US 20190166122A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2019/0166122 A1

MOCHIZUKI et al. (43) Pub. Date: May 30, 2019

(54) **AUTHENTICATION TERMINAL**

(71) Applicant: **AISIN SEIKI KABUSHIKI KAISHA**, Kariya-shi (JP)

(72) Inventors: **Kenta MOCHIZUKI**, Yokohama-shi (JP); **Yosuke Aoyagi**, Koganei-shi (JP)

(73) Assignee: **AISIN SEIKI KABUSHIKI KAISHA**, Kariya-shi (JP)

(21) Appl. No.: **16/199,365**

(22) Filed: **Nov. 26, 2018**

(30) **Foreign Application Priority Data**

Nov. 27, 2017 (JP) 2017-227091

Publication Classification

(51) **Int. Cl.**

H04L 29/06	(2006.01)
G06F 21/32	(2006.01)
A61B 5/117	(2006.01)
A61B 5/22	(2006.01)
A61B 5/024	(2006.01)
A61B 5/00	(2006.01)
A61B 5/0408	(2006.01)

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

CPC ***H04L 63/0861*** (2013.01); ***G06F 21/32*** (2013.01); ***A61B 5/117*** (2013.01); ***A61B 5/0408*** (2013.01); ***A61B 5/02438*** (2013.01); ***A61B 5/6801*** (2013.01); ***A61B 5/224*** (2013.01)

(57) **ABSTRACT**

An authentication terminal includes: a casing that is worn on a body of a target person; first and second electrodes that are provided in the casing and measure a measurement potential as biological information; a light emitting unit that is provided in the casing and emits measurement light for measuring a muscle potential to the body of the target person; a light receiving unit that receives the measurement light and outputs muscle potential information which corresponds to the muscle potential; and a terminal-side control unit that outputs authentication information which is generated based on the muscle potential that is indicated by the muscle potential information, and on a cardiac potential that is calculated from the measurement potential between the first electrode and the second electrode to another device.

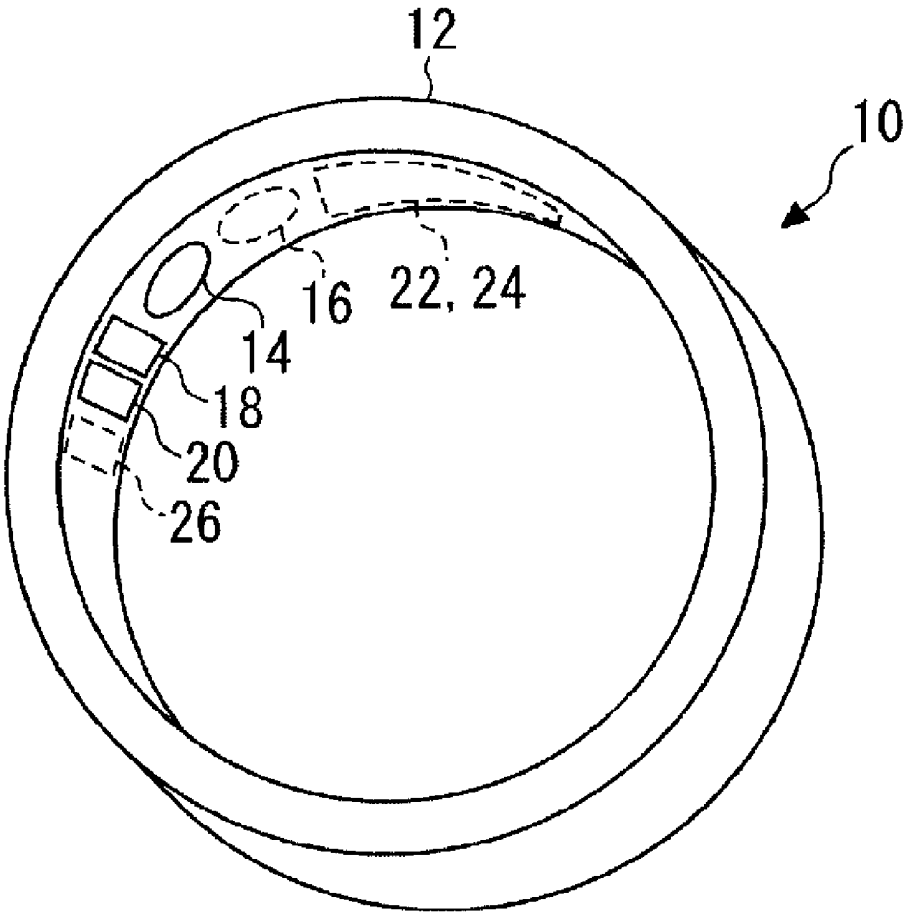


FIG.1

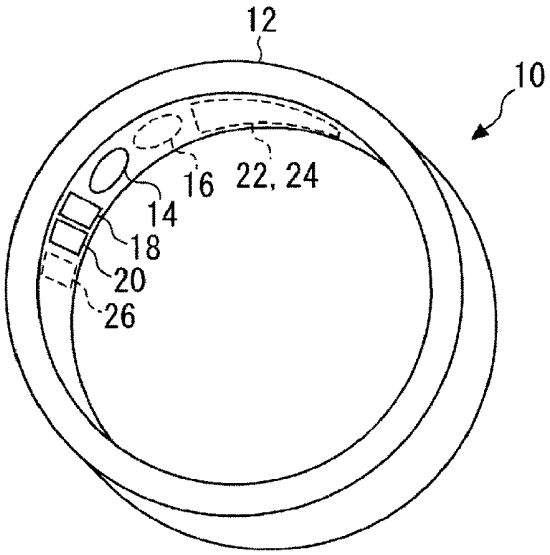


FIG.2

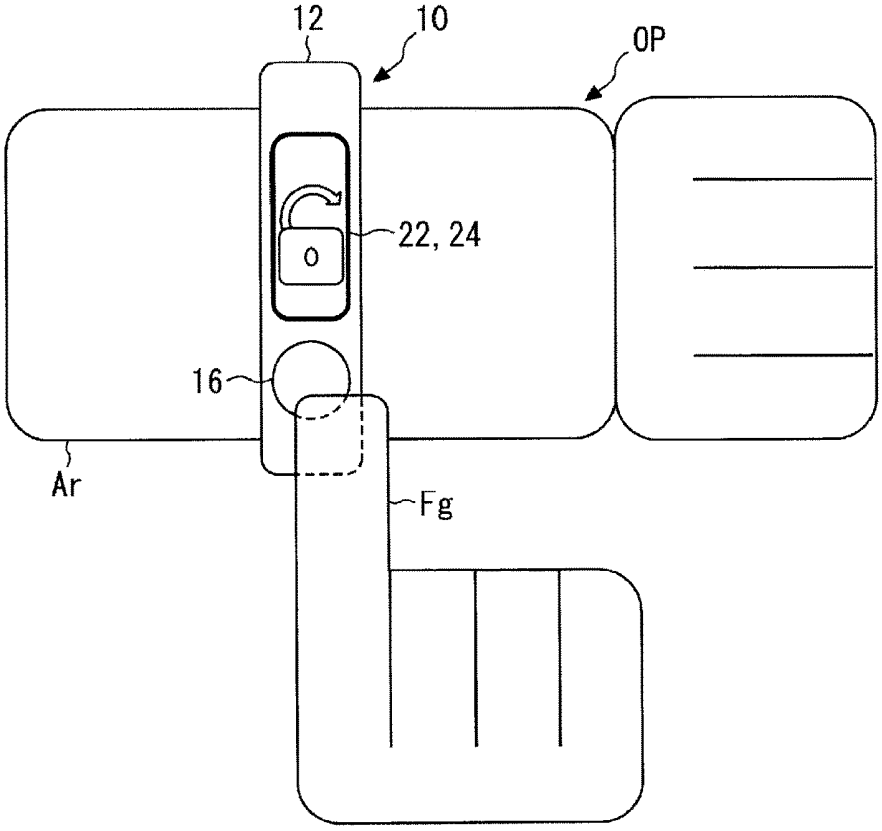


FIG.3

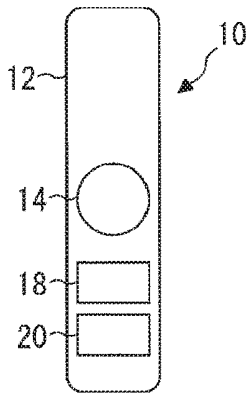

10
12
14
18
20

FIG.4

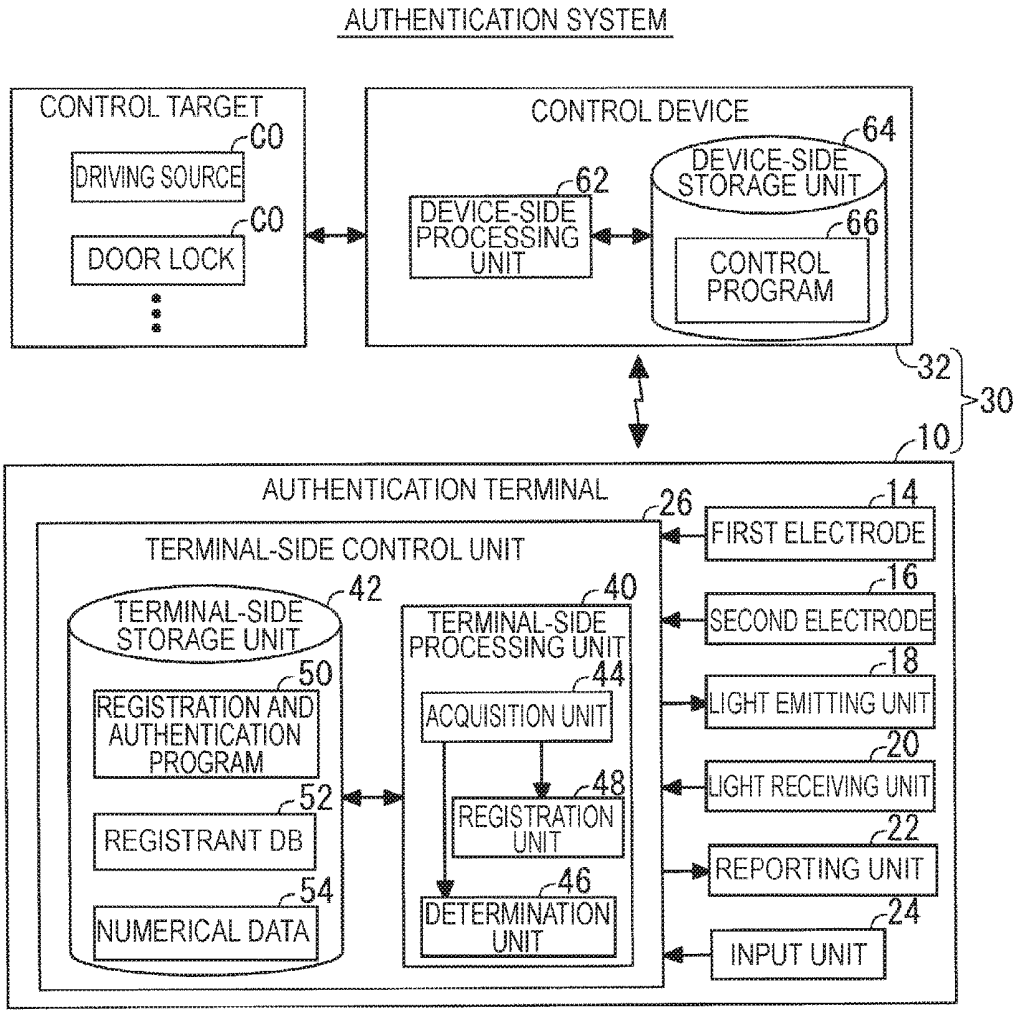

AUTHENTICATION SYSTEM
CONTROL TARGET
C0
DRIVING SOURCE
C0
DOOR LOCK
CONTROL DEVICE
64
DEVICE-SIDE STORAGE UNIT
62
DEVICE-SIDE PROCESSING UNIT
66
CONTROL PROGRAM
32
30
10
AUTHENTICATION TERMINAL
26
TERMINAL-SIDE CONTROL UNIT
42
TERMINAL-SIDE STORAGE UNIT
50
REGISTRATION AND AUTHENTICATION PROGRAM
52
REGISTRANT DB
54
NUMERICAL DATA
40
TERMINAL-SIDE PROCESSING UNIT
44
ACQUISITION UNIT
48
REGISTRATION UNIT
46
DETERMINATION UNIT
14
FIRST ELECTRODE
16
SECOND ELECTRODE
18
LIGHT EMITTING UNIT
20
LIGHT RECEIVING UNIT
22
REPORTING UNIT
24
INPUT UNIT

FIG.5

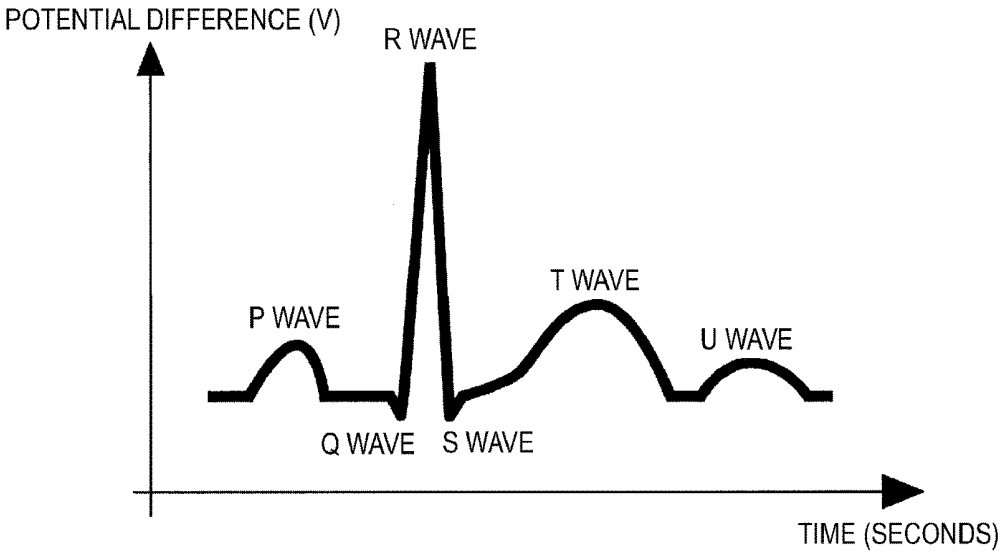


FIG.6

52

REGISTRANT ID	FIRST CARDIAC POTENTIAL INFORMATION	SECOND CARDIAC POTENTIAL INFORMATION	THIRD CARDIAC POTENTIAL INFORMATION	FOURTH CARDIAC POTENTIAL INFORMATION
ID000A	Dta1	Dta2	Dta3	Dta4
ID000B	Dtb1	Dtb2	Dtb3	Dtb4
ID000C	Dtc1	Dtc2	Dtc3	Dtc4
ID000D	Dtd1	Dtd2	Dtd3	Dtd4

FIG.7

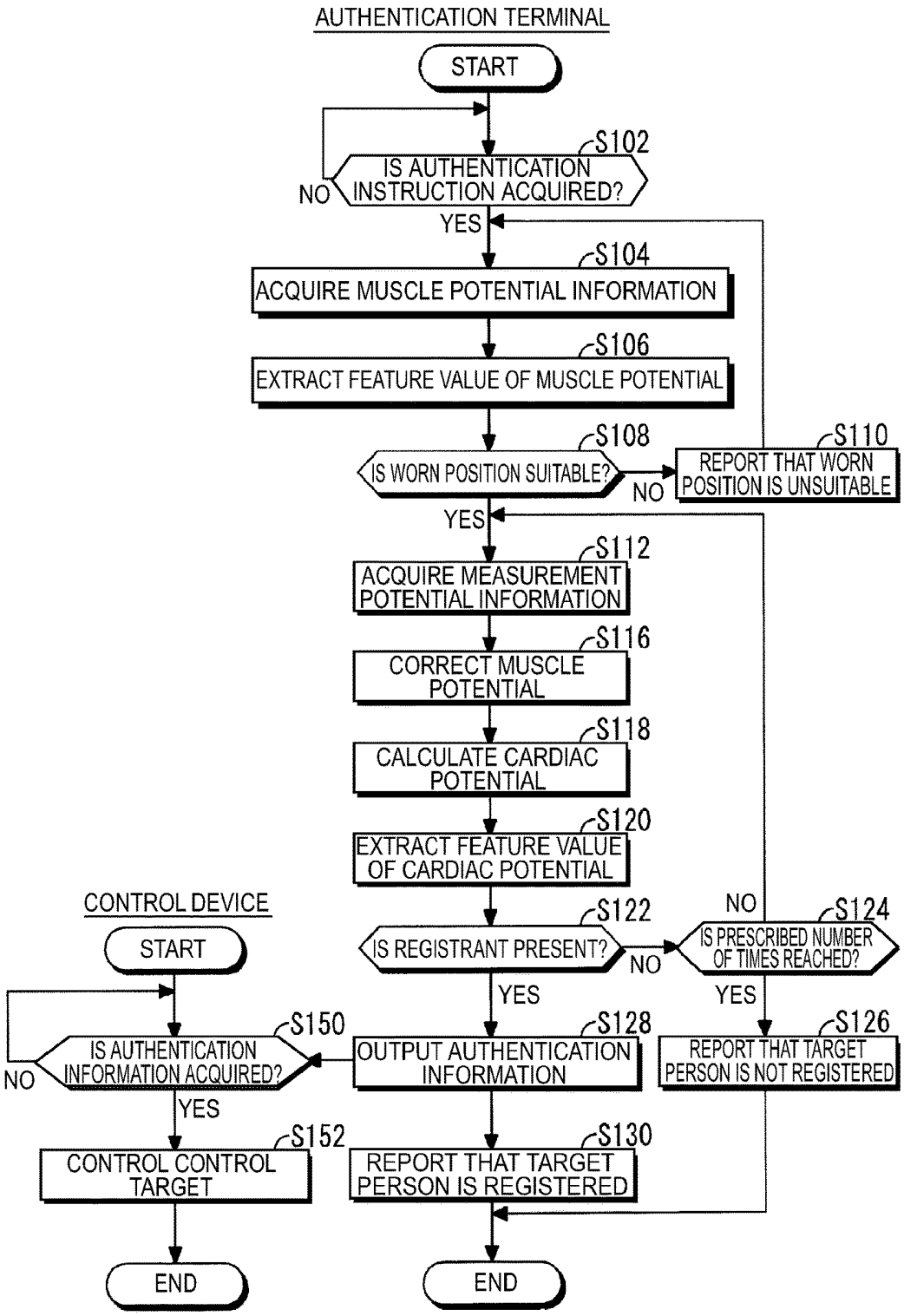
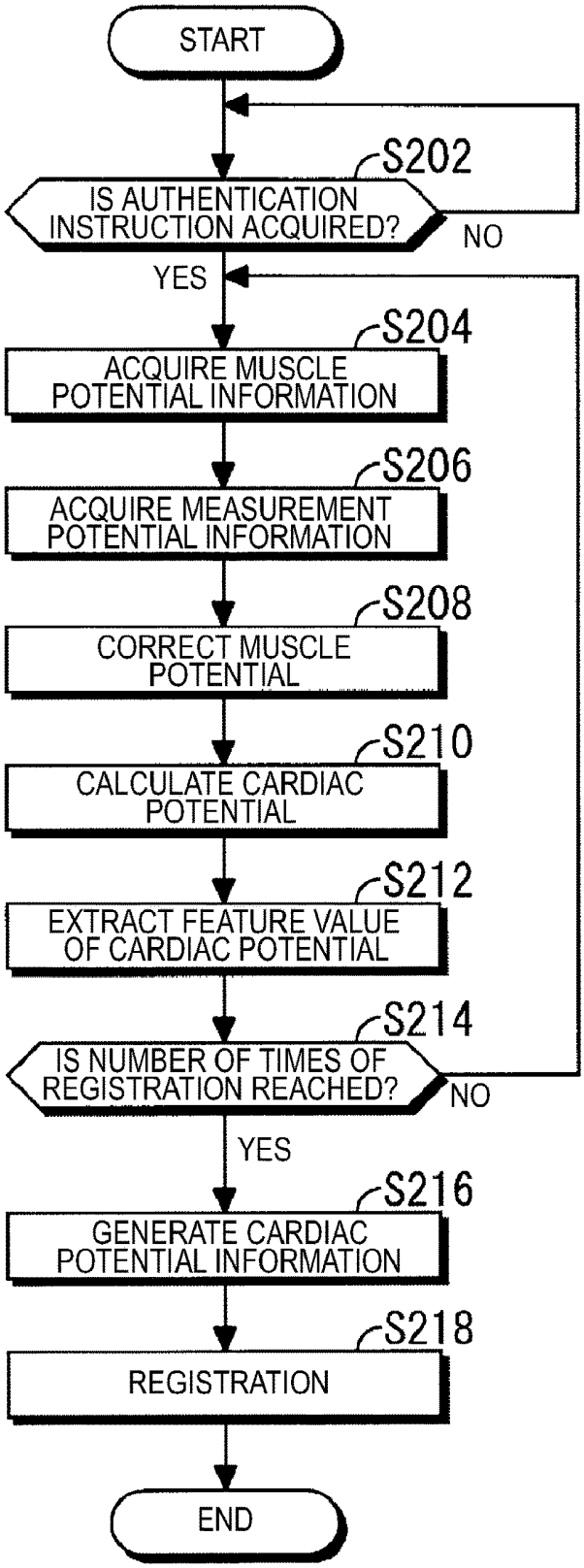

AUTHENTICATION TERMINAL
START
S102
IS AUTHENTICATION INSTRUCTION ACQUIRED?
NO
YES
S104
ACQUIRE MUSCLE POTENTIAL INFORMATION
S106
EXTRACT FEATURE VALUE OF MUSCLE POTENTIAL
S108
IS WORN POSITION SUITABLE?
NO
S110
REPORT THAT WORN POSITION IS UNSUITABLE
YES
S112
ACQUIRE MEASUREMENT POTENTIAL INFORMATION
S116
CORRECT MUSCLE POTENTIAL
S118
CALCULATE CARDIAC POTENTIAL
S120
EXTRACT FEATURE VALUE OF CARDIAC POTENTIAL
CONTROL DEVICE
START
S122
IS REGISTRANT PRESENT?
NO
NO
S124
IS PRESCRIBED NUMBER OF TIMES REACHED?
YES
YES
S150
IS AUTHENTICATION INFORMATION ACQUIRED?
NO
S128
OUTPUT AUTHENTICATION INFORMATION
S126
REPORT THAT TARGET PERSON IS NOT REGISTERED
YES
S152
CONTROL CONTROL TARGET
S130
REPORT THAT TARGET PERSON IS REGISTERED
END
END

FIG.8


START
S202
IS AUTHENTICATION INSTRUCTION ACQUIRED?
NO
YES
S204
ACQUIRE MUSCLE POTENTIAL INFORMATION
S206
ACQUIRE MEASUREMENT POTENTIAL INFORMATION
S208
CORRECT MUSCLE POTENTIAL
S210
CALCULATE CARDIAC POTENTIAL
S212
EXTRACT FEATURE VALUE OF CARDIAC POTENTIAL
S214
IS NUMBER OF TIMES OF REGISTRATION REACHED?
NO
YES
S216
GENERATE CARDIAC POTENTIAL INFORMATION
S218
REGISTRATION
END

AUTHENTICATION TERMINAL

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is based on and claims priority under 35 U.S.C. § 119 to Japanese Patent Application 2017-227091, filed on Nov. 27, 2017, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] This disclosure relates to an authentication terminal.

BACKGROUND DISCUSSION

[0003] An authentication terminal is known that authenticates a target person based on a biological signal of a human body. For example, the authentication terminal measures a cardiac potential of the target person as the biological signal of the human body using a pair of electrodes, compares data that is registered in advance and the cardiac potential, and determines whether or not the target person is a registrant that is registered.

[0004] However, because a potential that is measured using the pair of electrodes also includes a muscle potential and the like other than the cardiac potential, the precision of the authentication by the above-described authentication terminal is low. Therefore, a technology is disclosed that removes noise, such as the muscle potential that is included in the measured potential and the like, using a band pass filter and increases the precision of the authentication.

[0005] Examples of the related art include JP 2014-239737A and JP 2017-51611A.

[0006] However, the above-described device uniformly removes a component of a specific frequency that is included in the cardiac potential, as the muscle potential, using the band pass filter, not depending on a state of the target person. Because of this, the removal of the muscle potential is insufficient and one portion of the cardiac potential other than the muscle potential is also removed. As a result, there is a problem in that the precision of the authentication of the registrant, which uses the cardiac potential, is not sufficient in the above-described device.

[0007] Thus, a need exists for an authentication terminal which is not susceptible to the drawback mentioned above.

SUMMARY

[0008] An authentication terminal according to an aspect of this disclosure includes: a casing that is worn on a body of a target person; first and second electrodes that are provided in the casing and measure a measurement potential as biological information; a light emitting unit that is provided in the casing and emits measurement light for measuring a muscle potential to the body of the target person; a light receiving unit that receives the measurement light and outputs muscle potential information which corresponds to the muscle potential; and a terminal-side control unit that outputs authentication information which is generated based on the muscle potential that is indicated by the muscle potential information, and on a cardiac potential that is calculated from the measurement potential between the first electrode and the second electrode to another device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The foregoing and additional features and characteristics of this disclosure will become more apparent from the following detailed description considered with the reference to the accompanying drawings, wherein:

[0010] FIG. **1** is a perspective diagram of an authentication terminal according to an embodiment;

[0011] FIG. **2** is a plan-view diagram of the outside of the authentication terminal in a worn state;

[0012] FIG. **3** is a plan-view diagram of the inside of the authentication terminal;

[0013] FIG. **4** is a functional block diagram for describing a function of an authentication system that includes the authentication terminal;

[0014] FIG. **5** is a graph for describing a waveform of a cardiac potential of an ordinary person.

[0015] FIG. **6** is a table illustrating an example of a registrant database;

[0016] FIG. **7** is a flowchart illustrating an example of each of the authentication processing and the control processing that are performed by the authentication system; and

[0017] FIG. **8** is a flowchart illustrating an example of registration processing that is performed by the authentication terminal.

DETAILED DESCRIPTION

[0018] The same constituent elements in the following exemplary embodiment and the like are given the same reference numeral, and a description thereof is not properly repeated.

Embodiment

[0019] An authentication terminal **10** according to an embodiment is a bracelet type device that is worn on the vicinity of a wrist or the like of an authentication target person (hereinafter referred to as a target person OP). The authentication terminal **10** calculates a cardiac potential that results from converting an electrical change in the heart of the target person OP into an electric potential, and, based on the cardiac potential, determines whether or not the target person OP that wears the authentication terminal **10** is a registrant that is registered. The authentication terminal **10** outputs a result of the determination as authentication information. An example of the authentication terminal **10** is a smart key that authenticates the target person OP in order to unlock a door lock of a vehicle such as a motor car or cause a driving source, such as an engine, to start.

[0020] FIG. **1** is a perspective diagram of the authentication terminal **10** according to the embodiment. FIG. **2** is a plan-view diagram of the outside of the authentication terminal **10** in a worn state. FIG. **3** is a plan-view diagram of the inside of the authentication terminal **10**. As illustrated in FIGS. **1**, **2**, and **3**, the authentication terminal **10** includes a casing **12**, a first electrode **14**, a second electrode **16**, a light emitting unit **18**, a light receiving unit **20**, a reporting unit **22**, an input unit **24**, and a terminal-side control unit **26**.

[0021] The casing **12**, for example, is configured to be in the shape of a ring that has a hole in the center. An internal diameter of the casing **12** may be such that the authentication terminal **10** can be worn on the wrist of the target person OP who wants to wear the authentication terminal **10**, and is not particularly limited. The casing **12**, for example, is configured with an insulating material such as resin.

[0022] The first electrode **14** is configured with a conductive material such as metal. The first electrode **14** is electrically connected to the terminal-side control unit **26**. The first electrode **14** is provided inside of the casing **12**.

[0023] The second electrode **16** is configured with a conduction material such as metal. The second electrode **16** is electrically connected to the terminal-side control unit **26**. The second electrode **16** is provided outside of the casing **12**. It is preferable that in a circumferential direction of the casing **12**, the second electrode **16** is provided in the vicinity of the first electrode **14** or in the same position as the first electrode **14**. Accordingly, when the second electrode **16** is pressed with a finger Fg of the target person OP, the first electrode **14** can make contact with an arm Ar of the target person OP.

[0024] Both the first electrode **14** and the second electrode **16** make contact one portion of a body of the target person OP and thus measure a measurement potential as biological information. Specifically, when the finger Fg of one hand (for example, the right hand) of the target person OP makes contact with and presses the second electrode **16**, the first electrode **14** makes contact with a surface in the vicinity of the wrist, of the arm Ar (for example, the left arm) that is opposite the hand with which the second electrode **16** is in contact. Accordingly, the first electrode **14** and the second electrode **16** measure a potential between the first electrode **14** and the second electrode **16**, as the measurement potential. At this point, because the heart of the target person OP is present between the first electrode **14** and the second electrode **16**, the measurement potential includes the cardiac potential that is one piece of biological information. As described above, the first electrode **14** makes contact with the arm Ar in the vicinity of the wrist and the second electrode **16** makes contact with the finger Fg or the like of the opposite hand. Because of this, a difference between a path from the first electrode **14** to the heart and a path from the second electrode **16** to the heart increases. As a result, the authentication terminal **10** can improve the accuracy of the calculation of the cardiac potential. The first electrode **14** and the second electrode **16** output measurement potential information indicating the measurement potential, to the terminal-side control unit **26**. Moreover, the measurement potential information may be the measurement potential itself.

[0025] The light emitting unit **18** emits light (hereinafter referred to as measurement light) for measuring a muscle potential to the body of the target person OP. The light emitting unit **18**, for example, is a light emitting diode (LED) that emits blue light, as the measurement light, that has a wavelength of 435 nm to 480 nm and has difficulty in penetrating into the body. The light emitting unit **18** is provided inside of the casing **12**. Therefore, the light emitting unit **18** emits the measurement light to arm Ar of the target person OP inside of the casing **12**. It is preferable that the light emitting unit **18** is provided in the vicinity of the first electrode **14**. It is preferable that, for example, in the circumferential direction of the casing **12**, the light emitting unit **18** is positioned at or below an angle of 90° with respect to the first electrode **14**.

[0026] The light receiving unit **20** receives the measurement light that is emitted by the light emitting unit **18** and is reflected by the target person OP, and outputs muscle potential information that is generated as a result of converting the measurement light into an electrical signal, to the terminal-side control unit **26**. At this point, because the measurement light corresponds to the muscle potential, the muscle potential information that results from converting the measurement light into the electrical signal corresponds to the muscle potential of the target person OP. The light receiving unit **20** is a photo diode or a phototransistor. The light receiving unit **20** is provided inside of the casing **12**. It is preferable that the light receiving unit **20** is provided in the vicinity of the first electrode **14** and the light emitting unit **18**. It is preferable that for example, in the circumferential direction of the casing **12**, the light receiving unit **20** is positioned at or below an angle of 90° with respect to the first electrode **14** and the light emitting unit **18**. Accordingly, the light receiving unit **20** almost faces an area to which the measurement light is emitted by the light emitting unit **18**, and thus can efficiently receive the measurement light.

[0027] The reporting unit **22** reports report information, which is acquired from the terminal-side control unit **26**, to the target person OP. The reporting unit **22**, for example, includes any one of a display device, such as a liquid crystal display, a speaker that possibly outputs audio, and a vibration member, such as an actuator that causes the authentication terminal **10** to vibrate. The reporting unit **22**, for example, reports a result of authentication that determines whether or not the registrant is present based on the cardiac potential, information on the target person OP, such as a health state relating to the cardiac potential, information relating to a worn position of the authentication terminal **10**, and the like, to the target person OP, using any one of an image, audio, and vibration.

[0028] The input unit **24** receives an instruction or the like from the target person OP and outputs the instruction or the like, which is received, to the terminal-side control unit **26**. The input unit **24**, for example, is provided on a surface of the reporting unit **22**. The input unit **24**, for example, is a touch panel that possibly transmits light. Accordingly, the input unit **24** transmits an image that is displayed on the reporting unit **22**. The input unit **24**, for example, receives an instruction for authentication or registration from the target person OP, and outputs corresponding instruction information to the terminal-side control unit **26**.

[0029] The terminal-side control unit **26** administers general control of the authentication terminal **10**. The terminal-side control unit **26**, for example, is a computer.

[0030] FIG. **4** is a functional block diagram for describing a function of an authentication system **30** that includes the authentication terminal **10**. As illustrated in FIG. **4**, the authentication system **30** includes the authentication terminal **10** and a control device **32**.

[0031] The terminal-side control unit **26** has a terminal-side processing unit **40** and a terminal-side storage unit **42**.

[0032] The terminal-side processing unit **40**, for example, is a processor such as a central processing unit (CPU). The terminal-side processing unit **40** has an acquisition unit **44**, a registration unit **48**, and a determination unit **46**. The terminal-side processing unit **40**, for example, reads a registration and authentication program **50** that is stored in the terminal-side storage unit **42**, and thus may function as the acquisition unit **44**, the registration unit **48**, and the determination unit **46**. Moreover, one portion or all portions of each of the acquisition unit **44**, the registration unit **48**, and the determination unit **46** may be configured with an application specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or the like.

[0033] The acquisition unit **44** acquires various pieces of information, and outputs the acquires various pieces of information to the registration unit **48** or the determination unit **46**. For example, the acquisition unit **44** acquires the measurement potential information that includes information relating to the cardiac potential of the target person OP from the first electrode **14** and the second electrode **16** that are in contact with the target person OP. The acquisition unit **44** outputs the acquired measurement potential information to the registration unit **48** and the determination unit **46**. The acquisition unit **44** acquisition the muscle potential information that includes information relating to the muscle potential, from the light receiving unit **20**. The acquisition unit **44** outputs the acquired muscle potential information to the registration unit **48** and the determination unit **46**. The acquisition unit **44** acquires pieces of instruction information that are input by the target person OP, such as an authentication instruction and a registration instruction, from the input unit **24**. The acquisition unit **44** outputs the acquired instruction information to the registration unit **48**.

[0034] The determination unit **46** generates the authentication information based on the muscle potential that is indicated by the muscle potential information, and on the cardiac potential of the target person OP, which is calculated from the measurement potential that is output by the electrodes **14** and **16**, and outputs the generated authentication information to the control device **32**. For example, the determination unit **46** may determine whether or not the target person OP is registered in a registrant database **52**, based on the cardiac potential of the target person OP, may generate a result of the determination as the authentication information, and may output the authentication information. Specifically, the determination unit **46** uniformly removes the muscle potential that is indicated by the muscle potential information, from the measurement potential that is indicated by the measurement potential information, and calculates the cardiac potential. Because the measurement potential includes the cardiac potential and the muscle potential, a potential difference that results from removing the muscle potential from the measurement potential is almost the cardiac potential. At this point, the determination unit **46** may correct amplitude (that is, a maximum value) of the muscle potential that is indicated by the muscle potential information, may remove the corrected muscle potential from the measurement potential, and may output the cardiac potential. Specifically, the determination unit **46** may multiply the amplitude of the muscle potential by a correction coefficient, may make a scale adjustment, and thus may correct the muscle potential. The correction coefficient may be stored, as one portion of numerical data **54**, in the terminal-side storage unit **42**. The determination unit **46** extracts one, or two or more feature values, which are determined in advance, from the calculated cardiac potential. In a case where the extracted feature value of the cardiac potential is registered in cardiac potential information in the registrant database **52**, the determination unit **46** determines that the target person OP is a registrant. On the other hand, in a case where the feature value of the cardiac potential is not registered in the cardiac potential information in the registrant database **52**, the determination unit **46** determines that the target person OP is not a registrant. When it is determined that the target person OP is a registrant, the determination unit **46** outputs a result of the determination, as the authentication information, to the control device **32**.

[0035] Based on the muscle potential that is indicated by the muscle potential information which is acquired from the acquisition unit **44**, and on determination muscle potential that is registered in advance by the target person OP, the determination unit **46** may determine whether or not the worn position of the authentication terminal **10** is suitable. Accordingly, a true value of muscle potential for determination is set with worn-position information registered by the target person OP as a true value. For example, the determination unit **46** may extract the amplitude of the muscle potential as a feature value of the muscle potential, and may determine whether or not the worn position is suitable, depending on whether or not the amplitude is higher than the muscle potential for determination that is determined in advance. The muscle potential for determination, for example, is stored, as one portion of the numerical data **54**, in the terminal-side storage unit **42**. Specifically, in a case where the amplitude of the muscle potential is higher than determination muscle potential for determination that is determined in advance, the determination unit **46** may determine that the worn position of the authentication terminal **10** is suitable. On the other hand, in a case where the amplitude of the muscle potential is lower than the muscle potential for determination that is determined in advance, the determination unit **46** may determine that the worn position of the authentication terminal **10** is unsuitable. In a case where the muscle potential is equal to the muscle potential for determination that is determined in advance, the determination unit **46** may determine that the worn position of the authentication terminal **10** is suitable, or may determine that the worn position of the authentication terminal **10** is unsuitable. This determination may be performed by proper setting. Moreover, it is preferable that the determination unit **46** makes a determination of the worn position with the amplitude, as is, of the muscle potential, without correcting the muscle potential that is indicated by the muscle potential information, that is, without multiplying the muscle potential by the correction coefficient. Furthermore, the determination unit **46** may extract a frequency of the muscle potential that changes over time, which is indicated by the muscle potential information, as a feature value, and, with a difference between the frequency and a frequency for determination that is determined in advance, may determine whether or not the worn position of the authentication terminal **10** is suitable. Additionally, with both of the amplitude of the muscle potential and the frequency of the muscle potential as feature values, the determination unit **46** may determine whether or not the worn position of the authentication terminal **10** is suitable. In a case where it is determined that the worn position is suitable, as described above, based on the cardiac potential, the determination unit **46** may determine whether or not the target person OP is a registrant and may generate the authentication information. On the other hand, in a case where it is determined that the worn position is unsuitable, the determination unit **46** may cause the reporting unit **22** to report to the target person OP that the worn position is unsuitable, using any one of an image, audio, and vibration.

[0036] The determination unit **46** may provide information relating to a state of the target person OP based on the calculated cardiac potential. For example, the determination unit **46** may cause the reporting unit **22** to report a health state relating to a pulse wave or the like of the target person OP, which is calculated from the cardiac potential that is

registered in the registrant database **52**, or may output the health state together with the authentication information to the control device **32**.

[0037] The registration unit **48** registers one, or two or more feature values that are extracted from cardiac potential of a new target person OP, as pieces of cardiac potential information, in the registrant database **52** that is stored in the terminal-side storage unit **42**. For example, the registration unit **48** calculates a potential difference that results from removing the muscle potential that is indicated by the muscle potential information from the measurement potential that is indicated by the measurement potential information, as cardiac potential. At this point, the registration unit **48** may calculate the cardiac potential using muscle potential for correction, which results from correcting the muscle potential that is indicated by the muscle potential information. For example, the registration unit **48** multiplies the muscle potential, which is indicated by the muscle potential information, by the correction coefficient, makes a scale adjustment, and calculates the muscle potential for correction. The registration unit **48** extracts one, or two or more feature values that are indicated by the calculated cardiac potential, as pieces of cardiac potential information, and registers the cardiac potential information in the registrant database **52**, in a state of being associated with a registrant ID indicating a registrant.

[0038] The terminal-side storage unit **42** has storage devices, such as a Random Access Memory (RAM), a Read Only Memory (ROM), a Solid State Drive (SSD), and a Hard Disk Driver (HDD), that are connected to the terminal-side processing unit **40**. The terminal-side storage unit **42** may be a storage device that is provided outside and is connected to the terminal-side processing unit **40** through a network. Stored in the terminal-side storage unit **42** are a program that is executed by the terminal-side control unit **26**, data necessary to execute the program, and data that is generated by executing the program. For example, the registration and authentication program **50** that is executed by the terminal-side control unit **26** is stored in the terminal-side storage unit **42**. Moreover, instead of the registration and authentication program **50**, a registration program for registering a registrant and an authentication program for authenticating the target person OP may be individually stored in the terminal-side storage unit **42**. The registrant database **52** and the numerical data **54** are stored, as pieces of data necessary for executing the registration and authentication program **50**, in the terminal-side storage unit **42**. The registrant database **52**, for example, is a database that results from associating a registrant ID indicating a registrant and cardiac potential information on the registrant with each other. Pieces of numerical data **54** include a correction coefficient that is used to execute the registration and authentication program **50**, a numerical value for determination, a threshold, and the like. The measurement potential information, the muscle potential information, and the like on the target person OP are temporarily stored in the terminal-side storage unit **42**.

[0039] The control device **32**, for example, is a computer, such as an Electronic Control Unit (ECU), that is provided in a vehicle, such as a motor car. The control device **32** is configured in such a manner that information is possibly transmitted and received through communication such as wireless communication with the authentication terminal **10**. Based on the authentication information on the target person OP, which is received from the authentication terminal **10**, the control device **32** controls a control target CO of a vehicle. The control target CO, for example, is a driving source, such as an engine or a motor, a door lock of a vehicle, an air conditioner, or the like. The control device **32** has an apparatus-side processing unit **62** and an apparatus-side storage unit **64**.

[0040] The apparatus-side processing unit **62**, for example, is a hardware processor such as a CPU. The apparatus-side processing unit **62** reads a control program **66** that is stored in the apparatus-side storage unit **64**, and thus performs various controls. For example, when acquiring the authentication information that the target person OP is a registrant, from the authentication terminal **10**, the apparatus-side processing unit **62** unlocks a door lock of a vehicle, and causes a driving source, such as an engine, to start, or approves starting.

[0041] The apparatus-side storage unit **64** has storage devices, such as a RAM, a ROM, an SSD, and a HDD. The apparatus-side storage unit **64** may be a storage device that is provided outside and is connected to the apparatus-side processing unit **62** through a network. Stored in the apparatus-side storage unit **64** are the control program **66** that is executed by the apparatus-side processing unit **62**, data that is necessary to execute the control program **66**, and the like.

[0042] FIG. **5** is a graph for describing a waveform of cardiac potential of an ordinary person. As illustrated in FIG. **5**, the waveform (that is, an electrocardiogram) of the cardiac potential of the ordinary person includes a plurality of peaks. The plurality of peaks, for example, include a P wave, a Q wave, an R wave, an S wave, a T wave, a U wave, and the like.

[0043] FIG. **6** is a table illustrating an example of the registrant database **52**. As illustrated in FIG. **6**, the registrant database **52** includes one, or two or more registrant IDs, and each registrant ID is associated with one piece of, or two or more pieces of cardiac potential information. The two or more pieces of cardiac potential information may be feature values of different waveforms of cardiac potential. For example, a feature value of a waveform of cardiac potential may be any one of amplitude (that is, potential difference), a wave width, and an inter-wave interval of each of a P wave, a Q wave, an R wave, an S wave, a T wave, and U wave. The wave width is time from a starting point to an ending point of each of the P wave, the Q wave, the R wave, the S wave, the T wave, and the U wave. The starting and ending points are time at which potential exceeds a reference value that is determined in advance and time at which potential is at or below the reference value, respectively. The inter-wave interval is a time interval between two starting points or ending points of each of the P wave, the Q wave, the R wave, the S wave, the T wave, and the U wave.

[0044] FIG. **7** is a flowchart illustrating an example of each of the authentication processing and the control processing that are performed by the authentication system **30**. A flowchart on the right side of FIG. **7** is a flowchart for the authentication processing that is performed by the authentication terminal **10**. A flowchart on the left side of FIG. **7** is a flowchart for the control processing that is performed by the control device **32**. The authentication terminal **10** reads the registration and authentication program **50** and thus performs the authentication processing. The control device **32** reads the control program **66**, and thus performs the control processing.

[0045] As illustrated in FIG. **7**, when the authentication processing starts, the acquisition unit **44** determines whether or not the authentication instruction is acquired (S**102**). For example, when the target person OP inputs the authentication instruction using the input unit **24**, the acquisition unit **44** may determine that the authentication instruction is acquired. Furthermore, when the finger Fg of the target person OP makes contact with the second electrode **16** and thus the measurement potential changes, the acquisition unit **44** may determine that authentication instruction is acquired. The acquisition unit **44** repeats Step S**102** until the authentication instruction is acquired, and is in a standby state (No in S**102**).

[0046] On the other hand, when it is determined that the authentication instruction is acquired (Yes in S**102**), the acquisition unit **44** causes the light emitting unit **18** to emit the measurement light, acquires the muscle potential information from the light receiving unit **20** that receives the measurement light which is reflected by the target person OP, and outputs the acquired muscle potential information to the determination unit **46** (S**104**). The determination unit **46** extracts a feature value, such as the amplitude or the frequency of the muscle potential, from the muscle potential information (S**106**). Based on the feature value of the muscle potential and the muscle potential for determination, the determination unit **46** determines whether the worn position of the authentication terminal **10** is suitable (S**108**). For example, in a case where the amplitude, as the feature value of the muscle potential, is lower than the muscle potential for determination, the determination unit **46** determines that the worn position of the authentication terminal **10** is not suitable (No in S**108**). In this case, using any one of an image, audio, and vibration, the determination unit **46** causes the reporting unit **22** to report that the worn position of the authentication terminal **10** is unsuitable (S**110**). Accordingly, the target person OP that wears the authentication terminal **10** changes the worn position of the authentication terminal **10**. Thereafter, the acquisition unit **44** and the determination unit **46** again perform processing in Step S**104** and processing in each of the subsequent steps on the authentication terminal **10** of which the worn position is changed.

[0047] On the other hand, in a case where the amplitude, as the feature value of the muscle potential, is higher than the muscle potential for determination, the determination unit **46** determines that the worn position of the authentication terminal **10** is suitable (Yes in S**108**). In this case, the acquisition unit **44** acquires the measurement potential information from the first electrode **14** and the second electrode **16**, and outputs the acquired measurement potential information to the determination unit **46** (S**112**).

[0048] The determination unit **46** corrects the muscle potential that is indicated by the muscle potential information (S**116**). For example, the determination unit **46** multiplies the muscle potential by the correction coefficient that is determined in advance, and make a correction by making the scale adjustment. Based on the corrected muscle potential and the measurement potential that is indicated by the measurement potential information, the determination unit **46** calculates the cardiac potential (S**118**). For example, the determination unit **46** uniformly removes the corrected muscle potential from the measurement potential, and thus calculates the cardiac potential. The determination unit **46** extracts one, or two or more feature values of the cardiac potential from the calculated cardiac potential (S**120**). The feature value of the cardiac potential, for example, is amplitude, a wave width, an inter-wave interval, and the like of each of the P wave, the Q wave, the R wave, the S wave, the T wave, and the U wave.

[0049] The determination unit **46** determines whether or not the target person OP who wears the authentication terminal **10** is a registrant (S**122**). For example, based on the extracted feature value of the cardiac potential and the cardiac potential information in the registrant database **52**, the determination unit **46** determines whether or not the target person OP is a registrant. In a case where the cardiac potential information that is consistent with the extracted feature value of the cardiac potential is not registered in the registrant database **52**, the determination unit **46** determines that the target person OP is not a registrant (No in S**122**), and determines whether or not the number of times that it is determined that the target person OP is a registrant is a prescribed number of times (S**124**). The prescribed number of times may be set in advance and may be stored, as one portion of the numerical data **54**, in the terminal-side storage unit **42**. When it is determined that the number of times of determination does not reach the prescribed number of times (No in S**124**), the determination unit **46** repeats Step S**112** and subsequent steps. Moreover, in a case where the number of times of determination does not reach the prescribed number of times, the determination unit **46** may repeat Step S**104** and subsequent steps. Accordingly, the acquisition unit **44** and the determination unit **46** acquire the measurement potential information multiple times, and based on a plurality of pieces of measurement potential information, determine whether or not the target person OP is a registrant. Because of this, the registrant can be suppressed from not being authenticated.

[0050] When it is determined that the number of times of determination reaches the prescribed number of times (Yes in S**124**), the determination unit **46** causes the reporting unit **22** to report that the target person OP is not registered in the registrant database **52**, using any one of an image, audio, and vibration (S**126**), and the terminal-side processing unit **40** ends the authentication processing.

[0051] In a case where the extracted feature value of the cardiac potential is registered in the registrant database **52**, the determination unit **46** determines that the target person OP is a registrant (Yes in S**122**), and transmits the authentication information that the target person OP is a registrant, to the control device **32** (S**128**). The determination unit **46** causes the reporting unit **22** to report that the target person OP is a registrant, using any one of an image, audio, and vibration (S**130**). Moreover, the determination unit **46** may cause the reporting unit **22** to report the health state of the target person OP relating to the pulse wave or the like, based on the information that the target person OP is a registrant, the cardiac potential and the muscle potential, and the like, and may output the health state to the control device **32**, along with the authentication information. Accordingly, the terminal-side processing unit **40** ends the authentication processing.

[0052] In the control device **32**, during the control processing, the apparatus-side processing unit **62** determines whether or not the authentication information that the target person OP is a registrant is acquired from the authentication terminal **10** (S**150**). The apparatus-side processing unit **62** is in the standby state until the authentication information is

acquired from the authentication terminal **10** (No in S**150**). When receiving from the authentication terminal **10** the information that the target person OP is a registrant (Yes in S**150**), the apparatus-side processing unit **62** controls the control target CO (S**152**). For example, the apparatus-side processing unit **62** unlocks a door lock of a vehicle, and controls an air conditioner according to prior registration, or causes a driving source, such as an engine. Additionally, in a case where the health state of the target person OP is acquired along with the authentication information, the apparatus-side processing unit **62** may control the air conditioner in accordance with the health state. Accordingly, the apparatus-side processing unit **62** ends the control processing.

[0053] FIG. **8** is a flowchart illustrating an example of the registration processing that is performed by the authentication terminal **10**. The authentication terminal **10** reads the registration and authentication program **50** and thus performs the registration processing. Among steps of the registration processing, a description of a step that is the same as the step of the authentication processing is simplified.

[0054] As illustrated in FIG. **8**, in the registration processing, the acquisition unit **44** determines whether or not the registration instruction is acquired (S**202**). For example, when the target person OP inputs the registration instruction using the input unit **24**, the acquisition unit **44** may determine that the registration instruction is acquired. The acquisition unit **44** is in the standby state until the registration instruction is acquired (No in S**202**). When acquiring the registration instruction (Yes in S**202**), the acquisition unit **44** causes the light emitting unit **18** to emit the measurement light, acquires muscle potential information from the light receiving unit **20**, and outputs the acquired muscle potential information to the registration unit **48** (S**204**). The acquisition unit **44** acquires the measurement potential information from the first electrode **14** and the second electrode **16**, and outputs the acquired measurement potential information to the registration unit **48** (S**206**).

[0055] The registration unit **48** corrects the muscle potential that is indicated by the muscle potential information, by making, for example, the scale adjustment that uses the correction coefficient (S**208**). The registration unit **48** removes the corrected muscle potential from the measurement potential that is indicated by the measurement potential information, and calculates the cardiac potential (S**210**), and extracts one feature value or a set of two or more feature values of the cardiac potential (S**212**). The registration unit **48** determines whether or not the number of times that the feature value is extracted is the number of times of registration (S**214**). The number of times of registration may be stored, as one portion of the numerical data **54** that is set in advance, in the terminal-side storage unit **42**. When it is determined that the number of times of extraction is not the number of times of registration (No in S**214**), the registration unit **48** repeats Step S**204** and subsequent steps, and repeats the extraction of the feature value of the cardiac potential. Accordingly, the registration unit **48** extracts sets of feature values, of which the number is the same as the number of times of registration.

[0056] When it is determined that the number of times of extraction reaches the number of times of registration (Yes in S**214**), the registration unit **48** generates one piece of, or two or more pieces of cardiac potential information that are registered in the registrant database **52**, from one feature or a set of two or more feature values that are extracted (S**216**). For example, the registration unit **48** may generate an average value of each feature value as the cardiac potential information. Furthermore, the registration unit **48** may exclude an outlier or an abnormal value or the like from a plurality of feature values, and then may generate an average value of the calculated feature value as the cardiac potential information. The registration unit **48** registers one piece of, or two or more pieces of cardiac potential information in the registrant database **52** in a state of being associated with a new registrant ID (S**218**). Accordingly, the terminal-side processing unit **40** ends the registration processing.

[0057] As described above, in the authentication terminal **10**, the first electrode **14** and the second electrode **16** measure the measurement potential including the cardiac potential and generate the measurement potential information, and the light emitting unit **18** and the light receiving unit **20** measure the muscle potential and generate the muscle potential information. In this manner, the light emitting unit **18** and the light receiving unit **20** for measuring the muscle potential are provided separately from the electrodes **14** and **16**, and thus the authentication terminal **10** can improve the precision of the measurement of the muscle potential. Accordingly, although the state (for example, while in a walking or stopping state) of the target person OP changes, the authentication terminal **10** can measure the muscle potential that is close to actual muscle potential. As a result, the authentication terminal **10** removes high-precision muscle potential from the measurement potential and calculates the cardiac potential, compared with a case where regardless of the state of the target person OP, the muscle potential is uniformly removed from the measurement potential using a band pass filter. Because of this, the authentication terminal **10** can calculate the high-precision cardiac potential and thus can improve the precision of the authentication of the registrant using the cardiac potential.

[0058] Furthermore, the authentication terminal **10** calculates the cardiac potential based on the high-precision muscle potential regardless of the state of the target person OP. Therefore, the authentication terminal **10** can calculate the high-precision cardiac potential that is not influenced by the state of the target person OP. Because of this, one set of pieces of cardiac potential information on each registrant has to be registered in the registrant database **52**. Accordingly, the authentication terminal **10** can reduce an amount of data in the registrant database **52** compared with a case where a plurality of sets of cardiac potential information that correspond to a plurality of states of the target person OP are registered as in the authentication terminal that has the band pass filter. Additionally, the authentication terminal **10** can compare one set of pieces of cardiac potential information that corresponds to each registrant and a set of measured feature values of the cardiac potential and thus can perform the authentication, without the need to compare the plurality of sets of pieces of cardiac potential information that correspond to the plurality of states and the measured feature value of the cardiac potential. Because of this, the time required for the authentication can be shortened.

[0059] In the authentication terminal **10**, the first electrode **14** is provided inside of the casing **12** in the shape of a ring, and the second electrode **16** is provided outside of the casing **12**. Accordingly, the first electrode **14** makes contact with one arm Ar (for example, the vicinity of the wrist) of the target person OP, and the second electrode **16** makes contact

with the finger Fg of the other arm of the target person OP. Because of this, the authentication terminal **10** can increase a difference between a path from the first electrode **14** and heart of the target person OP and a path from the second electrode **16** to the heart of the target person OP. As a result, the authentication terminal **10** can improve the precision of the measurement of the cardiac potential regardless of a position of the heart of the target person OP.

[0060] Based on the muscle potential and the muscle potential for determination, the authentication terminal **10** determines whether or not the worn position of the authentication terminal **10** is suitable. In a case where the authentication terminal **10** determines that the worn position is suitable, the authentication terminal **10** can determine whether or not the target person OP is a registrant, based on the cardiac potential, and can generate the authentication information. Furthermore, in a case where the worn position is unsuitable, the authentication terminal **10** can report to the target person OP that the worn position is unsuitable and can provide a guidance so that the worn position becomes suitable, without determining whether or not the target person OP is a registrant. In this manner, the authentication terminal **10** determines the target person OP based on the cardiac potential in a case where the authentication terminal **10** is worn on a suitable position and performs the authentication. Because of this, the authentication terminal **10** can improve the precision for the authentication. Additionally, the authentication terminal **10** determines the worn position based on the muscle potential. Because of this, the authentication terminal **10** can improve the precision of the determination of the worn position compared with a case where the worn position is determined with the measurement potential in which noise increases because a plurality of potentials are included such as the muscle potential and the cardiac potential.

[0061] The authentication terminal **10** removes the muscle potential that results from correcting the amplitude of the muscle potential, from the measurement potential, and calculates the cardiac potential. Accordingly, the authentication terminal **10** can associate a scale of the muscle potential that is measured by the light receiving unit **20**, with a scale of the measurement potential that includes the cardiac potentials which are measured in the electrodes **14** and **16**. Because of this, the authentication terminal **10** can improve the precision of the calculation of the cardiac potential.

[0062] In the authentication terminal **10**, the light emitting unit **18** emits blue light, as the measurement light for measuring the muscle potential, to the target person OP. Accordingly, the authentication terminal **10** reduces an influence on a capillary vessel or the like within the body in a case where light with a long wavelength, such as green light, is emitted, and thus can measure the high-precision muscle potential from the surface of the body of the target person OP.

[0063] The authentication terminal **10** determines whether or not the target person OP is a registrant, based on the cardiac potential and the registrant database **52**, and outputs the authentication information, which is generated based on a result of the determination, to the control device **32**. Accordingly, the authentication terminal **10** can reduce an amount of data in the authentication information compared with a case where the cardiac potential or the feature value of the cardiac potential is transmitted as the authentication information to the control device **32**.

[0064] A function of a configuration, a connection relationship, the number of constituent elements, a shape, an arrangement, and the like in the embodiment described above are properly changed, deleted, and so on within the scope of the invention and the scope that is equivalent to the scope of the invention. The order of steps according to the embodiment may be properly changed.

[0065] In the above-described embodiment, as an example, the authentication system **30** in which the control device **32** is mounted in a vehicle or the like is described, but the authentication system **30** is not limited to this. For example, the authentication system **30** may find application in an authentication system that includes a control device which locks or unlocks a key to a door of a house.

[0066] In the above-described embodiment, the authentication terminal **10** sets the result of the authentication, which is obtained by determining whether or not the target person OP is a registrant based on the feature value of the cardiac potential and the cardiac potential information in the registrant database **52**, to be the authentication information, but the authentication information is not limited to this. For example, the authentication terminal **10** may generate the feature value of the cardiac potential as the authentication information, and may transmit the resulting authentication information to the control device **32**. In this case, the control device **32** may have the registrant database **52**, and may determine whether or not the target person OP is a registrant, based on the feature value of the cardiac potential that is indicated by the authentication information which is acquired from the authentication terminal **10**, and on the registrant database **52**.

[0067] In the above-described embodiment, as an example, the authentication terminal **10** that determines whether or not the target person OP is a registrant, using the cardiac potential, but the authentication terminal **10** may determine whether or not the target person OP is a registrant, using any other piece of information in addition to the cardiac potential, and thus may improve the robustness of the authentication. For example, the authentication terminal **10** may output as the authentication information the result of the determination that is obtained by determining whether or not the target person OP is a registrant who is registered in the registrant database that is set in advance, based on any one of authentication that uses a fingerprint, authentication that uses a finger vein, authentication that uses a gait which is detected by an acceleration sensor, and authentication that uses an iris, in addition to the authentication that uses the cardiac potential. Accordingly, the authentication terminal **10** can improve the robustness of the authentication. Additionally, the authentication that uses a fingerprint may be performed along with the measurement of the measurement potential, with the second electrode **16** as a transparent electrode.

[0068] An authentication terminal according to an aspect of this disclosure includes: a casing that is worn on a body of a target person; first and second electrodes that are provided in the casing and measure a measurement potential as biological information; a light emitting unit that is provided in the casing and emits measurement light for measuring a muscle potential to the body of the target person; a light receiving unit that receives the measurement light and outputs muscle potential information which corresponds to the muscle potential; and a terminal-side control unit that outputs authentication information which is generated based

on the muscle potential that is indicated by the muscle potential information, and on a cardiac potential that is calculated from the measurement potential between the first electrode and the second electrode to another device.

[0069] In the authentication terminal according to the aspect of this disclosure, the first electrode and the second electrode measure the measurement potential including the cardiac potential and the muscle potential is measured using the light emitting unit and the light receiving unit. In this manner, the authentication terminal that includes the light emitting unit and the light receiving unit, separately from the electrodes, and thus can reduce an influence due to a state of the target person and can improve the precision of the measurement of the muscle potential. Accordingly, the authentication terminal can improve the precision of the cardiac potential that is calculated from the muscle potential and the measurement potential, and can improve the precision of the authentication of the registrant, which uses the cardiac potential.

[0070] In the authentication terminal according to the aspect of this disclosure, the casing may be in the shape of a ring, the first electrode may be provided inside of the casing, the second electrode may be provided outside of the casing, and the measurement potential may be measured by causing one portion of the body of the target person to make contact with both of the first electrode and the second electrode.

[0071] With this configuration, in the authentication terminal according to the aspect of this disclosure, the first electrode makes contact with one arm or the like of the target person, and the second electrode makes contact with the finger of the other arm of the target person. Because of this, a difference between a path from the first electrode and the heart and a path from the second electrode to the heart increases. As a result, the authentication terminal can improve the precision of the measurement of the cardiac potential.

[0072] In the authentication terminal according to the aspect of this disclosure, based on the muscle potential that is indicated by the muscle potential information, and on a muscle potential for determination, which is registered in advance by the target person, the terminal-side control unit may determine whether or not a worn position of the authentication terminal is suitable, and the terminal-side control unit may generate the authentication information in a case where the worn position is determined as suitable, and may report to the target person that the worn position is unsuitable, in a case where the worn position is determined as unsuitable.

[0073] In this manner, the authentication terminal according to the aspect of this disclosure determines whether or not the worn position of the authentication terminal is suitable, based on the muscle potential that has the high precision of the calculation and the muscle potential for determination. The authentication terminal generates the authentication information in a case where the worn position is suitable, and makes a report in a case where the worn position is unsuitable. With this configuration, with the determination that is based on the cardiac potential that is measured in a suitable worn position, the authentication terminal can further improve the authentication information.

[0074] In the authentication terminal according to the aspect of this disclosure, the terminal-side control unit may remove the muscle potential that results from correcting an amplitude of the muscle potential that is indicated by the muscle potential information, from the measurement potential, and may calculate the cardiac potential.

[0075] With this configuration, the authentication terminal according to the aspect of this disclosure can associate a scale of the muscle potential that is measured by the light receiving unit, with a scale of the measurement potential that includes the cardiac potentials which are measured in the electrodes. Because of this, the authentication terminal can improve the precision of the calculation of the cardiac potential.

[0076] In the authentication terminal according to the aspect of this disclosure, the light emitting unit may emit blue light as the measurement light.

[0077] With this configuration, the authentication terminal according to this disclosure can measure the high-precision muscle potential, without being influenced by a capillary vessel or the like within the body.

[0078] In the authentication terminal according to the aspect of this disclosure, the terminal-side control unit may output, as the authentication information, a result of the determination that is obtained by determining whether or not the target person is registered in a registrant database that is set in advance based on the cardiac potential.

[0079] With this configuration, the authentication terminal according to the aspect of this disclosure can reduce an amount of data in the authentication information that is output.

[0080] In the authentication terminal according to the aspect of this disclosure, the terminal-side control unit may output, as the authentication information, the result of the determination that is obtained by determining whether or not the target person is registered in the registrant database that is set in advance based on a fingerprint or a finger vein.

[0081] With this configuration, the authentication terminal according to the aspect of this disclosure can improve the robustness of the authentication.

[0082] The principles, preferred embodiment and mode of operation of the present invention have been described in the foregoing specification. However, the invention which is intended to be protected is not to be construed as limited to the particular embodiments disclosed. Further, the embodiments described herein are to be regarded as illustrative rather than restrictive. Variations and changes may be made by others, and equivalents employed, without departing from the spirit of the present invention. Accordingly, it is expressly intended that all such variations, changes and equivalents which fall within the spirit and scope of the present invention as defined in the claims, be embraced thereby.

What is claimed is:

1. An authentication terminal comprising:

a casing that is worn on a body of a target person;

first and second electrodes that are provided in the casing and measure a measurement potential as biological information;

a light emitting unit that is provided in the casing and emits measurement light for measuring a muscle potential to the body of the target person;

a light receiving unit that receives the measurement light and outputs muscle potential information which corresponds to the muscle potential; and

a terminal-side control unit that outputs authentication information which is generated based on the muscle

potential that is indicated by the muscle potential information, and on a cardiac potential that is calculated from the measurement potential between the first electrode and the second electrode to another device.

2. The authentication terminal according to claim **1**,

wherein the casing is in the shape of a ring,

the first electrode is provided inside of the casing,

the second electrode is provided outside of the casing, and

the measurement potential is measured by causing one portion of the body of the target person to make contact with both of the first electrode and the second electrode.

3. The authentication terminal according to claim **1**,

wherein, based on the muscle potential that is indicated by the muscle potential information, and on a muscle potential for determination, which is registered in advance by the target person, the terminal-side control unit determines whether or not a worn position of the authentication terminal is suitable, and

the terminal-side control unit generates the authentication information in a case where the worn position is determined as suitable, and reports to the target person that the worn position is unsuitable, in a case where the worn position is determined as unsuitable.

4. The authentication terminal according to claim **1**,

wherein the terminal-side control unit removes the muscle potential that results from correcting an amplitude of the muscle potential that is indicated by the muscle potential information, from the measurement potential, and calculates the cardiac potential.

5. The authentication terminal according to claim **1**,

wherein the light emitting unit emits blue light as the measurement light.

6. The authentication terminal according to claim **1**,

wherein, the terminal-side control unit outputs, as the authentication information, a result of the determination that is obtained by determining whether or not the target person is registered in a registrant database that is set in advance based on the cardiac potential.

7. The authentication terminal according to claim **6**,

wherein the terminal-side control unit outputs, as the authentication information, the result of the determination that is obtained by determining whether or not the target person is registered in the registrant database that is set in advance based on a fingerprint or a finger vein.

* * * * *

专利名称(译)	认证终端		
公开(公告)号	US20190166122A1	公开(公告)日	2019-05-30
申请号	US16/199365	申请日	2018-11-26
[标]申请(专利权)人(译)	爱信精机株式会社		
申请(专利权)人(译)	爱信精机株式会社		
当前申请(专利权)人(译)	爱信精机株式会社		
[标]发明人	MOCHIZUKI KENTA AOYAGI YOSUKE		
发明人	MOCHIZUKI, KENTA AOYAGI, YOSUKE		
IPC分类号	H04L29/06 G06F21/32 A61B5/117 A61B5/22 A61B5/024 A61B5/00 A61B5/0408		
CPC分类号	H04L63/0861 G06F21/32 A61B5/117 A61B5/224 A61B5/02438 A61B5/6801 A61B5/0408 A61B5/02427 A61B5/0245 A61B5/0404 A61B5/681 H04W12/06		
优先权	2017227091 2017-11-27 JP		
外部链接	Espacenet USPTO		

摘要(译)

认证终端包括：佩戴在目标人体上的外壳;第一和第二电极设置在壳体中并测量作为生物信息的测量电位;发光单元，设置在壳体中并发射测量光，用于测量目标人体的肌肉电位;光接收单元，接收测量光并输出对应于肌肉电位的肌肉电位信息;终端侧控制单元，输出基于由肌肉电位信息指示的肌肉电位产生的认证信息，以及根据第一电极和第二电极之间的测量电位计算到另一个的心电位。设备。