement section 100 includes a light emitting portion 11, a light receiving portion 12, a light detection portion 13, and a wireless transmission portion 14. The biological information measurement section 100 may further include a calculation portion and a display portion.

[0043] On the other hand, the biological information output section 200 includes a reception portion 15 and an output portion 16. The biological information output section 200 may further include a calculation portion, a display portion, and a determination portion.

(Configuration of Biological Information Measurement Section 100 of Biological Information Measurement System 300)

[0044] The light emitting portion 11 has a function of irradiating the head of a subject with near-infrared light. As the light emitting portion 11, for example, a light emitting diode (LED) may be used.

[0045] The light receiving portion 12 has a function of light as a result of the near-infrared light applied from the light emitting portion 11 propagating inside the head of the subject. As the light receiving portion 12, for example, a photodiode (PD) may be used.

[0046] The light detection portion 13 has a function of detecting the intensity of the light received by the light receiving portion 12. As the light detection portion 13, for example, a light detector which detects the intensity of light received by the light receiving portion 12, that is, the intensity (intensity of transmitted light) of light transmitted inside the head of a subject may be used.

[0047] The wireless transmission portion 14 has a function of wirelessly transmitting information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity detected by the light detection portion 13. For example, a device which can perform wireless transmission may be used as the wireless transmission portion 14, and a Bluetooth (registered trademark) method may be employed.

[0048] Here, the "information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin" may be information regarding a detection result of the light intensity (intensity of transmitted light) detected by the light detection portion 13, or may be information regarding a result obtained by converting the information regarding a detection result of the light intensity (intensity of transmitted light) detected by the light detection portion 13 into the concentration or the amount of hemoglobin.

[0049] As illustrated in Fig. 2, the biological information measurement section 100 may include not only the light emitting portion 11, the light receiving portion 12, the light detection portion 13, and the wireless transmission portion 14, described above, but also a calculation portion and a display portion (not illustrated) described below.

[0050] The calculation portion has a function of performing a calculation process on information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity detected by the light detection portion 13. For example, the calculation portion performs a calculation process so as to convert information regarding a detection result of the light intensity (intensity of transmitted light) detected by the light detection portion 13 into information regarding the concentration or the amount of hemoglobin.

[0051] The display portion has a function of displaying display information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity detected by the light detection portion 13. For example, the display portion displays display information based on the information regarding a detection result of the light intensity (intensity of transmitted light) detected by the light detection portion 13 on a monitor or the like.

[0052] A storage portion 30 stores information acquired by each portion of the biological information measurement section 100. The storage portion 30 is formed of, for example, a nonvolatile semiconductor memory such as a flash memory.

(Configuration of Biological Information Output Section 200 of Biological Information Measurement System 300)

[0053] The reception portion 15 has a function of receiving information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based the light intensity, wirelessly transmitted from the wireless transmission portion 14 of the biological information measurement section 100. For example, a device which can perform wireless reception may be used as the reception portion 15, and a Bluetooth (registered trademark) method may be employed.

[0054] The output portion 16 has a function of outputting output information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, received by the reception portion 15. The output portion 16 outputs the output information based on information regarding a detection result of the light intensity (intensity of transmitted light), received by the reception portion 15, to a monitor, a speaker, or the like.

[0055] As illustrated in Fig. 2, the biological information output section 200 may include not only the reception portion 15 and the output portion 16, described above, but also a calculation portion, a display portion, and a determination portion (not illustrated) described below.

[0056] The calculation portion has a function of performing a calculation process on information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, received by the reception portion 15. For example, the calculation portion performs a calculation process so as to convert information regarding a detection result of the light intensity (intensity of transmitted light), received by the reception portion 15, into information regarding the concentration or the amount of hemoglobin.

[0057] The display portion has a function of displaying display information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, received by the reception portion 15. For example, the display portion displays display information based on the information regarding a detection result of the light intensity (intensity of transmitted light), received by the reception portion 15.

[0058] The determination portion has a function of determining whether or not the output information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, received by the reception portion 15, exceeds a predetermined reference value. For example, in a case where determination portion determines that the output information based on the information regarding a detection result of the light intensity (intensity of transmitted light), received by the reception portion 15, exceeds the predetermined reference value, the output portion 16 outputs output information based on notification information for notifying the outside (for example, a medical worker) of the fact to a monitor, a speaker, or the like.

[0059] Here, regarding the "predetermined reference value", a change in the intensity (intensity of transmitted light) of light which is not absorbed inside the head and is transmitted may be monitored over time, and a predetermined reference may be provided in a rate of the change so as to be used as the predetermined reference value.

[0060] Specifically, in a case where the biological information system 300 of the present invention is applied to a subject such as a patient requiring cardiopulmonary resuscitation, a change in the intensity (intensity of transmitted light) of light which is not absorbed inside the head of the subject and is transmitted may be monitored over time, and, in a case where a change to an increase in the concentration or the amount of hemoglobin in blood of the head of the subject occurs according to timings at which the sternum of the subject is pressed, a change in the intensity of transmitted light appears. In a case where a rate of the change exceeds a predetermined reference value, a medical worker may be notified of the fact by using display means, sound means, or the like.

[0061] A storage portion 40 stores information acquired by each portion of the biological information output section

200. The storage portion 40 is formed of, for example, a nonvolatile semiconductor memory such as a flash memory.

(Embodiments of Biological Information Measurement Section 100 According to Present Invention)

[0062] An embodiment of the biological information measurement section 100 according to the present invention is not particularly limited as long as the biological information measurement section can be attached (adhered) to the head of a subject such as a patient, but, a first embodiment illustrated in Figs. 3 and 6 and a second embodiment illustrated in Figs. 7 and 8 may be preferable.

(Biological Information Measurement Section 100 related to First Embodiment)

[0063] Fig. 3 is a diagram illustrating a first embodiment of the biological information measurement section 100 according to the present invention.

[0064] In the biological information measurement section 100 related to the first embodiment of the present invention, a light detection unit A including the light emitting portion 11, the light receiving portion 12, and the light detection portion 13 has a first terminal x, a wireless transmission unit B including the wireless transmission portion 14 has a second terminal y, and the first terminal x and the second terminal y can be directly connected to each other in an attachable and detachable manner.

[0065] Fig. 3a is a diagram illustrating a state in which the first terminal x of the light detection unit A and the second terminal y of the wireless communication unit B are directly connected to each other.

[0066] Fig. 3b is a diagram illustrating a state before the first terminal x of the light detection unit A and the second terminal y of the wireless communication unit B are directly connected to each other.

[0067] Fig. 6 is a diagram in which a state in which the biological information measurement section 100 according to the first embodiment is attached (adhered) to the head of a subject such as a patient is viewed from the side.

[0068] The biological information measurement section 100 related to the first embodiment, illustrated in Figs. 3a and 6 has a form in which the first terminal x of the light detection unit A and the second terminal y of the wireless transmission unit B are directly connected to each other.

[0069] Shapes of the first terminal x and the second terminal y are not particularly limited as long as the terminals can be directly connected to each other.

[0070] In the biological information measurement section 100 related to the first embodiment, as illustrated in Fig. 3, the first terminal x of the light detection unit A and the second terminal y of the wireless transmission unit B are connected to each other so that the light detection unit A and the wireless transmission unit B are integrated with each other as illustrated in Fig. 6, and thus it is possible to measure biological information by attaching (adhering) the biological information measurement section 100 to the head of a subject such as a patient.

[0071] In the biological information measurement system 300 including the biological information measurement section 100 related to the first embodiment and the biological information output section 200, measurement information obtained by the biological information measurement section 100 can be wirelessly transmitted to the biological information output section 200 without using a communication cable between the biological information measurement section 100 and the biological information output section 200. Consequently, when a medical worker performs measurement of biological information on a subject such as a patient, the medical worker can easily perform smooth medical practice.

[0072] In the biological information measurement section 100 related to the first embodiment, since the light detection unit A and the wireless transmission unit B are integrated with each other, when a medical worker performs measurement of biological information on a subject such as a patient, a restriction imposed on a posture of the subject such as a patient during measurement can be alleviated so that the subject can take a free posture to some degree, and thus a burden placed on the subject such as a patient during measurement can be reduced.

(Biological Information Measurement Section 100 related to Second Embodiment)

[0073] Fig. 7 is a diagram illustrating a second embodiment of the biological information measurement section 100 according to the present invention.

[0074] In the biological information measurement section 100 related to the second embodiment of the present invention, a light detection unit A including the light emitting portion 11, the light receiving portion 12, and the light detection portion 13 has a first terminal x, a wireless transmission unit B including the wireless transmission portion 14 has a second terminal y, and the first terminal x and the second terminal y can be connected to each other via a wire.

[0075] Fig. 8 is a diagram in which a state in which the biological information measurement section 100 according to the second embodiment is attached (adhered) to the head of a subject such as a patient is viewed from the side.

[0076] The biological information measurement section 100 related to the second embodiment, illustrated in Figs. 7 and 8 has a form in which the first terminal x of the light detection unit A and the second terminal y of the wireless transmission unit B are connected to each other via a wire.

[0077] Shapes of the first terminal x and the second terminal y are not particularly limited as long as the terminals can be connected to each other via a wire.

[0078] In the biological information measurement section 100 related to the second embodiment, as illustrated in Fig. 7, the first terminal x of the light detection unit A and the second terminal y of the wireless transmission unit B are connected to each other via a wire so that the light detection unit A and the wireless transmission unit B are separate from each other as illustrated in Fig. 8, and thus it is possible to measure biological information by attaching (adhering) the biological information measurement section 100 to the head of a subject such as a patient.

[0079] In the biological information measurement system 300 including the biological information measurement section 100 related to the second embodiment and the biological information output section 200, in the same manner as in the biological information measurement section 100 related to the first embodiment, measurement information obtained by the biological information measurement section 100 can be wirelessly transmitted to the biological information output section 200 without using a communication cable between the biological information measurement section 100 and the biological information output section 200. Consequently, when a medical worker performs measurement of biological information on a subject such as a patient, the medical worker can easily perform smooth medical practice.

[0080] In the biological information measurement section 100 related to the second embodiment, since the light detection unit A and the wireless transmission unit B are separate from each other, when a medical worker performs measurement of biological information on a subject such as a patient, for example, continuously for a long period of time such as sleeping, a weight is applied to the head of the subject such as a patient by only the light detection unit A, and the wireless transmission unit B is placed beside the subject such as a patient, so that a burden placed on the head of the subject such as a patient during continuous measurement for a long period of time such as sleeping can be reduced.

(Details of Biological Information Measurement System including Biological Information Measurement Section and Biological Information Output Section)

[0081] A configuration of the light emitting portion 11 is not particularly limited as long as the light emitting portion can irradiate the head of a subject such as a patient with near-infrared light in a near-infrared region, and may be a configuration in which, for example, light emitting elements such as light emitting diodes (LEDs) are provided on element boards (not illustrated), and the element boards are respectively installed at installation positions o1 (left) and o2 (right) illustrated in Fig. 3.

[0082] In the present invention, a method of irradiating the head of a subject with near-infrared light is not particularly limited, but irradiation (lighting) is preferably performed in a predetermined order by using near-infrared light beams respectively having three different wavelengths (a first wavelength λ_1 (770 nm $\pm$ 20 nm), a second wavelength λ_2 (805 nm $\pm$ 20 nm), and a third wavelength λ_3 (870 nm $\pm$ 20 nm)).

[0083] Here, the first wavelength λ_1 (770 nm $\pm$ 20 nm) and the third wavelength λ_3 (870 nm $\pm$ 20 nm) are irradiation wavelengths used to calculate rSO_2 (oxygen saturation).

[0084] On the other hand, the second wavelength λ_2 (805 nm $\pm$ 20 nm) is an irradiation wavelength used to calculate a hemoglobin index (HbI).

[0085] Here, rSO_2 (oxygen saturation) is preferably calculated by using two wavelengths (the first wavelength λ_1 and the third wavelength λ_3), but may be calculated by using only either one (the first wavelength λ_1 or the third wavelength λ_3) of the wavelengths.

[0086] Fig. 4 is a diagram illustrating the order of applying near-infrared light beams respectively having different wavelengths (the first wavelength λ_1, the second wavelength λ_2, and the third wavelength λ_3) eight times every cycle in a time series.

[0087] Fig. 5 is a diagram illustrating the order of applying near-infrared light beams respectively having different wavelengths (the first wavelength λ_1, the second wavelength λ_2, and the third wavelength λ_3) six times every cycle in a time series.

[0088] In the present invention, the number of times of irradiation performed in one cycle is not particularly limited, but a case where the number of times of irradiation is eight is more preferable than a case where the number of times of irradiation is six from the viewpoint of obtaining data with high reliability.

[0089] As illustrated in Fig. 4, in a case where the number of times of irradiation is eight, irradiation using three different wavelengths (the first wavelength λ_1, the second wavelength λ_2, and the third wavelength λ_3) is performed eight times in a predetermined order in a first cycle, and is performed eight times in a second cycle and the subsequent cycles in the same order as the order in the first cycle. This irradiation repeatedly performed until an eighth cycle is regarded as one set, and irradiation is preferably performed for one or more sets.

[0090] The order of eight times of irradiation performed in the first cycle is the order of "A→B→C→D→E→F→G→H" as follows (first aspect).

<First aspect of order of eight times of irradiation>

[0091]

A: o1 (left) first wavelength λ_1 (770 nm $\pm$ 20 nm)
B: o1 (left) second wavelength λ_2 (805 nm $\pm$ 20 nm)
C: o1 (left) third wavelength λ_3 (870 nm $\pm$ 20 nm)
D: o2 (right) second wavelength λ_2 (805 nm $\pm$ 20 nm)
E: o2 (right) first wavelength λ_1 (770 nm $\pm$ 20 nm)
F: o1 (left) second wavelength λ_2 (805 nm $\pm$ 20 nm)
G: o2 (right) third wavelength λ_3 (870 nm $\pm$ 20 nm)
H: o2 (right) second wavelength λ_2 (805 nm $\pm$ 20 nm)

[0092] Here, since both of the first wavelength λ_1 (770 nm $\pm$ 20 nm) and the third wavelength λ_3 (870 nm $\pm$ 20 nm) are irradiation wavelengths used to calculate rSO_2 (oxygen saturation), irradiation may be performed in the following order by replacing the orders of the first wavelength λ_1 (770 nm $\pm$ 20 nm) and the third wavelength λ_3 (870 nm $\pm$ 20 nm) with each other (second aspect).

<Second aspect of order of eight times of irradiation>

[0093]

A: o1 (left) third wavelength λ_3 (870 nm $\pm$ 20 nm)
B: o1 (left) second wavelength λ_2 (805 nm $\pm$ 20 nm)
C: o1 (left) first wavelength λ_1 (770 nm $\pm$ 20 nm)
D: o2 (right) second wavelength λ_2 (805 nm $\pm$ 20 nm)
E: o2 (right) third wavelength λ_3 (870 nm $\pm$ 20 nm)
F: o1 (left) second wavelength λ_2 (805 nm $\pm$ 20 nm)
G: o2 (right) first wavelength λ_1 (770 nm $\pm$ 20 nm)
H: o2 (right) second wavelength λ_2 (805 nm $\pm$ 20 nm)

[0094] In the first and second aspects of the order of eight times of irradiation, the first irradiation is started from "A", but irradiation may be started from any one of "B" to "H". In a case where irradiation is started from orders other than "A", irradiation is performed according to "A" following "H".

[0095] For example, in a case where the first irradiation is started from "C", eight times of irradiation is performed in the order of "C$\rightarrow$D$\rightarrow$E$\rightarrow$F$\rightarrow$G$\rightarrow$H$\rightarrow$A$\rightarrow$B".

[0096] As described above, in a case where irradiation is performed eight times every cycle, irradiation from the first cycle to the eighth cycle, that is, a total of 64 times of irradiation is regarded as one set, and irradiation is preferably performed for one or more sets. At least one set of irradiation (64 times of irradiation in eight cycles) is preferably performed within one second.

[0097] For example, four sets of irradiation (256 times of irradiation in 32 cycles) may be performed within one second.

[0098] The irradiation time of one second for which at least one set of irradiation is performed also includes an irradiation standby time, and the time required for one time of irradiation using each of three different wavelengths (the first wavelength λ_1, the second wavelength λ_2, and the third wavelength λ_3) is actually about 90 to 180 μsec.

[0099] In the present invention, a case of eight times of irradiation performed in one cycle is preferable from the viewpoint of obtaining data with reliability, but a case of six times of irradiation may be employed.

[0100] As illustrated in Fig. 5, in a case where the number of times of irradiation is eight, irradiation using three different wavelengths (the first wavelength λ_1, the second wavelength λ_2, and the third wavelength λ_3) is performed six times in a predetermined order in a first cycle, and is performed eight times in a second cycle and the subsequent cycles in the same order as the order in the first cycle. This irradiation repeatedly performed until an eighth cycle is regarded as one set, and irradiation is preferably performed for one or more sets.

[0101] The order of six times of irradiation performed in the first cycle is the order of "A$\rightarrow$B$\rightarrow$C$\rightarrow$D$\rightarrow$E$\rightarrow$F" as follows.

<Order of six times of irradiation>

[0102]

A: o1 (left) first wavelength λ_1 (770 nm $\pm$ 20 nm)

B: o2 (right) second wavelength λ_2 (805 nm $\pm$ 20 nm)
C: o1 (left) third wavelength λ_3 (870 nm $\pm$ 20 nm)
D: o2 (right) first wavelength λ_1 (770 nm $\pm$ 20 nm)
E: o1 (left) second wavelength λ_2 (805 nm $\pm$ 20 nm)
F: o2 (right) third wavelength λ_3 (870 nm $\pm$ 20 nm)

[0103] Here, the second wavelength λ_2 (805 nm $\pm$ 20 nm) is an irradiation wavelength used to calculate a hemoglobin index (HbI), and irradiation using the wavelength is performed twice for each of the left and right in the case of eight times of irradiation illustrated in Fig. 4, but irradiation may be performed once for each of the left and right in the case of six times of irradiation illustrated in Fig. 5.

[0104] In the order of six times of irradiation, the first irradiation is started from "A", but irradiation may be started from any one of "B" to "F". In a case where irradiation is started from orders other than "A", irradiation is performed according to "A" following "F".

[0105] For example, in a case where the first irradiation is started from "C", six times of irradiation is performed in the order of "C→D→E→F→A→B".

[0106] As described above, in a case where irradiation is performed six times every cycle, irradiation from the first cycle to the eighth cycle, that is, a total of 48 times of irradiation is regarded as one set, and irradiation is preferably performed for one or more sets. At least one set of irradiation (48 times of irradiation in eight cycles) is preferably performed within one second.

[0107] For example, four sets of irradiation (144 times of irradiation in 24 cycles) may be performed within one second.

[0108] The irradiation time of one second for which at least one set of irradiation is performed also includes an irradiation standby time, and the time required for one time of irradiation using each of three different wavelengths (the first wavelength λ_1, the second wavelength λ_2, and the third wavelength λ_3) is actually about 90 to 180 μsec.

[0109] A configuration of the light receiving portion 12 is not particularly limited as long as the light receiving portion can receive light as a result of near-infrared light applied from the light emitting portion 11 propagating inside the head of a subject, and may be a configuration in which, for example, light receiving elements such as photodiodes (PDs) are provided on element boards (not illustrated), and the element boards are respectively installed at installation positions p1 (left) and p2 (right) illustrated in Fig. 3.

[0110] Here, the "light propagating inside the head of a subject" indicates light (transmitted light) as a result of near-infrared light irradiated from the light emitting portion 11 transmitted without being absorbed inside the head.

[0111] The light receiving portion 12 may be appropriately designed so as to receive light in synchronization with an irradiation timing of near-infrared light and to receive light (transmitted light) which is not absorbed inside the head and is transmitted without missing the light.

[0112] As described above, also in a case where the light emitting portion 11 performs irradiation (lighting) with near-infrared light beams respectively having three different wavelengths (the first wavelength λ_1 (770 nm $\pm$ 20 nm), the second wavelength λ_2 (805 nm $\pm$ 20 nm), and the third wavelength λ_3 (870 nm $\pm$ 20 nm)) in a predetermined order, the light receiving portion 12 can receive light beams as a result of the near-infrared light beams respectively having the three different wavelengths (the first wavelength λ_1 (770 nm $\pm$ 20 nm), the second wavelength λ_2 (805 nm $\pm$ 20 nm), and the third wavelength λ_3 (870 nm $\pm$ 20 nm)) applied from the light emitting portion 11 in the predetermined order propagating inside the head of a subject.

[0113] A configuration of the light detection portion 13 is not particularly limited as long as the light detection portion can detect the intensity of light received by the light receiving portion 12, and may be a configuration in which, for example, a light detector which detects the intensity of light detected by the light receiving portion 12, that is, the intensity (intensity of transmitted light) of light transmitted inside the head of a subject is provided on a board (not illustrated), and the board is installed at an installation position q illustrated in Fig. 3.

[0114] As described above, also in a case where the light receiving portion 12 receives light beams as a result of near-infrared light beams respectively having three different wavelengths (the first wavelength λ_1 (770 nm $\pm$ 20 nm), the second wavelength λ_2 (805 nm $\pm$ 20 nm), and the third wavelength λ_3 (870 nm $\pm$ 20 nm)) propagating inside the head of a subject, the light detection portion 13, the light detection portion 13 can detect the intensities of the respective light beams received from the light receiving portion 12, that is, the intensities (intensity of transmitted light) of light beams transmitted inside the head of the subject.

[0115] A configuration of the wireless transmission portion 14 is not particularly limited as long as the wireless transmission portion can wirelessly transmit information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity detected by the light detection portion 13, and a device which can perform wireless transmission may be provided in the wireless transmission unit B of the biological information measurement section 100, and a Bluetooth (registered trademark) method may be employed.

[0116] Here, the "information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin" may be information regarding a detection result of the light intensity (intensity of transmitted light) detected by the light detection portion 13, or may be information regarding a result obtained by converting the information regarding a detection result of the light intensity (intensity of transmitted light) detected by the light detection portion 13 into the concentration or the amount of hemoglobin.

[0117] In the present invention, the biological information measurement section 100 may include a calculation portion. A configuration of the calculation portion is not limited as long as the calculation portion can perform a calculation process on information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity detected by the light detection portion 13.

[0118] For example, the calculation portion performs a calculation process so as to convert information regarding a detection result of the light intensity (intensity of transmitted light) detected by the light detection portion 13 into information regarding the concentration or the amount of hemoglobin. Alternatively, the calculation portion performs a calculation process so as to generate information regarding a detection result of the light intensity (intensity of transmitted light) detected by the light detection portion 13 as numerical values or images.

[0119] In the present invention, since the biological information measurement section 100 includes the calculation portion, an amount of information wirelessly transmitted by the wireless transmission portion 14 or an amount of information received by the reception portion 15 can be reduced, and thus a burden placed on the wireless transmission portion 14 and the reception portion 15 can be reduced so that the time required for wireless transmission and wireless reception can be reduced.

[0120] In the present invention, the biological information measurement section 100 may include a display portion. A configuration of the display portion is not limited as long as the display portion can perform display of display information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity detected by the light detection portion 13, and, for example, the biological information measurement section 100 may be provided with a monitor or the like.

[0121] For example, the display portion displays display information based on the information regarding a detection result of the light intensity (intensity of transmitted light) detected by the light detection portion 13 on a monitor or the like. Alternatively, the display portion displays display information based on information regarding a result of a calculation process in the calculation portion in order to convert information regarding a detection result of the light intensity (intensity of transmitted light) detected by the light detection portion 13 into information regarding the concentration or the amount of hemoglobin. Alternatively, the display portion displays display information based on information regarding a result of a calculation process in the calculation portion in order to generate information regarding a detection result of the light intensity (intensity of transmitted light) detected by the light detection portion 13 as numerical values or images.

[0122] In the present invention, since the biological information measurement section 100 includes the display portion, when a medical worker performs other medical practice while measuring biological information of a subject such as a patient, the medical worker can accurately perform other medical practice while checking a change (a change in a blood flow) in an amount of blood flowing inside the head of the subject in real time by using not only the biological information output section 200 but also the biological information measurement section 100.

[0123] A configuration of the reception portion 15 is not particularly limited as long as the reception portion can wirelessly receive information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based the light intensity, wirelessly transmitted from the wireless transmission portion 14 of the biological information measurement section 100, and, for example, a device which can perform wireless reception may be provided in the biological information output section 200, and a Bluetooth (registered trademark) method may be employed.

[0124] A configuration of the output portion 16 is not particularly limited as long as the output portion can perform outputting of output information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, received by the reception portion 15, and the output portion outputs the output information based on information regarding a detection result of the light intensity (intensity of transmitted light), received by the reception portion 15, visually with a monitor or the like, or auditorily with a speaker, or the like.

[0125] Here, an example of the monitor may include a small-sized and lightweight communication apparatus such as a smart phone. An aspect may also be realized in which output information which is output from the small-sized and lightweight communication apparatus may be transmitted to other communication apparatuses.

[0126] In the present invention, the biological information output section 200 may also include a calculation portion in the same manner as the above-described biological information measurement section 100. A configuration of the calculation portion is not limited as long as the calculation portion can perform a calculation process on information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, received by the reception portion 15.

[0127] For example, the calculation portion performs a calculation process so as to convert information regarding a detection result of the light intensity (intensity of transmitted light), received by the reception portion 15, into information regarding the concentration or the amount of hemoglobin. Alternatively, the calculation portion performs a calculation process so as to generate information regarding a detection result of the light intensity (intensity of transmitted light), received by the reception portion 15, as numerical values or images.

[0128] In the present invention, since the biological information output section 200 includes the calculation portion, the biological information output section 200 performs a calculation process on information regarding a detection result of the light intensity (intensity of transmitted light), received by the reception portion 15, and thus the biological information measurement section 100 is made to have a calculation process function, or the calculation process function of the biological information measurement section 100 can be restricted. Therefore, the biological information measurement section 100 can be designed to be small-sized and lightweight.

[0129] In the present invention, the biological information output section 200 may also include a display portion in the same manner as the biological information measurement section 100. A configuration of the display portion is not limited as long as the display portion can perform display of display information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, received by the reception portion 15, and, for example, the biological information output section 200 may be provided with a monitor or the like.

[0130] For example, the display portion displays display information based on the information regarding a detection result of the light intensity (intensity of transmitted light), received by the reception portion 15, on a monitor or the like. Alternatively, the display portion displays display information based on information regarding a result of a calculation process in the calculation portion in order to convert information regarding a detection result of the light intensity (intensity of transmitted light), received by the reception portion 15, into information regarding the concentration or the amount of hemoglobin. Alternatively, the display portion displays display information based on information regarding a result of a calculation process in the calculation portion in order to convert information regarding a detection result of the light intensity (intensity of transmitted light), received by the reception portion 15, as numerical values or images.

[0131] In the present invention, since the biological information output section 200 includes the display portion, when a medical worker performs other medical practice while measuring biological information of a subject such as a patient, the medical worker can accurately perform other medical practice while checking a change (a change in a blood flow) in an amount of blood flowing inside the head of the subject in real time by using the display portion provided in the biological information output section 200.

[0132] In the present invention, the biological information output section 200 may include a determination portion. The determination portion may determine whether or not there is a change in information regarding a change in a blood flow, that is, a blood flow changes on the basis of the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity.

[0133] In the present invention, according to a method of determining whether or not a blood flow changes, in a light emitting portion on o1 (left) and a light receiving portion on Pl (left) forming a pair, and a light emitting portion on o2 (right) and a light receiving portion on P2 (right) forming a pair, light beams having respective wavelengths (the first wavelength λ_1, the second wavelength λ_2, or the third wavelength λ_3) are applied from the light emitting portions on o1 (left) and o2 (right) in a predetermined order, and the light detection portion detects the intensities (intensity of transmitted light) of light beams respectively received by the light receiving portions on p1 (left) and p2 (right).

[0134] In respective pieces of data detected by the light detection portion in each cycle, in a case where differences between pieces of data are all laid in the same direction (for example, all in an increase direction) through comparison between adjacent cycles (for example, a first cycle and a second cycle), whereas differences between pieces of data are all laid in an opposite direction (for example, all in a decrease direction) through comparison between other adjacent cycles (for example, a third cycle and a fourth cycle), it may be determined that a blood flow changes.

[0135] Specifically, according to <Method of determining whether or not blood flow changes> described below, in a case where (i) the light emitting portion on o1 (left) applies light beams having respective wavelengths (the first wavelength λ_1, the second wavelength λ_2, and the third wavelength λ_3), and pieces of data obtained by the light detection portion detecting the intensities of light beams received by the light receiving portion on p1 (left) satisfy all of tendencies of the following (1) to (3), and (ii) the light emitting portion on o2 (right) applies light beams having respective wavelengths (the first wavelength λ_1, the second wavelength λ_2, and the third wavelength λ_3), and pieces of data obtained by the light detection portion detecting the intensities (intensity of transmitted light) of light beams received by the light receiving portion on p2 (right) satisfy all of tendencies of the following (4) to (6), it may be determined that a blood flow changes.

[0136] Conversely, if at least one of a total of six tendencies of (i) the following (1) to (3) and the following (4) to (6) is not satisfied, it may be determined that a blood flow does not change.

<Method of determining whether or not blood flow changes>

(i) o1 (left)

[0137]

(1) In pieces of data obtained by applying light having the first wavelength λ_1 and the light detection portion detecting the intensity (intensity of transmitted light) of light received by the light receiving portion on p1 (left) in each cycle, a difference between pieces of data based on comparison between the first cycle and the second cycle increases, whereas a difference between pieces of data based on comparison between the third cycle and the fourth cycle decreases. (2) In pieces of data obtained by applying light having the second wavelength λ_2 and the light detection portion detecting the intensity (intensity of transmitted light) of light received by the light receiving portion on p1 (left) in each cycle, a difference between pieces of data based on comparison between the first cycle and the second cycle increases, whereas a difference between pieces of data based on comparison between the third cycle and the fourth cycle decreases. (3) In pieces of data obtained by applying light having the third wavelength λ_3 and the light detection portion detecting the intensity (intensity of transmitted light) of light received by the light receiving portion on p1 (left) in each cycle, a difference between pieces of data based on comparison between the first cycle and the second cycle increases, whereas a difference between pieces of data based on comparison between the third cycle and the fourth cycle decreases. (ii) o2 (right)

(4) In pieces of data obtained by applying light having the first wavelength λ_1 and the light detection portion detecting the intensity (intensity of transmitted light) of light received by the light receiving portion on p1 (left) in each cycle, a difference between pieces of data based on comparison between the first cycle and the second cycle increases, whereas a difference between pieces of data based on comparison between the third cycle and the fourth cycle decreases. (5) In pieces of data obtained by applying light having the second wavelength λ_2 and the light detection portion detecting the intensity (intensity of transmitted light) of light received by the light receiving portion on p1 (left) in each cycle, a difference between pieces of data based on comparison between the first cycle and the second cycle increases, whereas a difference between pieces of data based on comparison between the third cycle and the fourth cycle decreases. (6) In pieces of data obtained by applying light having the third wavelength λ_3 and the light detection portion detecting the intensity (intensity of transmitted light) of light received by the light receiving portion on p1 (left) in each cycle, a difference between pieces of data based on comparison between the first cycle and the second cycle increases, whereas a difference between pieces of data based on comparison between the third cycle and the fourth cycle decreases.

[0138] In the above <Method of determining whether or not blood flow changes>, the first cycle and the second cycle are used as examples of adjacent cycles, the third cycle and the fourth cycle are used as examples other adjacent cycles, but these are only examples.

[0139] As described above, in the present invention, it is possible to obtain data with high reliability by performing irradiation (lighting) in a predetermined order by using near-infrared light beams respectively having three different wavelengths (the first wavelength λ_1 (770 nm $\pm$ 20 nm), the second wavelength λ_2 (805 nm $\pm$ 20 nm), and the third wavelength λ_3 (870 nm $\pm$ 20 nm)).

[0140] It is possible to accurately determine whether or not there is a change in a blood flow according to the above-described method of determining whether or not a blood flow changes on the basis of the data with high reliability.

[0141] Thus, according to the present invention, even if a subject' body is shaken due to pressing of the sternum of the subject, it is possible to accurately determine even a minute change in a blood flow without being influenced much by the shaking on the basis of the data with high reliability.

[0142] The determination portion monitors information regarding a change in a blood flow based on information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, received by the reception portion 15, over time, and determines whether or not a rate of the change in a blood flow exceeds a predetermined reference value in a case where there is a change in the information regarding a change in a blood flow according to a timing of chest compressions of a subject.

[0143] Here, the "information regarding a change in a blood flow based on information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity" may be, for example, (1) output information based on information regarding a detection result of the light intensity (intensity of transmitted light), (2) output information based on information regarding a result of a calculation process performed in the calculation portion in order to convert information regarding a detection result of the light intensity (intensity of transmitted light) into information regarding the concentration or the amount of hemoglobin, and (3) output information based on information regarding a result of a calculation process in the calculation portion performed in order to generate information regarding a detection result of the light intensity (intensity of transmitted light) as numerical values or images.

[0144] The above-described determination portion has been described to be included in the biological information output section 200, but a determination portion may also be included in the biological information measurement section 100.

[0145] In a case where the determination portion determines that information regarding a change in a blood flow based on information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, received by the reception portion 15, exceeds the predetermined reference value, the biological information output section 200 outputs output information based on notification information for notifying the outside (for example, a medical worker) of the fact to a monitor, a speaker, or the like. Consequently, the medical worker can accurately perform medical practice on the basis of the notification information output from the biological information output section 200.

[0146] In a case where the determination portion determines that information regarding a change in a blood flow exceeds a predetermined reference value, the biological information output section 200 notifies the outside of the fact, and, similarly, in a case where the determination portion determines that information regarding a change in a blood flow exceeds a predetermined reference value, the biological information measurement section 100 may notify the outside of the fact.

(Process Performed by Biological Information Measurement System 300)

[0147] Fig. 9 is a flowchart illustrating an example of a process performed by the biological information measurement system 300 including the biological information measurement section 100 and the biological information output section 200. Fig. 9 is a flowchart corresponding to the block diagram in Fig. 2.

[0148] In the following description, "step" in a parenthesis indicates each step executed by the biological information measurement section 100 and the biological information output section 200.

[0149] A process performed by the biological information measurement system 300 is realized through respective steps exemplified in Fig. 9.

[0150] The head of a subject is irradiated with near-infrared light (step 1 (S1); hereinafter, a "step" is abbreviated to "S"; a light emission step), and the head of the subject is irradiated with near-infrared light from the lighting step (S2; light reception step).

[0151] The intensity of light received in the light reception step is detected (S3; light detection step), and information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity detected in the light detection step is wirelessly transmitted (S4; wireless transmission step).

[0152] Next, the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, wirelessly transmitted from the wireless transmission step, is received (S5; reception step), and output information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, received in the reception step, is output (S6; output step).

Claims

1. A biological information measurement system (300) applied to a subject requiring cardiopulmonary resuscitation, comprising:

    a biological information measurement section (100); and
    a biological information output section (200),
    wherein the biological information measurement section (100) includes
    a light emitting portion (11) that irradiates the head of the subject with near-infrared light,
    a light receiving portion (12) that receives light as a result of the near-infrared light applied from the light emitting portion (11) propagating inside the head of the subj ect,
    a light detection portion (13) that detects the intensity of the light received by the light receiving portion (12), and
    a wireless transmission portion (14) that wirelessly transmits information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity detected by the light detection portion (13), and
    wherein the biological information output section (200) includes
    a reception portion (15) that receives the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, wirelessly transmitted from the wireless transmission portion (14) of the biological information measurement section (100), and
    a determination portion that monitors information regarding a change in a blood flow based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity, received by the reception portion (15), over time, and determines whether or not a rate of the change in a blood flow exceeds a predetermined reference value in a case where there is a change in the information regarding a change in a blood flow according to a timing of chest compressions

of the subject,
wherein, in the biological information measurement section (100), a light detection unit (A) including the light emitting portion (11), the light receiving portion (12), and the light detection portion (13) has a first terminal (x), and a wireless transmission unit (B) including the wireless transmission portion (14) has a second terminal (y),
wherein the light emitting portion (11) and the light receiving portion (12) include a first light emitting portion (o1) and a first light receiving portion (p1) for performing measurement, provided on the left of the first terminal (x) as a pair, and a second light emitting portion (o2) and a second light receiving portion (p2) for performing measurement, provided on the right of the first terminal (x) as a pair,
wherein an order of eight times of irradiation performed every cycle by using near-infrared light having three different wavelengths is any one of the following orders of

$$A \to B \to C \to D \to E \to F \to G \to H,$$

$$B \to C \to D \to E \to F \to G \to H \to A,$$

$$C \to D \to E \to F \to G \to H \to A \to B,$$

$$D \to E \to F \to G \to H \to A \to B \to C,$$

$$E \to F \to G \to H \to A \to B \to C \to D,$$

$$F \to G \to H \to A \to B \to C \to D \to E,$$

$$G \to H \to A \to B \to C \to D \to E \to F,$$

and

$$H \to A \to B \to C \to D \to E \to F \to G$$

with:

A: first light emitting portion (o1) at first wavelength $\lambda 1$ (770 nm $\pm$ 20 nm)
B: first light emitting portion (o1) at second wavelength $\lambda 2$ (805 nm $\pm$ 20 nm)
C: first light emitting portion (o1) at third wavelength $\lambda 3$ (870 nm $\pm$ 20 nm)
D: second light emitting portion (o2) at second wavelength $\lambda 2$ (805 nm $\pm$ 20 nm)
E: second light emitting portion (o2) at first wavelength $\lambda 1$ (770 nm $\pm$ 20 nm)
F: first light emitting portion (o1) at second wavelength $\lambda 2$ (805 nm $\pm$ 20 nm)
G: second light emitting portion (o2) at third wavelength $\lambda 3$ (870 nm $\pm$ 20 nm)
H: second light emitting portion (o2) at second wavelength $\lambda 2$ (805 nm $\pm$ 20 nm).

2. The biological information measurement system according to claim 1,
wherein the first terminal (x) and the second terminal (y) are directly connected to each other in an attachable and detachable manner.

3. The biological information measurement system according to claim 1,
wherein the first terminal (x) and the second terminal (y) are connected to each other via a wire.

4. The biological information measurement system according to any one of claims 1 to 3,
wherein the biological information measurement section (100) further includes
a display portion that displays display information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, detected by the light detection portion (13).

5. The biological information measurement system according to any one of claims 1 to 4,
wherein the biological information output section (200) further includes
a display portion that displays display information based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, received by the reception portion (15).

6. The biological information measurement system according to any one of claims 1 to 5, wherein the biological information measurement section (100) further includes a calculation portion that performs a calculation process on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, detected by the light detection portion (13).

7. The biological information measurement system according to any one of claims 1 to 6, wherein the biological information output section (200) further includes a calculation portion that performs a calculation process on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, received by the reception portion (15).

8. The biological information measurement system according to any one of claims 1 to 7, wherein, in a case where the determination portion determines that the predetermined reference value is exceeded, the biological information output section (200) outputs output information based on notification information for notifying the outside that the predetermined reference value is exceeded.

9. The biological information measurement system according to any one of claims 1 to 8, wherein the orders of A: first light emitting portion (o1) at first wavelength $\lambda 1$ (770 nm $\pm$ 20 nm) and C: first light emitting portion (o1) at third wavelength $\lambda 3$ (870 nm $\pm$ 20 nm) are replaced with each other, or the orders of E: second light emitting portion (o2) at first wavelength $\lambda 1$ (770 nm $\pm$ 20 nm) and G: second light emitting portion (o2) at third wavelength $\lambda 3$ (870 nm $\pm$ 20 nm) are replaced with each other.

10. The biological information measurement system according to any one of claims 1 to 9, wherein, in a case where irradiation is performed eight times every cycle, irradiation from a first cycle to an eighth cycle is regarded as one set, one or more sets of irradiation is performed, and at least one set of irradiation is performed within one second.

11. The biological information measurement system according to any one of claims 1 to 10, wherein light beams having the three different wavelengths are applied from the first and second light emitting portions (o1, o2) in the irradiation order, and the light detection portion detects the intensities of light beams received by the first and second light receiving portions (p1, p2) in each cycle, and
wherein, in respective pieces of data detected by the light detection portion in each cycle, in a case where differences between pieces of data are all laid in the same direction through comparison between adjacent cycles, whereas differences between pieces of data are all laid in an opposite direction through comparison between other adjacent cycles, the determination portion determines that there is a change in a blood flow.

12. An operation method of a biological information measurement system (300) applied to a subject requiring cardiopulmonary resuscitation, comprising:

a biological information measurement step executed in a biological information measurement section (100); and
a biological information output step executed in a biological information output section (200),
wherein the biological information measurement step includes
a light emission step of emitting near-infrared light by a light emitting portion (11),
a light reception step of receiving light by a light receiving portion (12) as a result of the near-infrared light applied in the light emission step propagating inside the head of the subject,
a light detection step of detecting the intensity of the light received in the light reception step, and
a wireless transmission step of wirelessly transmitting information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin in blood based on the light intensity detected in the light detection step, and
wherein the biological information output step includes
a reception step of receiving the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, wirelessly transmitted in the wireless transmission step of the biological information measurement step, and
a determination step of causing the biological information output section (200) to monitor information regarding a change in a blood flow based on the information for specifying a change corresponding to an increase or a decrease in the concentration or the amount of hemoglobin, received in the reception step, over time, and to determine whether or not a rate of the change in a blood flow exceeds a predetermined reference value in a case where there is a change in the information regarding a change in a blood flow according to a timing of

chest compressions of the subject,
wherein, in the biological information measurement section (100), a light detection unit (A) including the light emitting portion (11), the light receiving portion (12), and the light detection portion (13) has a first terminal (x), and a wireless transmission unit (B) including the wireless transmission portion (14) has a second terminal (y),
wherein the light emitting portion (11) and the light receiving portion (12) include a first light emitting portion (o1) and a first light receiving portion (p1) for performing measurement, provided on the left of the first terminal (x) as a pair, and a second light emitting portion (o2) and a second light receiving portion (p2) for performing measurement, provided on the right of the first terminal (x) as a pair,
wherein an order of eight times of irradiation performed every cycle by using near-infrared light having three different wavelengths is any one of the following orders of

$$A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F \rightarrow G \rightarrow H,$$

$$B \rightarrow C \rightarrow D \rightarrow E \rightarrow F \rightarrow G \rightarrow H \rightarrow A,$$

$$C \rightarrow D \rightarrow E \rightarrow F \rightarrow G \rightarrow H \rightarrow A \rightarrow B,$$

$$D \rightarrow E \rightarrow F \rightarrow G \rightarrow H \rightarrow A \rightarrow B \rightarrow C,$$

$$E \rightarrow F \rightarrow G \rightarrow H \rightarrow A \rightarrow B \rightarrow C \rightarrow D,$$

$$F \rightarrow G \rightarrow H \rightarrow A \rightarrow B \rightarrow C \rightarrow D \rightarrow E,$$

$$G \rightarrow H \rightarrow A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F,$$

and

$$H \rightarrow A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F \rightarrow G$$

with:

A: first light emitting portion (o1) at first wavelength $\lambda 1$ (770 nm $\pm$ 20 nm)
B: first light emitting portion (o1) at second wavelength $\lambda 2$ (805 nm $\pm$ 20 nm)
C: first light emitting portion (o1) at third wavelength $\lambda 3$ (870 nm $\pm$ 20 nm)
D: second light emitting portion (o2) at second wavelength $\lambda 2$ (805 nm $\pm$ 20 nm)
E: second light emitting portion (o2) at first wavelength $\lambda 1$ (770 nm $\pm$ 20 nm)
F: first light emitting portion (o1) at second wavelength $\lambda 2$ (805 nm $\pm$ 20 nm)
G: second light emitting portion (o2) at third wavelength $\lambda 3$ (870 nm $\pm$ 20 nm)
H: second light emitting portion (o2) at second wavelength $\lambda 2$ (805 nm $\pm$ 20 nm).

Patentansprüche

1. Biologisches Informationsmesssystem (300), das auf einen Probanden angewandt wird, der eine kardiopulmonale Reanimation benötigt, umfassend:

einen biologischen Informationsmessteil (100); und
einen biologischen Informationsausgabeteil (200),
wobei der biologische Informationsmessteil (100)
einen lichtemittierenden Abschnitt (11) beinhaltet, der den Kopf des Probanden mit nahinfrarotem Licht bestrahlt,
einen lichtempfangenden Abschnitt (12) beinhaltet, der Licht als Folge des nahinfraroten Lichts empfängt, das von dem lichtemittierenden Abschnitt (11) angelegt wird, das sich innerhalb des Kopfes des Probanden ausbreitet,
einen lichterfassenden Abschnitt (13) beinhaltet, der die Intensität des von dem lichtempfangenden Abschnitt (12) empfangenen Lichts erfasst, und
einen drahtlosen übertragenden Abschnitt (14) beinhaltet, der eine Information zur Angabe einer Änderung überträgt, die einer Erhöhung oder einer Abnahme der Konzentration oder der Menge an Hämoglobin im Blut entspricht, basierend auf der von dem lichterfassenden Abschnitt (13) erfassten Lichtintensität, und

wobei der biologische Informationsausgabeteil (200)
einen empfangenden Abschnitt (15) beinhaltet, der die Information zur Angabe einer Änderung empfängt, die einer Erhöhung oder einer Abnahme der Konzentration oder der Menge an Hämoglobin entspricht, die drahtlos von dem drahtlosen übertragenden Abschnitt (14) des biologischen Informationsmessteils (100) übertragen wird, und
einen bestimmenden Abschnitt beinhaltet, der eine Information über eine Änderung eines Blutflusses überwacht, basierend auf der Information zur Angabe einer Änderung, die einer Erhöhung oder einer Abnahme der Konzentration oder der Menge an Hämoglobin im Blut entspricht, basierend auf der Lichtintensität, die vom dem empfangenden Abschnitt (15) über die Zeit empfangen wird, und bestimmt, ob eine Änderungsrate eines Blutflusses einen vorbestimmten Referenzwert überschreitet oder nicht, in einem Fall, in dem eine Änderung der Information bezüglich einer Änderung eines Blutflusses gemäß einem Zeitpunkt der Brustkompressionen des Probanden vorliegt,
wobei in dem biologischen Informationsmessteil (100) eine Lichtdetektionseinheit (A), die den lichtemittierenden Abschnitt (11), den lichtempfangenden Abschnitt (12) und den lichterfassenden Abschnitt (13) beinhaltet, einen ersten Anschluss (x) aufweist, und eine drahtlose Übertragungseinheit (B), die den drahtlosen übertragenden Abschnitt (14) beinhaltet, einen zweiten Anschluss (y) aufweist,
wobei der lichtemittierende Abschnitt (11) und der lichtempfangenden Abschnitt (12) einen ersten lichtemittierenden Abschnitt (o1) und einen ersten lichtempfangenden Abschnitt (p1) zum Durchführen einer Messung beinhalten, der links von dem ersten Anschluss (x) als Paar vorgesehen ist, und einen zweiten lichtemittierenden Abschnitt (o2) und einen zweiten lichtempfangenden Abschnitt (p2) zum Durchführen einer Messung beinhalten, der rechts von dem ersten Anschluss (x) als Paar vorgesehen ist,
wobei eine achtmalige Bestrahlungsreihenfolge, die in jedem Zyklus unter Verwendung von nahinfrarotem Licht mit drei verschiedenen Wellenlängen durchgeführt wird, eine der folgenden Reihenfolgen ist:

$$A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F \rightarrow G \rightarrow H,$$

$$B \rightarrow C \rightarrow D \rightarrow E \rightarrow F \rightarrow G \rightarrow H \rightarrow A,$$

$$C \rightarrow D \rightarrow E \rightarrow F \rightarrow G \rightarrow H \rightarrow A \rightarrow B,$$

$$D \rightarrow E \rightarrow F \rightarrow G \rightarrow H \rightarrow A \rightarrow B \rightarrow C,$$

$$E \rightarrow F \rightarrow G \rightarrow H \rightarrow A \rightarrow B \rightarrow C \rightarrow D,$$

$$F \rightarrow G \rightarrow H \rightarrow A \rightarrow B \rightarrow C \rightarrow D \rightarrow E,$$

$$G \rightarrow H \rightarrow A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F,$$

und

$$H \rightarrow A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F \rightarrow G$$

mit:

A: erster lichtemittierender Abschnitt (o1) bei erster Wellenlänge $\lambda 1$ (770 nm $\pm$ 20 nm)
B: erster lichtemittierender Abschnitt (o1) bei zweiter Wellenlänge A2 (805 nm $\pm$ 20 nm)
C: erster lichtemittierender Abschnitt (o1) bei dritter Wellenlänge A3 (870 nm $\pm$ 20 nm)
D: zweiter lichtemittierender Abschnitt (o2) bei zweiter Wellenlänge A2 (805 nm $\pm$ 20 nm)
E: zweiter lichtemittierender Abschnitt (o2) bei erster Wellenlänge $\lambda 1$ (770 nm $\pm$ 20 nm)
F: erster lichtemittierender Abschnitt (o1) bei zweiter Wellenlänge A2 (805 nm $\pm$ 20 nm)
G: zweiter lichtemittierender Abschnitt (o2) bei dritter Wellenlänge A3 (870 nm $\pm$ 20 nm)
H: zweiter lichtemittierender Abschnitt (o2) bei zweiter Wellenlänge A2 (805 nm $\pm$ 20 nm).

2. Biologisches Informationsmesssystem nach Anspruch 1,
wobei der erste Anschluss (x) und der zweite Anschluss (y) direkt miteinander in einer befestigbaren und lösbaren Weise verbunden sind.

3. Biologisches Informationsmesssystem nach Anspruch 1, wobei der erste Anschluss (x) und der zweite Anschluss (y) über einen Draht miteinander verbunden sind.

4. Biologisches Informationsmesssystem nach einem der Ansprüche 1 bis 3, wobei der biologische Informationsmessteil (100) weiter einen anzeigenden Abschnitt beinhaltet, der eine Anzeigeinformation basierend auf der Information zur Angabe einer Änderung anzeigt, die einer Erhöhung oder einer Abnahme der Konzentration oder der Menge an Hämoglobin entspricht, die durch den lichterfassenden Abschnitt (13) erfasst wird.

5. Biologisches Informationsmesssystem nach einem der Ansprüche 1 bis 4, wobei der biologische Informationsausgabeteil (200) weiter einen anzeigenden Abschnitt umfasst, der eine Anzeigeinformation basierend auf der Information zur Angabe einer Änderung anzeigt, die einer Erhöhung oder einer Abnahme der Konzentration oder der Menge an Hämoglobin entspricht, die von dem empfangenden Abschnitt (15) empfangen wird.

6. Biologisches Informationsmesssystem nach einem der Ansprüche 1 bis 5, wobei der biologische Informationsmessteil (100) weiter einen berechnenden Abschnitt beinhaltet, der einen Berechnungsprozess an der Information zur Angabe einer Änderung durchführt, die einer Erhöhung oder einer Abnahme der Konzentration oder der Menge an Hämoglobin entspricht, die durch den lichterfassenden Abschnitt (13) erfasst wird.

7. Biologisches Informationsmesssystem nach einem der Ansprüche 1 bis 6, wobei der biologische Informationsausgabeteil (200) weiter einen berechnenden Abschnitt beinhaltet, der einen Berechnungsprozess an der Information zur Angabe einer Änderung durchführt, die einer Erhöhung oder einer Abnahme der Konzentration oder der Menge an Hämoglobin entspricht, die von dem empfangenden Abschnitt (15) empfangen wird.

8. Biologisches Informationsmesssystem nach einem der Ansprüche 1 bis 7, wobei in einem Fall, in dem der bestimmende Abschnitt bestimmt, dass der vorgegebene Referenzwert überschritten ist, der biologische Informationsausgabeteil (200) basierend auf einer Benachrichtigungsinformation eine Ausgabeinformation ausgibt, um der Außenseite mitzuteilen, dass der vorgegebene Referenzwert überschritten ist.

9. Biologisches Informationsmesssystem nach einem der Ansprüche 1 bis 8, wobei die Reihenfolgen von A: erster lichtemittierender Abschnitt (o1) bei erster Wellenlänge $\lambda 1$ (770 nm $\pm$ 20 nm) und C: erster lichtemittierender Abschnitt (o1) bei dritter Wellenlänge A3 (870 nm $\pm$ 20 nm) miteinander ausgetauscht werden, oder die Reihenfolgen von E: zweiter lichtemittierender Abschnitt (o2) bei erster Wellenlänge $\lambda 1$ (770 nm $\pm$ 20 nm) und G: zweiter lichtemittierender Abschnitt (o2) bei dritter Wellenlänge A3 (870 nm $\pm$ 20 nm) miteinander ausgetauscht werden.

10. Biologisches Informationsmesssystem nach einem der Ansprüche 1 bis 9, wobei in einem Fall, in dem die Bestrahlung achtmal pro Zyklus durchgeführt wird, die Bestrahlung von einem ersten Zyklus zu einem achten Zyklus als ein Satz betrachtet wird, ein oder mehrere Sätze der Bestrahlung durchgeführt werden, und mindestens ein Satz der Bestrahlung innerhalb einer Sekunde durchgeführt wird.

11. Biologisches Informationsmesssystem nach einem der Ansprüche 1 bis 10, wobei Lichtstrahlen mit den drei verschiedenen Wellenlängen von den ersten und zweiten lichtemittierenden Abschnitten (o1, o2) in der Bestrahlungsreihenfolge angelegt werden, und der lichterfassenden Abschnitt die Intensitäten der Lichtstrahlen erfasst, die von den ersten und zweiten lichtempfangenden Abschnitten (p1, p2) in jedem Zyklus empfangen werden, und
wobei in jeweiligen Datenstücken, die durch dem lichterfassenden Abschnitt in jedem Zyklus erfasst werden, in einem Fall, in dem Unterschiede zwischen Datenstücken durch Vergleich zwischen benachbarten Zyklen alle in die gleiche Richtung gelegt werden, während Unterschiede durch Vergleich zwischen Datenstücken zwischen anderen benachbarten Zyklen alle in eine entgegengesetzte Richtung gelegt werden, der bestimmende Abschnitt bestimmt, dass es eine Änderung in einem Blutfluss gibt.

12. Betriebsverfahren eines biologischen Informationsmesssystems (300), das auf einen Probanden angewandt wird, der eine kardiopulmonale Reanimation benötigt, umfassend:

einen biologischen Informationsmessschritt, der in einem biologischen Informationsmessteil (100); ausgeführt

wird; und
einen biologischen Informationsausgabeschritt, der in einem biologischen Informationsausgabeteil (200) ausgeführt wird,
wobei der biologischen Informationsmessschritt einen Lichtemissionsschritt zum Emittieren von Nahinfrarotlicht durch einen lichtemittierenden Abschnitt (11) beinhaltet,
einen Lichtempfangsschritt zum Empfangen von Licht durch einen lichtempfangenden Abschnitt (12), als Folge des nahinfraroten Lichts beinhaltet, das im Lichtemissionsschritt angelegt wird, das sich innerhalb des Kopfes des Probanden ausbreitet,
einen Lichterfassungsschritt zum Erfassen der Intensität des in dem Lichtempfangsschritt empfangenen Lichts beinhaltet, und
einen drahtlosen Übertragungsschritt zum drahtlosen Übertragen von einer Information zur Angabe einer Änderung beinhaltet, die einer Erhöhung oder einer Abnahme der Konzentration oder der Menge an Hämoglobin entspricht, basierend auf der in dem Lichterfassungsschritt erfassten Lichtintensität, und
wobei der biologische Informationsausgabeschritt
einen Empfangsschritt zum Empfangen der Information zur Angabe einer Änderung beinhaltet, die einer Erhöhung oder einer Abnahme der Konzentration oder der Menge an Hämoglobin entspricht, die drahtlos in dem drahtlosen Übertragungsschritt des biologischen Informationsmessschritts übertragen wird, und
einen Bestimmungsschritt beinhaltet, bei dem der biologische Informationsausgabeteil (200) veranlasst wird, die Information über eine Änderung in einem Blutfluss zu überwachen, basierend auf der Information zur Angabe einer Änderung, die einer Erhöhung oder einer Abnahme der Konzentration oder der Menge an Hämoglobin entspricht, die im Empfangsschritt über die Zeit empfangen werden und bestimmt, ob eine Änderungsrate eines Blutflusses einen vorbestimmten Referenzwert überschreitet oder nicht, in einem Fall, in dem eine Änderung der Information bezüglich einer Änderung eines Blutflusses gemäß einem Zeitpunkt der Brustkompressionen des Probanden vorliegt,
wobei in dem biologischen Informationsmessteil (100) eine Lichtdetektionseinheit (A), die den lichtemittierenden Abschnitt (11), den lichtempfangenden Abschnitt (12) und den lichterfassenden Abschnitt (13) beinhaltet, einen ersten Anschluss (x) aufweist, und eine drahtlose Übertragungseinheit (B), die den drahtlosen übertragenden Abschnitt (14) beinhaltet, einen zweiten Anschluss (y) aufweist,
wobei der lichtemittierende Abschnitt (11) und der lichtempfangenden Abschnitt (12) einen ersten lichtemittierenden Abschnitt (o1) und einen ersten lichtempfangenden Abschnitt (p1) zum Durchführen einer Messung beinhalten, der links vom ersten Anschluss (x) als Paar vorgesehen ist, und einen zweiten lichtemittierenden Abschnitt (o2) und einen zweiten lichtempfangenden Abschnitt (p2) zum Durchführen einer Messung, der rechts vom ersten Anschluss (x) als Paar vorgesehen ist,
wobei eine achtmalige Bestrahlungsreihenfolge, die in jedem Zyklus unter Verwendung von nahinfrarotem Licht mit drei verschiedenen Wellenlängen durchgeführt wird, eine der folgenden Reihenfolgen ist:

$$A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F \rightarrow G \rightarrow H,$$

$$B \rightarrow C \rightarrow D \rightarrow E \rightarrow F \rightarrow G \rightarrow H \rightarrow A,$$

$$C \rightarrow D \rightarrow E \rightarrow F \rightarrow G \rightarrow H \rightarrow A \rightarrow B,$$

$$D \rightarrow E \rightarrow F \rightarrow G \rightarrow H \rightarrow A \rightarrow B \rightarrow C,$$

$$E \rightarrow F \rightarrow G \rightarrow H \rightarrow A \rightarrow B \rightarrow C \rightarrow D,$$

$$F \rightarrow G \rightarrow H \rightarrow A \rightarrow B \rightarrow C \rightarrow D \rightarrow E,$$

$$G \rightarrow H \rightarrow A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F,$$

und

$$H \rightarrow A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F \rightarrow G$$

mit:

A: erster lichtemittierender Abschnitt (o1) bei erster Wellenlänge $\lambda 1$ (770 nm $\pm$ 20 nm)
B: erster lichtemittierender Abschnitt (o1) bei zweiter Wellenlänge A2 (805 nm $\pm$ 20 nm)

C: erster lichtemittierender Abschnitt (o1) bei dritter Wellenlänge A3 (870 nm ± 20 nm)
D: zweiter lichtemittierender Abschnitt (o2) bei zweiter Wellenlänge A2 (805 nm ± 20 nm)
E: zweiter lichtemittierender Abschnitt (o2) bei erster Wellenlänge λ1 (770 nm ± 20 nm)
F: erster lichtemittierender Abschnitt (o1) bei zweiter Wellenlänge A2 (805 nm ± 20 nm)
G: zweiter lichtemittierender Abschnitt (o2) bei dritter Wellenlänge A3 (870 nm ± 20 nm)
H: zweiter lichtemittierender Abschnitt (o2) bei zweiter Wellenlänge A2 (805 nm ± 20 nm).

Revendications

1. Système de mesure de l'information biologique (300) appliqué à un sujet nécessitant une réanimation cardiopulmonaire, comprenant :

une section de mesure de l'information biologique (100) ; et
une section de sortie de l'information biologique (200),
dans laquelle la section de mesure de l'information biologique (100) inclut
une partie émettrice de lumière (11) qui irradie la tête du sujet avec de la lumière proche infrarouge,
une partie réceptrice de lumière (12) qui reçoit de la lumière comme résultat de la lumière proche infrarouge appliquée par la partie émettrice de lumière (11) se propageant à l'intérieur de la tête du sujet,
une partie de détection de lumière (13) qui détecte l'intensité de la lumière reçue par la partie réceptrice de lumière (12), et
une partie de transmission sans fil (14) qui transmet sans fil de l'information servant à spécifier un changement correspondant à une hausse ou une baisse dans la concentration ou la quantité d'hémoglobine dans le sang sur la base de l'intensité de lumière détectée par la partie de détection de lumière (13), et
dans laquelle la section de sortie de l'information biologique (200) inclut
une partie de réception (15) qui reçoit l'information servant à spécifier un changement correspondant à une hausse ou une baisse dans la concentration ou la quantité d'hémoglobine, transmises sans fil depuis la partie de transmission sans fil (14) de la section de mesure de l'information biologique (100), et
une partie de détermination qui suit l'information relatives à un changement dans un flux sanguin sur la base l'information servant à spécifier un changement correspondant à une hausse ou une baisse dans la concentration ou la quantité d'hémoglobine dans le sang sur la base de l'intensité de lumière, reçues par la partie de réception (15), dans le temps, et détermine si un taux du changement dans un flux sanguin dépasse ou non une valeur de référence prédéterminée dans un cas où il y a un changement dans l'information relative à un changement dans un flux sanguin selon une temporalité de compressions thoraciques du sujet,
dans laquelle, dans la section de mesure de l'information biologique (100), une unité de détection de lumière (A) incluant la partie émettrice de lumière (11), la partie réceptrice de lumière (12), et la partie de détection de lumière (13) présente une première borne (x), et une unité de transmission sans fil (B) incluant la partie de transmission sans fil (14) présente une deuxième borne (y),
dans laquelle la partie émettrice de lumière (11) et la partie réceptrice de lumière (12) incluent une première partie émettrice de lumière (o1) et une première partie réceptrice de lumière (p1) servant à effectuer une mesure, prévues comme paire à gauche de la première borne (x), et une deuxième partie émettrice de lumière (o2) et une deuxième partie réceptrice de lumière (p2) servant à effectuer une mesure, prévues comme paire à droite de la première borne (x),
dans laquelle un ordre de huit fois d'irradiation effectuées à chaque cycle moyennant de la lumière proche infrarouge ayant trois longueurs d'ondes différentes est l'un quelconque des ordres suivants de

A→B→C→D→E→F→G→H,

B→C→D→E→F→G→H→A,

C→D→E→F→G→H→A→B,

D→E→F→G→H→A→B→C,

E→F→G→H→A→B→C→D,

F→G→H→A→B→C→D→E,

G→H→A→B→C→D→E→F,

et

H→A→B→C→D→E→F→G

avec :

A : première partie émettrice de lumière (o1) à une première longueur d'onde λ1 (770 nm ± 20 nm)
B : première partie émettrice de lumière (o1) à une deuxième longueur d'onde A2 (805 nm ± 20 nm)
C : première partie émettrice de lumière (o1) à une troisième longueur d'onde A3 (870 nm ± 20 nm)
D : deuxième partie émettrice de lumière (o2) à une deuxième longueur d'onde A2 (805 nm ± 20 nm)
E : deuxième partie émettrice de lumière (o2) à une première longueur d'onde λ1 (770 nm ± 20 nm)
F : première partie émettrice de lumière (o1) à une deuxième longueur d'onde A2 (805 nm ± 20 nm)
G : deuxième partie émettrice de lumière (o2) à une troisième longueur d'onde A3 (870 nm ± 20 nm)
H : deuxième partie émettrice de lumière (o2) à une deuxième longueur d'onde A2 (805 nm ± 20 nm).

2. Le système de mesure de l'information biologique selon la revendication 1,
dans laquelle la première borne (x) et la deuxième borne (y) sont directement connectées l'une à l'autre de manière attachable et détachable.

3. Le système de mesure de l'information biologique selon la revendication 1,
dans laquelle la première borne (x) et la deuxième borne (y) sont connectées l'une à l'autre via un fil.

4. Le système de mesure de l'information biologique selon l'une quelconque des revendications 1 à 3,
dans laquelle la section de mesure de l'informations biologiques (100) inclut en outre
une partie d'affichage qui affiche l'information d'affichage sur la base l'information servant à spécifier un changement correspondant à une hausse ou une baisse dans la concentration ou la quantité d'hémoglobine, détectées par la partie de détection de lumière (13).

5. Le système de mesure de l'information biologique selon l'une quelconque des revendications 1 à 4,
dans laquelle la section de sortie de l'information biologique (200) inclut en outre
une partie d'affichage qui affiche l'information d'affichage sur la base l'information servant à spécifier un changement correspondant à une hausse ou une baisse dans la concentration ou la quantité d'hémoglobine, reçues par la partie de réception (15).

6. Le système de mesure de l'information biologique selon l'une quelconque des revendications 1 à 5,
dans laquelle la section de mesure de l'information biologique (100) inclut en outre
une partie de calcul qui effectue un processus de calcul sur l'information servant à spécifier un changement correspondant à une hausse ou une baisse dans la concentration ou la quantité d'hémoglobine, détectées par la partie de détection de lumière (13).

7. Le système de mesure de l'information biologique selon l'une quelconque des revendications 1 à 6,
dans laquelle la section de sortie de l'information biologique (200) inclut en outre
une partie de calcul qui effectue un processus de calcul sur l'information servant à spécifier un changement correspondant à une hausse ou une baisse dans la concentration ou la quantité d'hémoglobine, reçues par la partie de réception (15).

8. Le système de mesure de l'information biologique selon l'une quelconque des revendications 1 à 7,
dans laquelle, dans un cas où la partie de détermination détermine que la valeur de référence prédéterminée est dépassée, la section de sortie de l'information biologique (200) sort l'information de sortie sur la base de l'informations de notification servant à notifier à l'extérieur que la valeur de référence prédéterminée est dépassée.

9. Le système de mesure de l'information biologique selon l'une quelconque des revendications 1 à 8,
dans laquelle les ordres de A : première partie émettrice de lumière (o1) à une première longueur d'onde λ1 (770 nm ± 20 nm) et C : première partie émettrice de lumière (o1) à une troisième longueur d'onde A3 (870 nm ± 20 nm) sont remplacés l'un par l'autre, et les ordres de E : deuxième partie émettrice de lumière (o2) à une première longueur d'onde λ1 (770 nm ± 20 nm) et G : deuxième partie émettrice de lumière (o2) à une troisième longueur

d'onde A3 (870 nm ± 20 nm) sont remplacés l'un par l'autre.

10. Le système de mesure de l'information biologique selon l'une quelconque des revendications 1 à 9, dans laquelle, dans un cas où une irradiation est effectuée huit fois à chaque cycle, une irradiation d'un premier cycle à un huitième cycle est considérée comme un ensemble, un ou plusieurs ensembles d'irradiation est effectué, et au moins une ensemble d'irradiation est effectué en une seconde.

11. Le système de mesure de l'information biologique selon l'une quelconque des revendications 1 à 10, dans laquelle des faisceaux de lumière ayant les trois longueurs d'ondes différentes sont appliqués depuis la première et la deuxième partie émettrice de lumière (o1, o2) dans l'ordre d'irradiation, et la partie de détection de lumière détecte les intensités de faisceaux de lumière reçus par la première et la deuxième partie réceptrice de lumière (p1, p2) à chaque cycle, et
dans laquelle, dans des éléments de données respectifs détectés par la partie de détection de lumière à chaque cycle, dans un cas où des différences entre des éléments de donnés sont toutes situées dans la même direction par comparaison entre des cycles adjacents, tandis que des différences entre des éléments de données sont toutes situées dans une direction opposée par comparaison entre d'autres cycles adjacents, la partie de détermination détermine qu'il y a un changement dans un flux sanguin.

12. Procédé de fonctionnement d'un système de mesure de l'information biologique (300) appliqué à un sujet nécessitant une réanimation cardiopulmonaire, comprenant :

une étape de mesure de l'information biologique exécutée dans une section de mesure de l'information biologique (100) ; et
une étape de sortie de l'information biologique exécutée dans une section de sortie de l'information biologique (200),
dans laquelle l'étape de mesure de l'information biologique inclut
une étape d'émission de lumière consistant à émettre de la lumière proche infrarouge par une partie émettrice de lumière (11),
une étape de réception de lumière consistant à recevoir de la lumière par une partie réceptrice de lumière (12) comme résultat de la lumière proche infrarouge appliquée à l'étape d'émission de lumière se propageant à l'intérieur de la tête du sujet,
une étape de détection de lumière consistant à détecter l'intensité de la lumière reçue à l'étape de réception de lumière, et
une étape de transmission sans fil consistant à transmettre sans fil de l'information servant à spécifier un changement correspondant à une hausse ou une baisse dans la concentration ou la quantité d'hémoglobine dans le sang sur la base de l'intensité de lumière détectée à l'étape de détection de lumière, et
dans laquelle l'étape de sortie de l'information biologique inclut
une étape de réception consistant à recevoir l'information servant à spécifier un changement correspondant à une hausse ou une baisse dans la concentration ou la quantité d'hémoglobine, transmises sans fil à l'étape de transmission sans fil de l'étape de mesure de l'information biologique, et
une étape de détermination consistant à faire en sorte que la section de sortie de l'information biologique (200) suit de l'information relatives à un changement dans un flux sanguin sur la base de l'information servant à spécifier un changement correspondant à une hausse ou une baisse dans la concentration ou la quantité d'hémoglobine, reçues à l'étape de réception, dans le temps, et détermine si un taux du changement dans un flux sanguin dépasse ou non une valeur de référence prédéterminée dans un cas où il y a un changement dans l'informations relatives à un changement dans un flux sanguin selon une temporalité de compressions thoraciques du sujet,
dans laquelle, dans la section de mesure de l'information biologique (100), une unité de détection de lumière (A) incluant la partie émettrice de lumière (11), la partie réceptrice de lumière (12), et la partie de détection de lumière (13) présente une première borne (x), et une unité de transmission sans fil (B) incluant la partie de transmission sans fil (14) présente une deuxième borne (y),
dans laquelle la partie émettrice de lumière (11) et la partie réceptrice de lumière (12) incluent une première partie émettrice de lumière (o1) et une première partie réceptrice de lumière (p1) servant à effectuer une mesure, prévues comme paire à gauche de la première borne (x), et une deuxième partie émettrice de lumière (o2) et une deuxième partie réceptrice de lumière (p2) servant à effectuer une mesure, prévues comme paire à droite de la première borne (x),
dans laquelle un ordre de huit fois d'irradiation effectuées à chaque cycle moyennant de la lumière proche infrarouge ayant trois longueurs d'ondes différentes est l'un quelconque des ordres suivants de

A→B→C→D→E→F→G→H,

B→C→D→E→F→G→H→A,

C→D→E→F→G→H→A→B,

D→E→F→G→H→A→B→C,

E→F→G→H→A→B→C→D,

F→G→H→A→B→C→D→E,

G→H→A→B→C→D→E→F,

et

H→A→B→C→D→E→F→G

avec :

A : première partie émettrice de lumière (o1) à une première longueur d'onde λ1 (770 nm ± 20 nm)
B : première partie émettrice de lumière (o1) à une deuxième longueur d'onde λ2 (805 nm ± 20 nm)
C : première partie émettrice de lumière (o1) à une troisième longueur d'onde λ3 (870 nm ± 20 nm)
D : deuxième partie émettrice de lumière (o2) à une deuxième longueur d'onde λ2 (805 nm ± 20 nm)
E : deuxième partie émettrice de lumière (o2) à une première longueur d'onde λ1 (770 nm ± 20 nm)
F : première partie émettrice de lumière (o1) à une deuxième longueur d'onde λ2 (805 nm ± 20 nm)
G : deuxième partie émettrice de lumière (o2) à une troisième longueur d'onde λ3 (870 nm ± 20 nm)
H : deuxième partie émettrice de lumière (o2) à une deuxième longueur d'onde λ2 (805 nm ± 20 nm).

FIG. 1

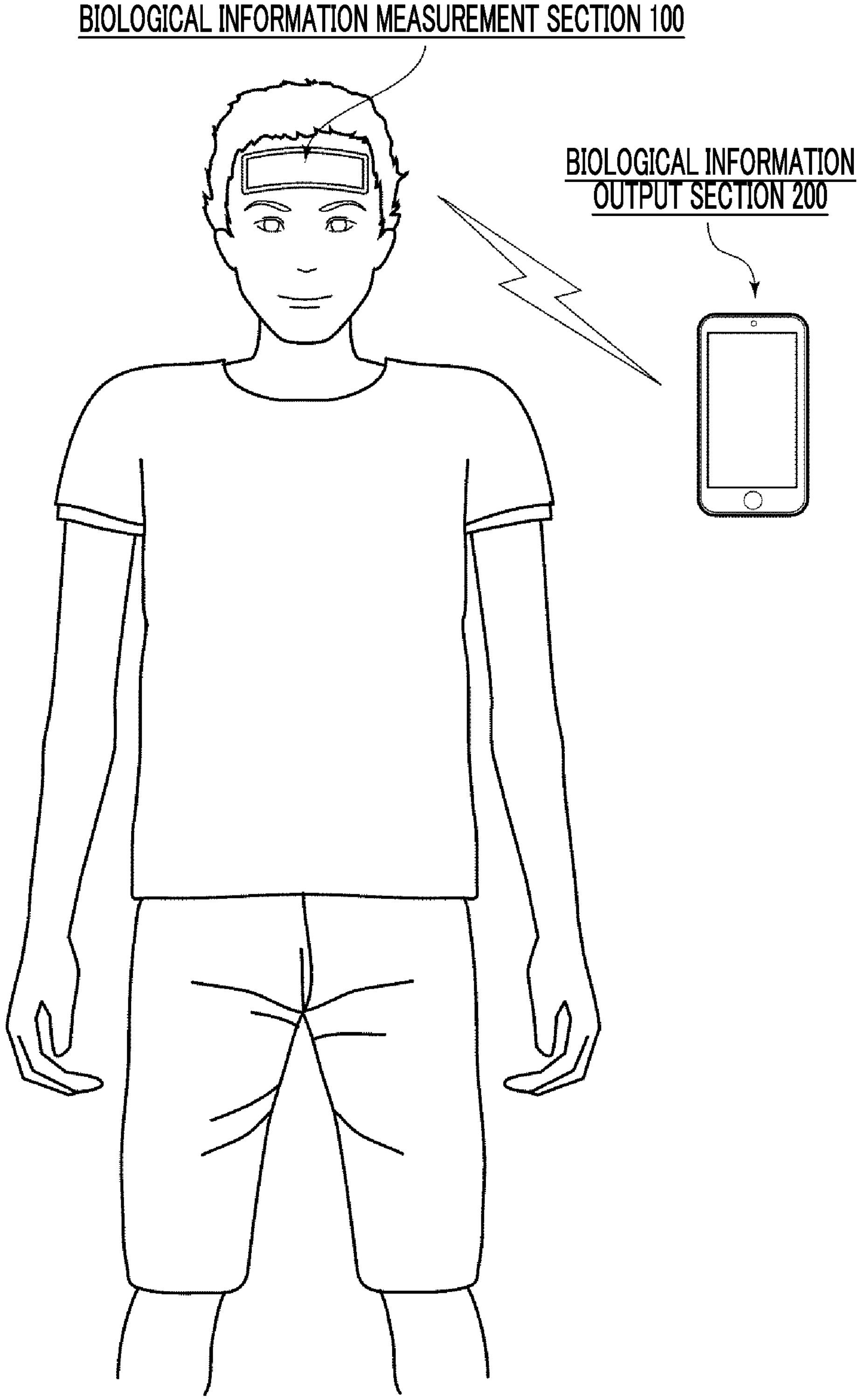

BIOLOGICAL INFORMATION MEASUREMENT SECTION 100
BIOLOGICAL INFORMATION OUTPUT SECTION 200

FIG. 2

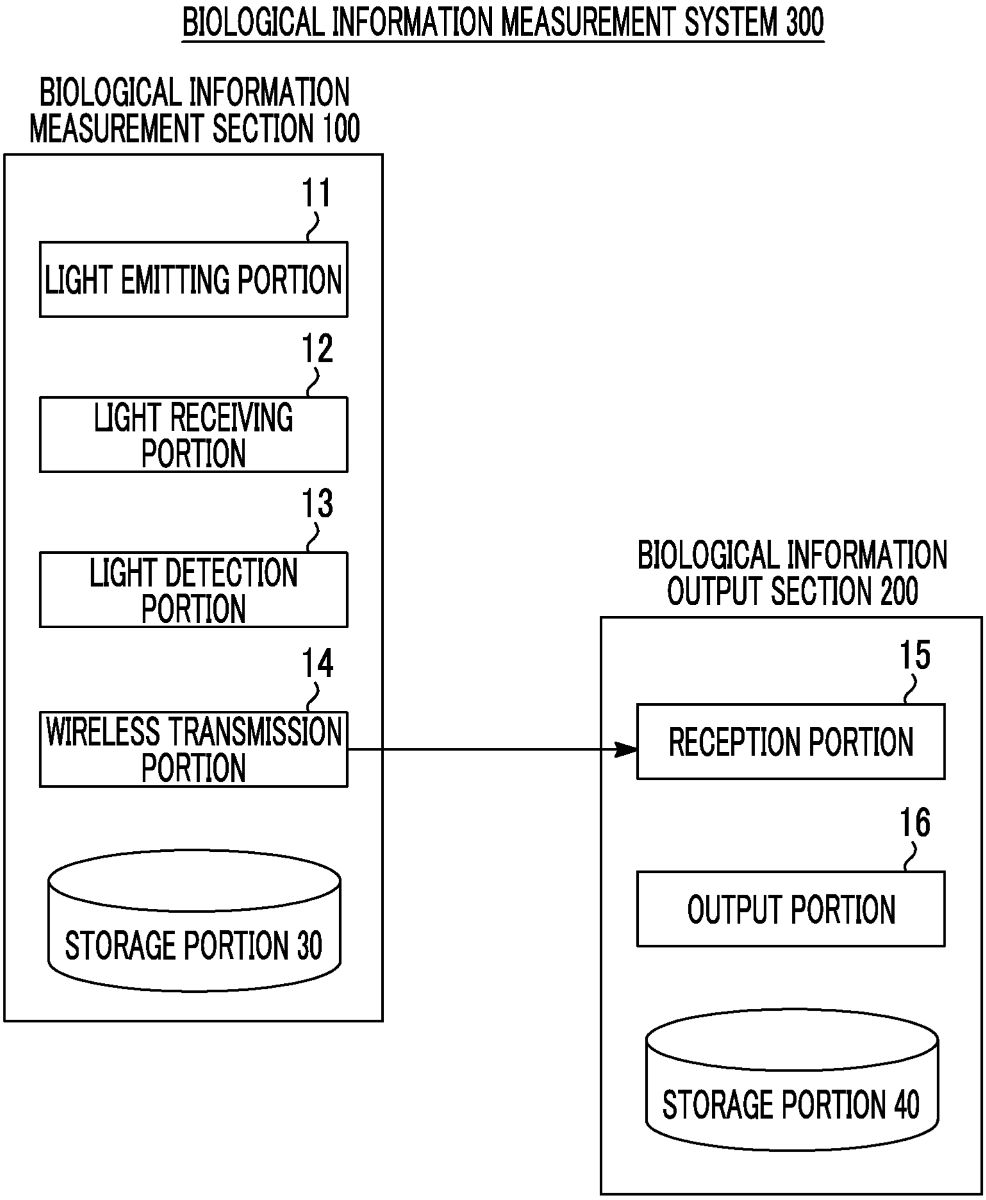

BIOLOGICAL INFORMATION MEASUREMENT SYSTEM 300
BIOLOGICAL INFORMATION MEASUREMENT SECTION 100
11
LIGHT EMITTING PORTION
12
LIGHT RECEIVING PORTION
13
LIGHT DETECTION PORTION
14
WIRELESS TRANSMISSION PORTION
STORAGE PORTION 30
BIOLOGICAL INFORMATION OUTPUT SECTION 200
15
RECEPTION PORTION
16
OUTPUT PORTION
STORAGE PORTION 40

FIG. 3

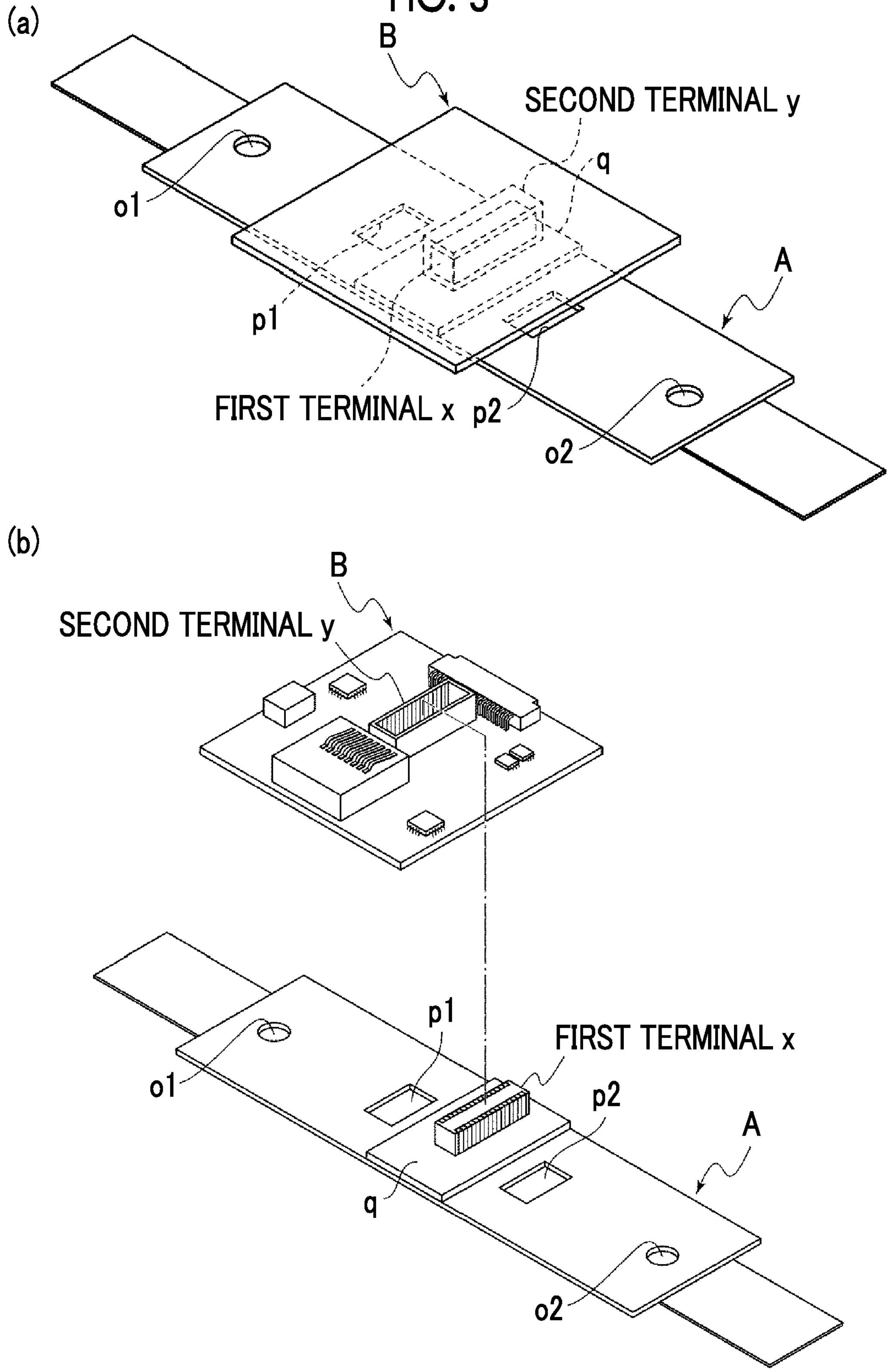

(a)
B
SECOND TERMINAL y
q
o1
A
p1
FIRST TERMINAL x
p2
o2
(b)
B
SECOND TERMINAL y
p1
FIRST TERMINAL x
o1
p2
A
q
o2

FIG. 4

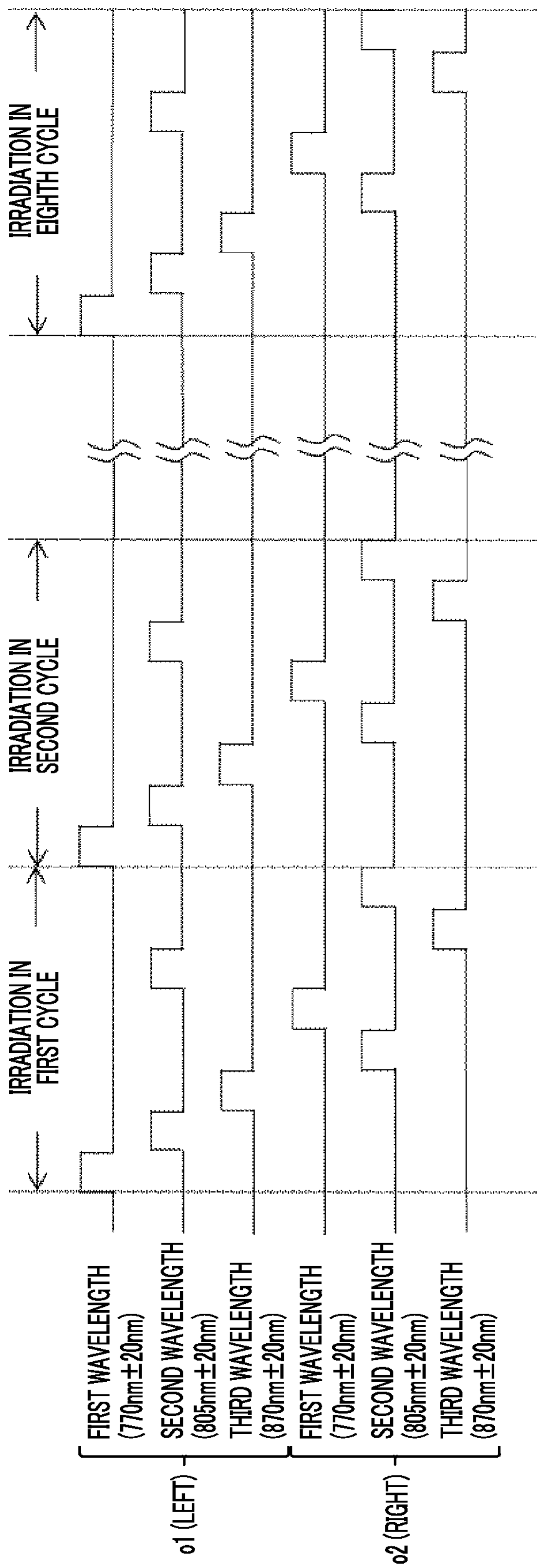

IRRADIATION IN FIRST CYCLE
IRRADIATION IN SECOND CYCLE
IRRADIATION IN EIGHTH CYCLE
o1 (LEFT)
FIRST WAVELENGTH (770nm±20nm)
SECOND WAVELENGTH (805nm±20nm)
THIRD WAVELENGTH (870nm±20nm)
o2 (RIGHT)
FIRST WAVELENGTH (770nm±20nm)
SECOND WAVELENGTH (805nm±20nm)
THIRD WAVELENGTH (870nm±20nm)

FIG. 5

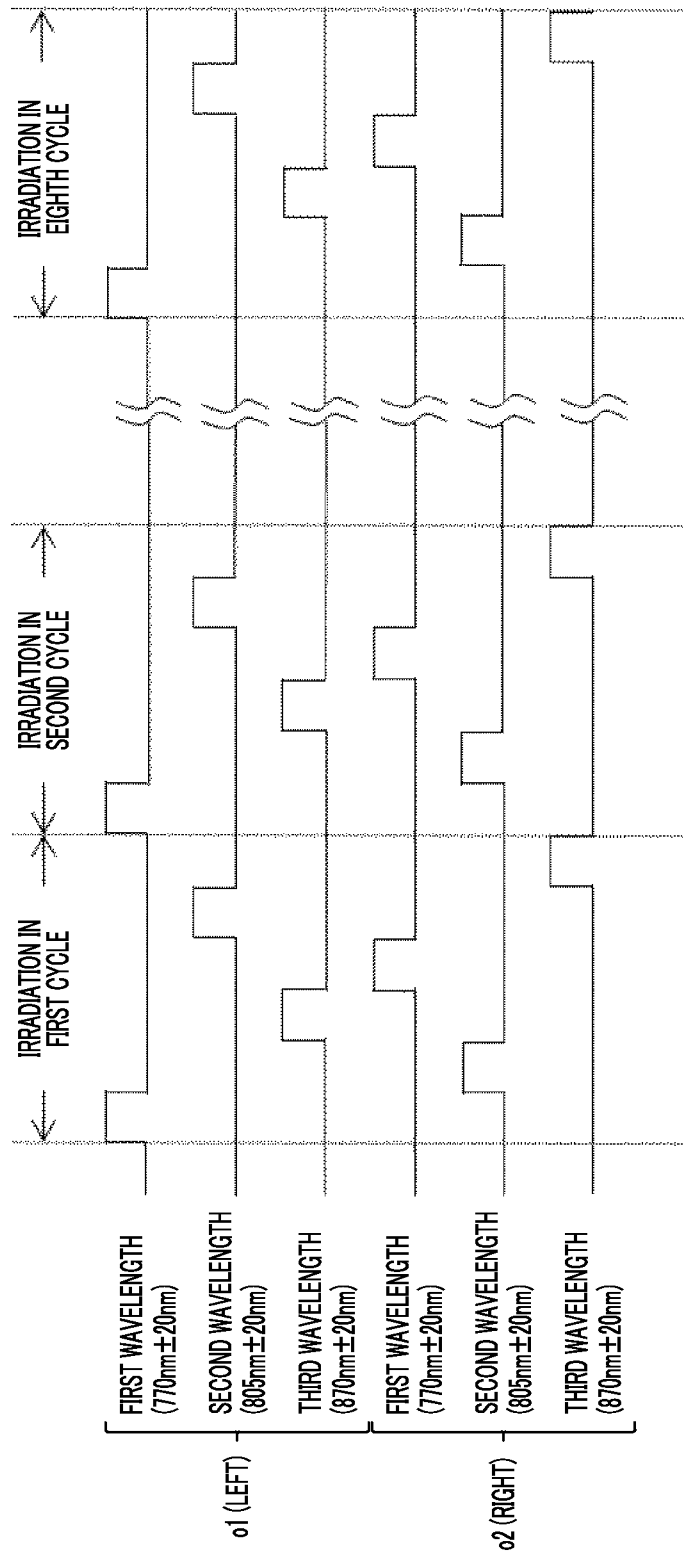

IRRADIATION IN FIRST CYCLE
IRRADIATION IN SECOND CYCLE
IRRADIATION IN EIGHTH CYCLE
o1 (LEFT)
FIRST WAVELENGTH (770nm±20nm)
SECOND WAVELENGTH (805nm±20nm)
THIRD WAVELENGTH (870nm±20nm)
o2 (RIGHT)
FIRST WAVELENGTH (770nm±20nm)
SECOND WAVELENGTH (805nm±20nm)
THIRD WAVELENGTH (870nm±20nm)

FIG. 6

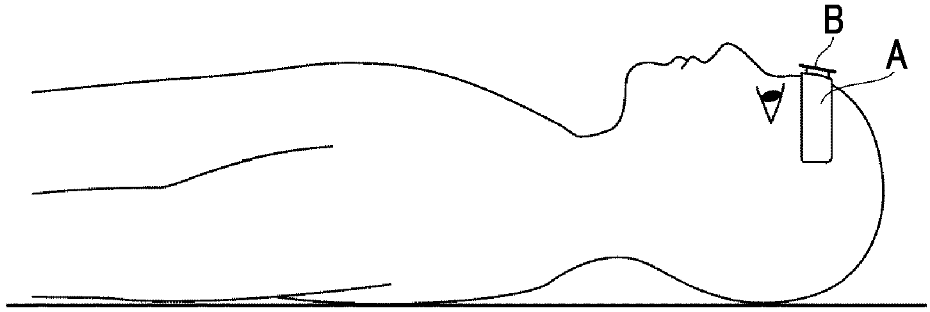


FIG. 7

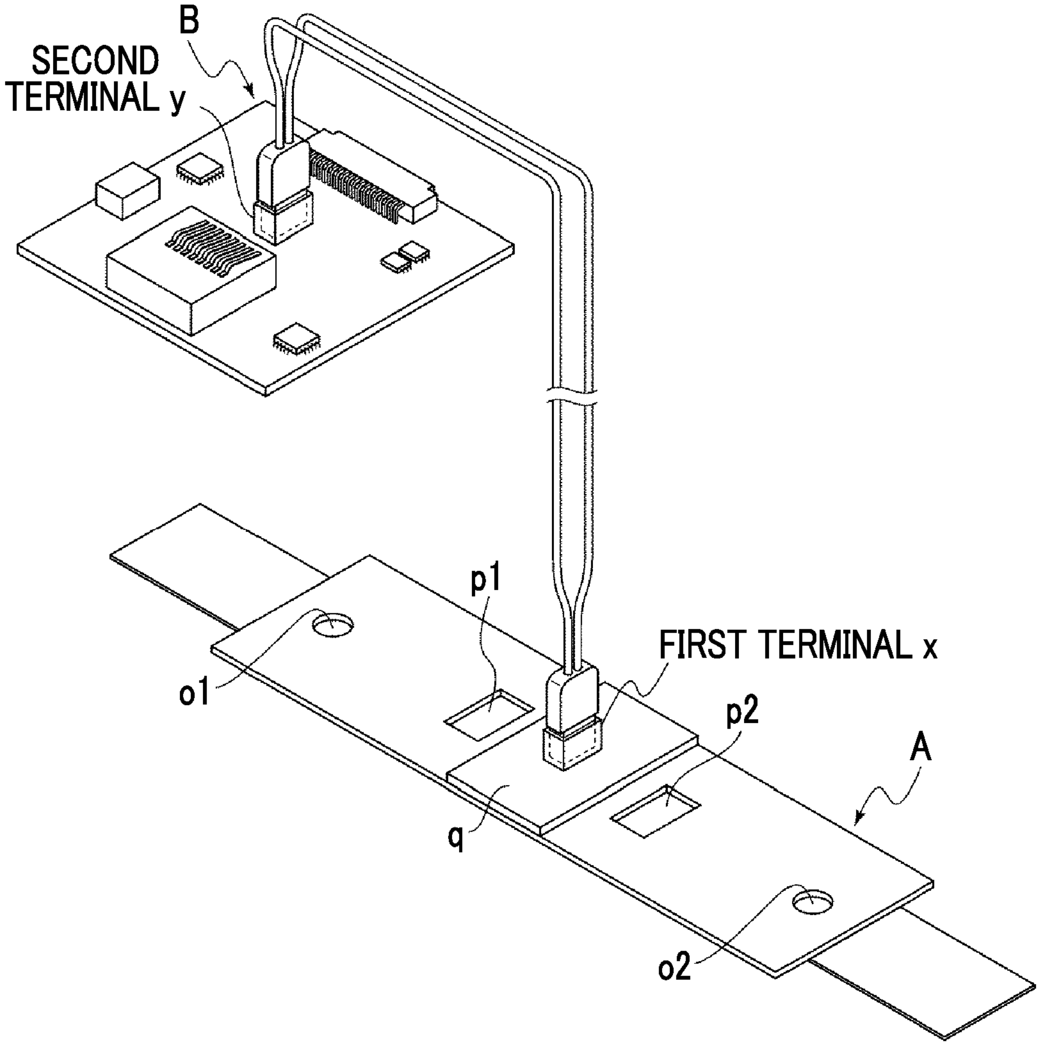


FIG. 8

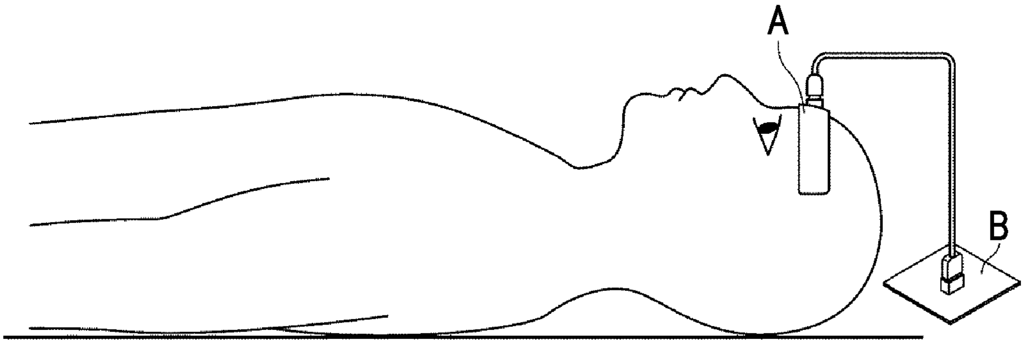
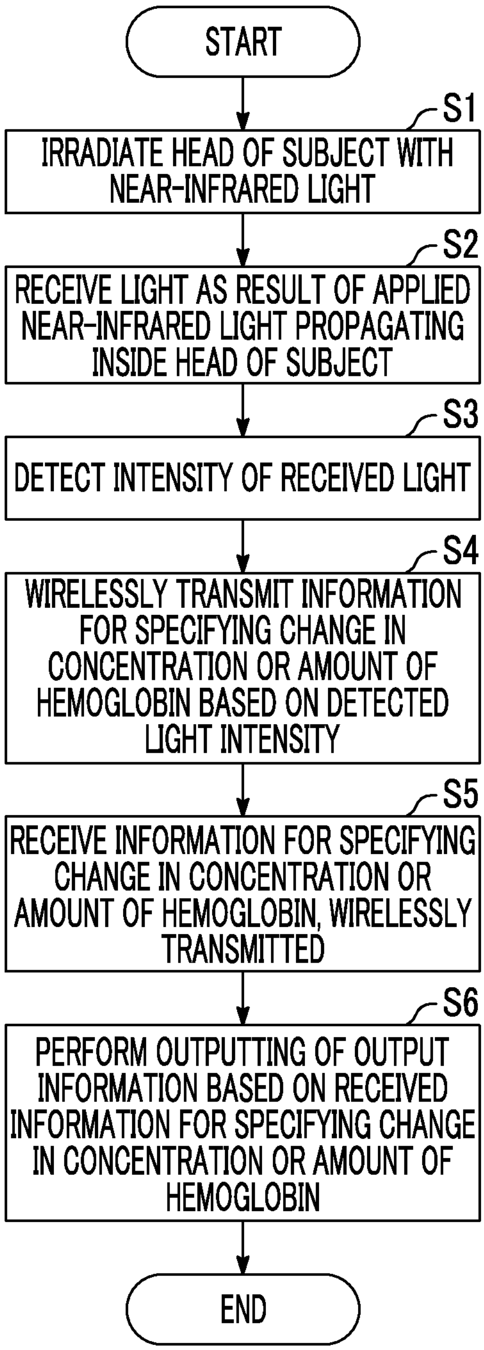


FIG. 9


START
S1
IRRADIATE HEAD OF SUBJECT WITH NEAR-INFRARED LIGHT
S2
RECEIVE LIGHT AS RESULT OF APPLIED NEAR-INFRARED LIGHT PROPAGATING INSIDE HEAD OF SUBJECT
S3
DETECT INTENSITY OF RECEIVED LIGHT
S4
WIRELESSLY TRANSMIT INFORMATION FOR SPECIFYING CHANGE IN CONCENTRATION OR AMOUNT OF HEMOGLOBIN BASED ON DETECTED LIGHT INTENSITY
S5
RECEIVE INFORMATION FOR SPECIFYING CHANGE IN CONCENTRATION OR AMOUNT OF HEMOGLOBIN, WIRELESSLY TRANSMITTED
S6
PERFORM OUTPUTTING OF OUTPUT INFORMATION BASED ON RECEIVED INFORMATION FOR SPECIFYING CHANGE IN CONCENTRATION OR AMOUNT OF HEMOGLOBIN
END

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20140058233 A1 **[0002]**
- JP 2014064929 A **[0006] [0007] [0008]**

专利名称(译)	生物信息测量系统和方法		
公开(公告)号	EP3318190B1	公开(公告)日	2020-01-29
申请号	EP2017754591	申请日	2017-04-28
[标]发明人	TAKAGI RUITA		
发明人	TAKAGI, RUITA		
IPC分类号	A61B5/1455 A61B5/026 A61B5/024 A61H31/00 A61B5/00		
CPC分类号	A61B5/02416 A61B5/6814 A61H31/004 A61B5/026 A61B5/1455 A61B5/002		
优先权	2016092726 2016-05-02 JP		
其他公开文献	EP3318190A1 EP3318190A4		
外部链接	Espacenet		

摘要(译)

当医务人员对诸如患者的对象进行生物信息的测量时，医务人员可以容易地进行顺畅的医疗实践，并且可以减轻在测量期间对诸如患者的对象的姿势施加的限制。 根据本发明，提供了一种生物信息测量系统，其应用于需要进行心肺复苏的对象，包括生物信息测量部分和生物信息输出部分，其中，所述生物信息测量部分包括照射所述发光部分的发光部分。 被检体的头部被近红外光照射，受光部接收由从在被检体的头部内部传播的发光部施加的近红外光所产生的光。 光接收部接收的光；以及无线发送部，该无线发送部基于由光检测部检测出的光强度，无线地发送用于确定与血液中的血红蛋白的浓度或量的增减相对应的变化的信息。 以及其中的生物学信息 n输出部包括：接收部，其从生物信息测定部的无线发送部无线地接收用于确定与血红蛋白的浓度或量的增加或减少相对应的变化的信息；以及 基于用于指定与接收部接收的，随着时间的推移对应于血红蛋白浓度或量的增加或减少的变化有关的信息，监视与血流变化有关的信息，并确定 在根据受试者的胸部按压的时机，关于血流量的变化的信息发生变化的情况下，血流量的变化超过规定的基准值。

FIG. 1