US 20190374170A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2019/0374170 A1
(43) Pub. Date: Dec. 12, 2019
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(54) **INFORMATION PROCESSING APPARATUS AND INFORMATION PROCESSING PROGRAM**

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(21) Appl. No.: **16/549,010**

(22) Filed: **Aug. 23, 2019**

**Related U.S. Application Data**

(63) Continuation of application No. PCT/JP2018/004914, filed on Feb. 13, 2018.

(30) **Foreign Application Priority Data**

Mar. 14, 2017 (JP) ................................ 2017-048725

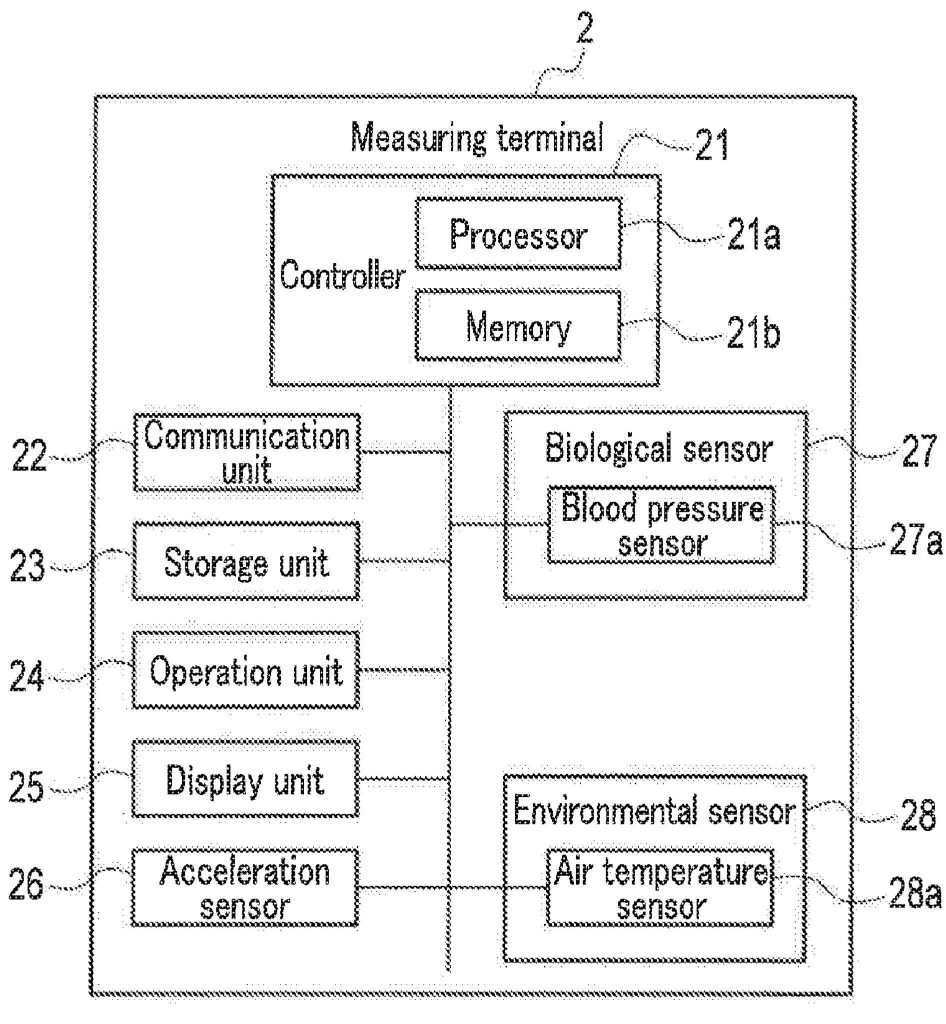
**Publication Classification**

(51) **Int. Cl.**
*A61B 5/00* (2006.01)
*A61B 5/0205* (2006.01)

(52) **U.S. Cl.**
CPC .......... ***A61B 5/7275*** (2013.01); ***A61B 5/0205*** (2013.01); ***A61B 5/0002*** (2013.01); ***A61B 5/021*** (2013.01); ***A61B 5/743*** (2013.01); ***A61B 5/4818*** (2013.01); ***A61B 5/7246*** (2013.01)

(57) **ABSTRACT**

An information processing apparatus of the invention includes an information acquisition circuit configured to acquire, from a specific subject to be measured, successively measured blood pressure data and measurement data of a plurality of elements other than a blood pressure, a blood pressure fluctuation detection circuit configured to detect a blood pressure fluctuation of a reference value or more from the successively measured blood pressure data which is acquired by the information acquisition circuit, and a display controller configured to cause a display device to display blood pressure data and measurement data.



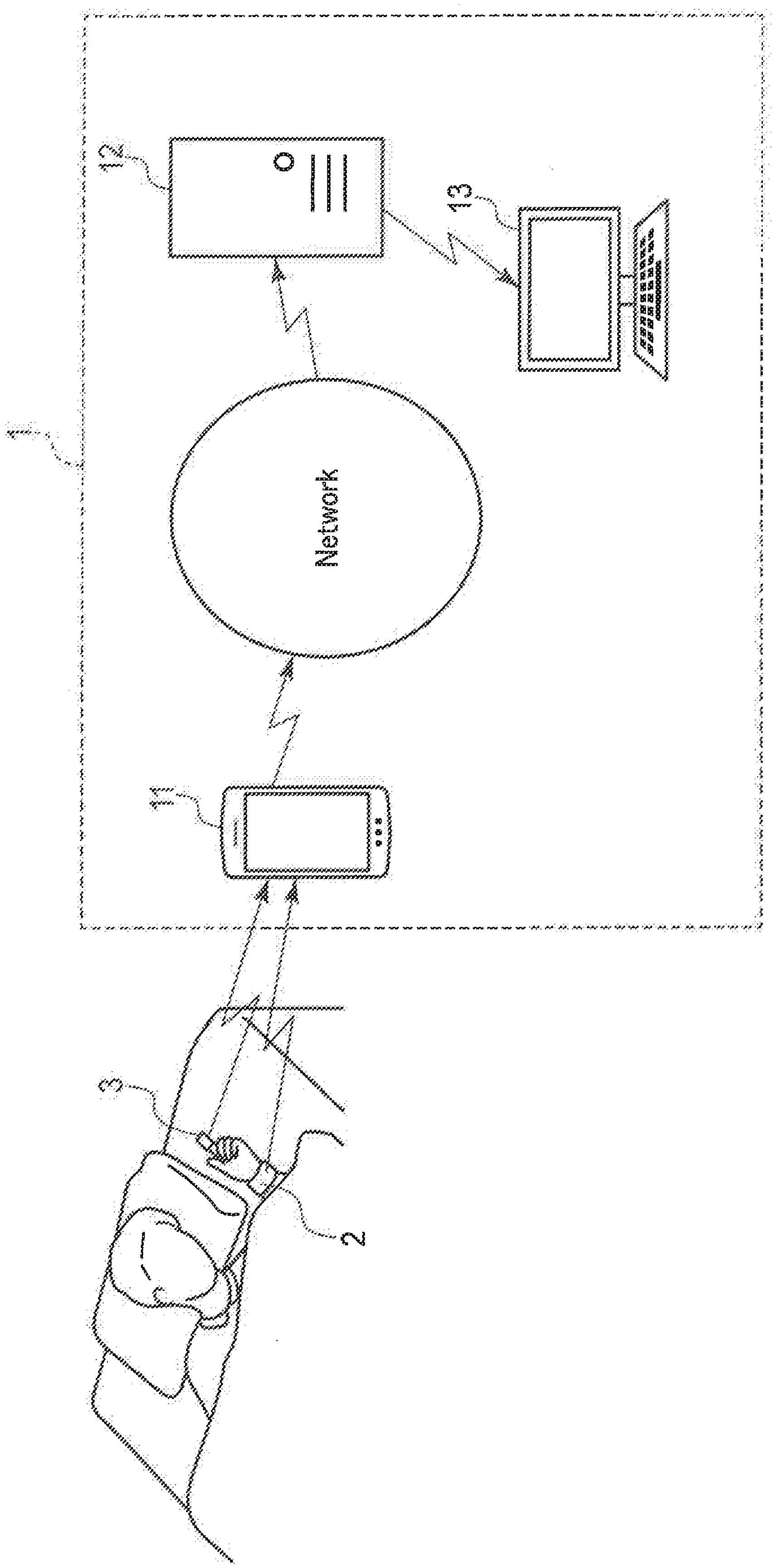
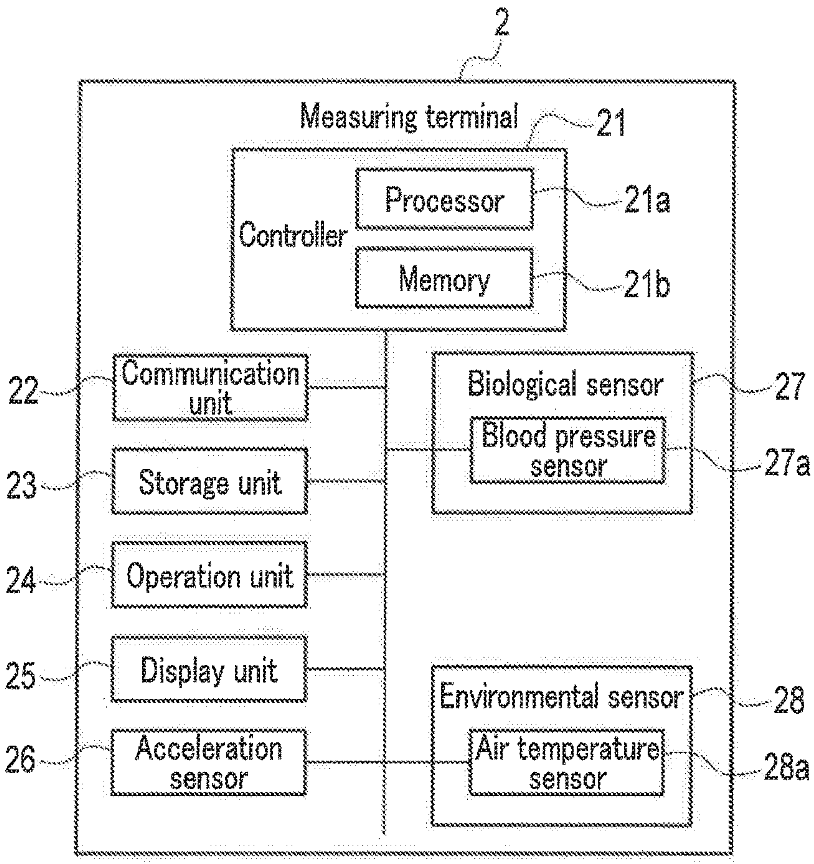
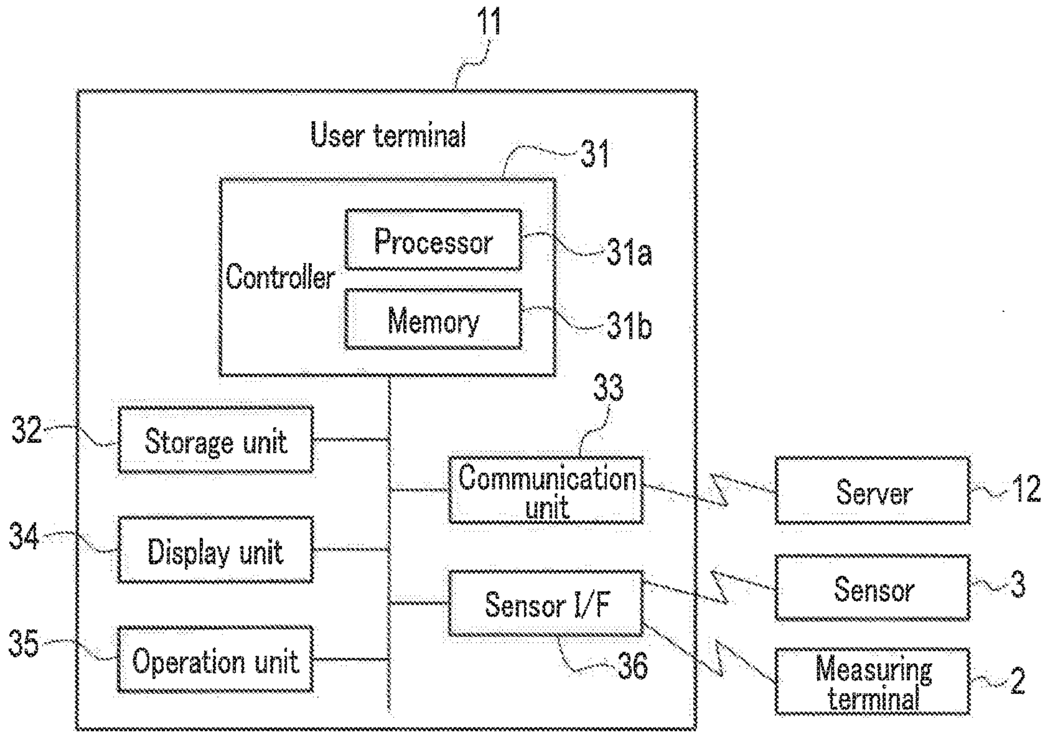



FIG. 1


2
Measuring terminal
21
Controller
Processor
21a
Memory
21b
22
Communication unit
23
Storage unit
24
Operation unit
25
Display unit
26
Acceleration sensor
Biological sensor
27
Blood pressure sensor
27a
Environmental sensor
28
Air temperature sensor
28a

F I G. 2


11
User terminal
31
Controller
Processor
31a
Memory
31b
32
Storage unit
34
Display unit
35
Operation unit
33
Communication unit
Sensor I/F
36
Server
12
Sensor
3
Measuring terminal
2

F I G. 3

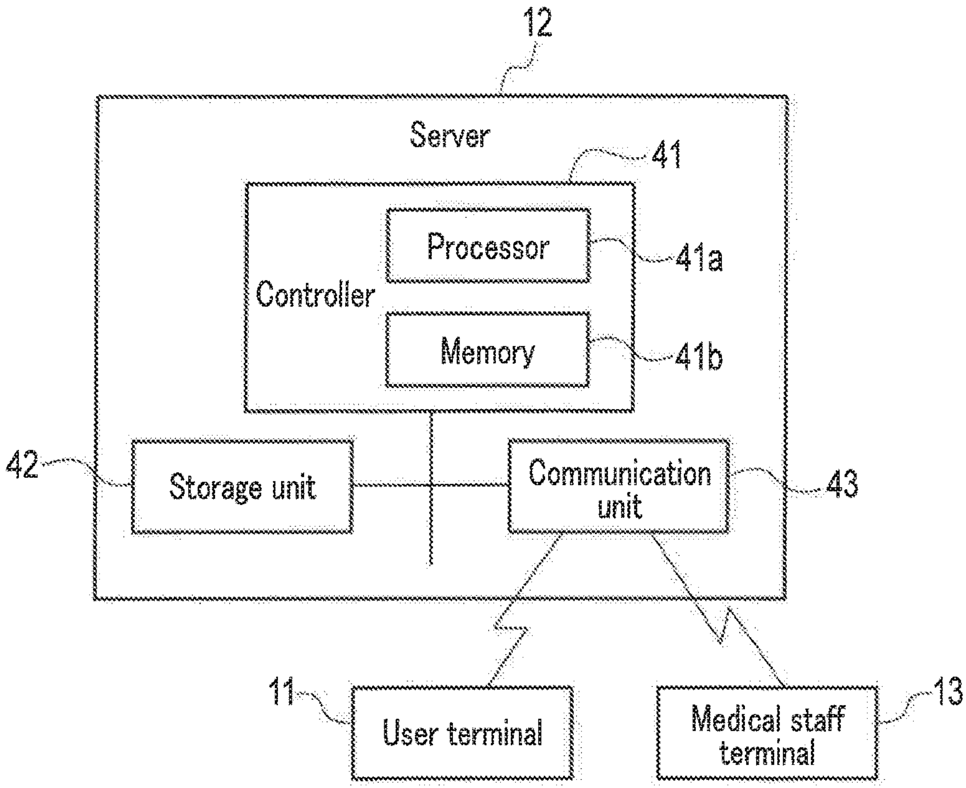

12
Server
41
Processor
41a
Controller
Memory
41b
42
Storage unit
Communication unit
43
11
User terminal
Medical staff terminal
13

FIG. 4

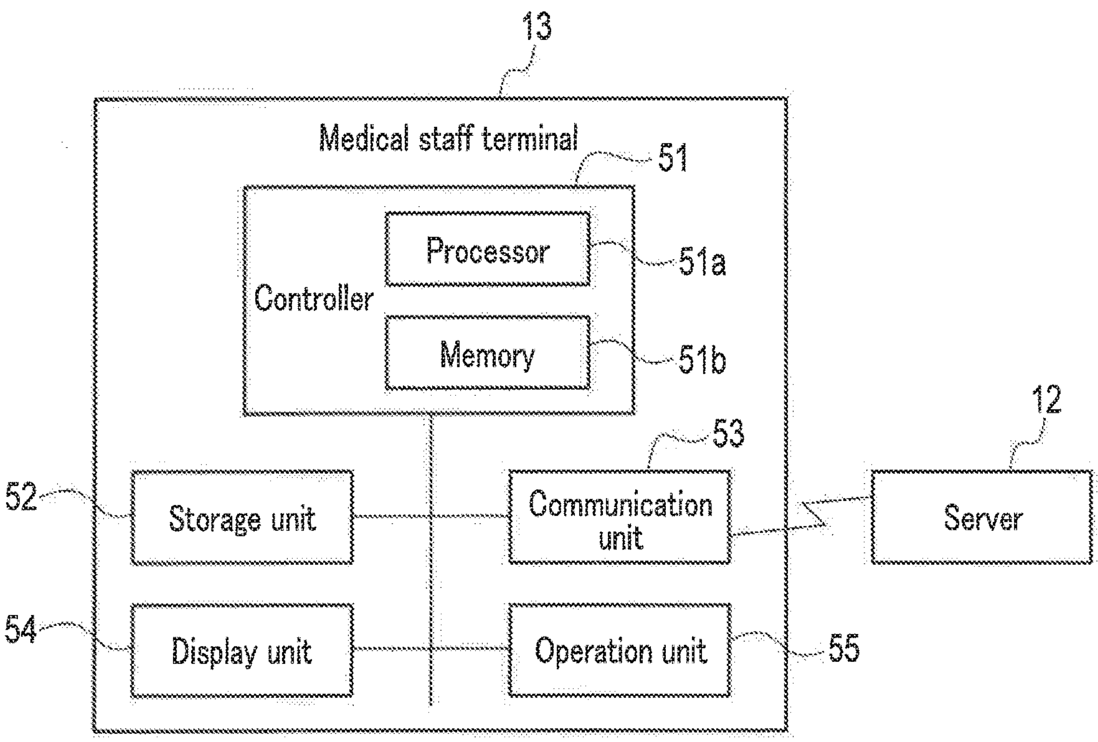

13
Medical staff terminal
51
Processor
51a
Controller
Memory
51b
53
12
52
Storage unit
Communication unit
Server
54
Display unit
Operation unit
55

FIG. 5

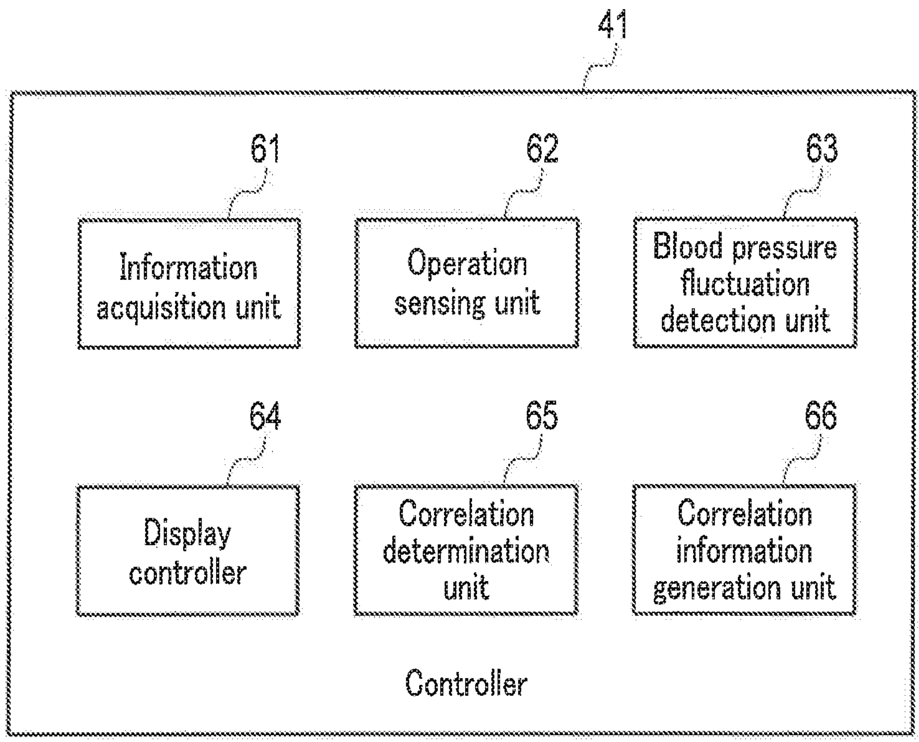
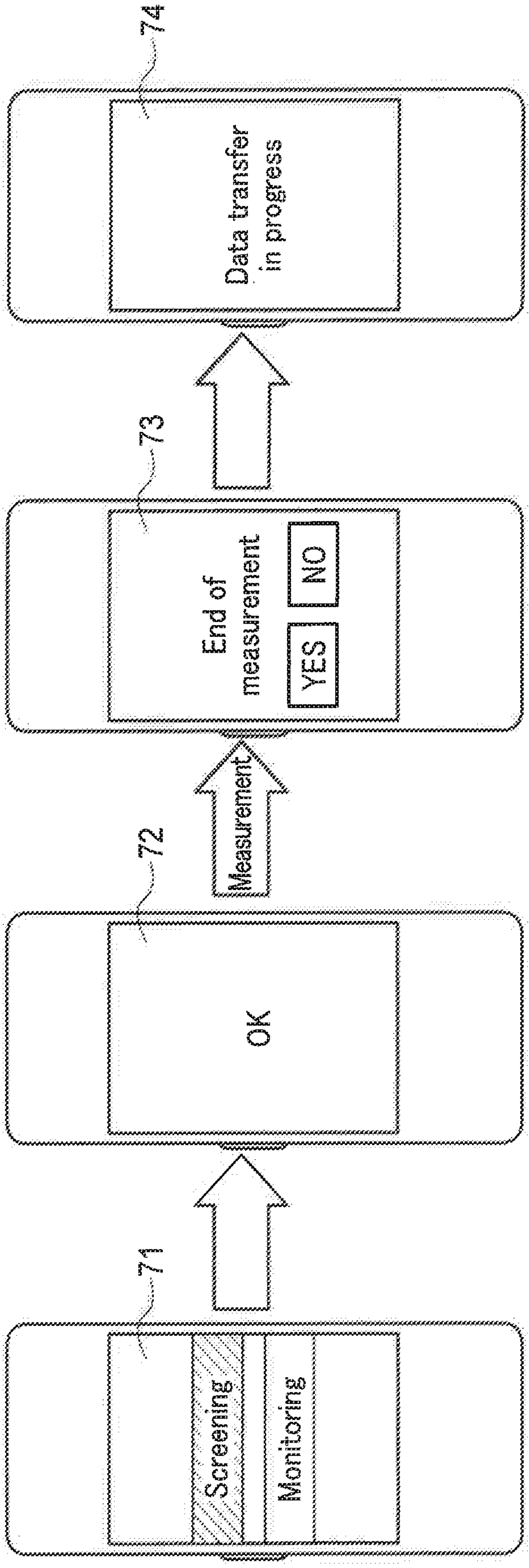
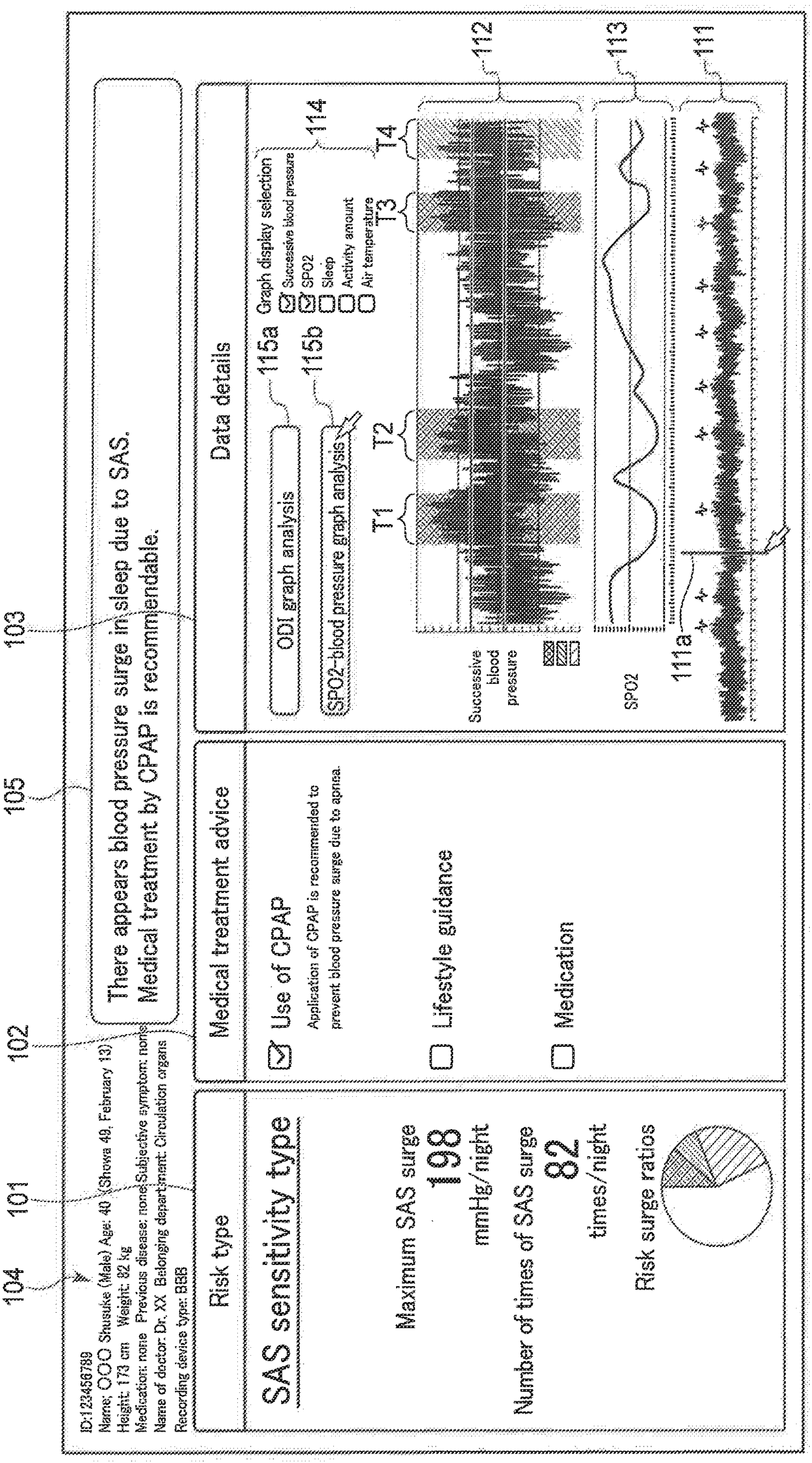

41
61
Information acquisition unit
62
Operation sensing unit
63
Blood pressure fluctuation detection unit
64
Display controller
65
Correlation determination unit
66
Correlation information generation unit
Controller

FIG. 6



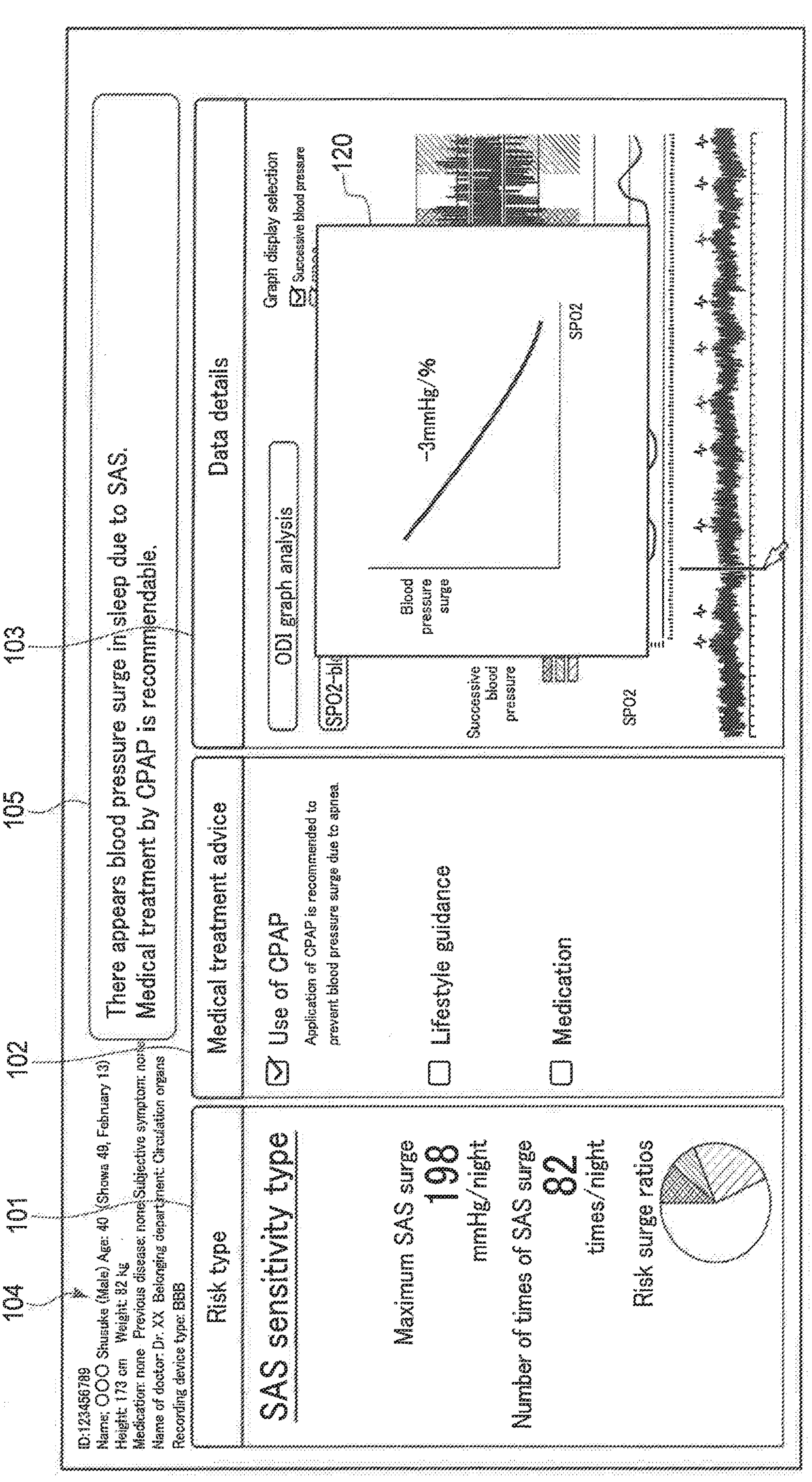
71
Screening
Monitoring
72
OK
Measurement
73
End of measurement
YES
NO
74
Data transfer in progress


FIG. 7



104
101
102
105
103
ID:123456789
Name; OOO Shusuke (Male) Age: 40 (Showa 49, February 13)
Height: 173 cm Weight: 82 kg
Medication: none Previous disease: none Subjective symptom: none
Name of doctor: Dr. XX Belonging department: Circulation organs
Recording device type: BBB
There appears blood pressure surge in sleep due to SAS.
Medical treatment by CPAP is recommendable.
Risk type
SAS senstivity type
Maximum SAS surge
198
mmHg/night
Number of times of SAS surge
82
times/night
Risk surge ratios
Medical treatment advice
Use of CPAP
Application of CPAP is recommended to prevent blood pressure surge due to apnea.
Lifestyle guidance
Medication
Data details
ODI graph analysis
SPO2-blood pressure graph analysis
115a
115b
Graph display selection
Successive blood pressure
SPO2
Sleep
Activity amount
Air temperature
114
112
113
111
111a
T1
T2
T3
T4
Successive blood pressure
SPO2


F I G. 8


104
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Risk type
SAS sensitivity type
Maximum SAS surge
198
mmHg/night
Number of times of SAS surge
82
times/night
Risk surge ratios
Medical treatment advice
Use of CPAP
Application of CPAP is recommended to prevent blood pressure surge due to apnea.
Lifestyle guidance
Medication
Data details
ODI graph analysis
Graph display selection
Successive blood pressure
SPO2-bl
Blood pressure surge
-3mmHg/%
SPO2
Successive blood pressure
SPO2

FIG. 9

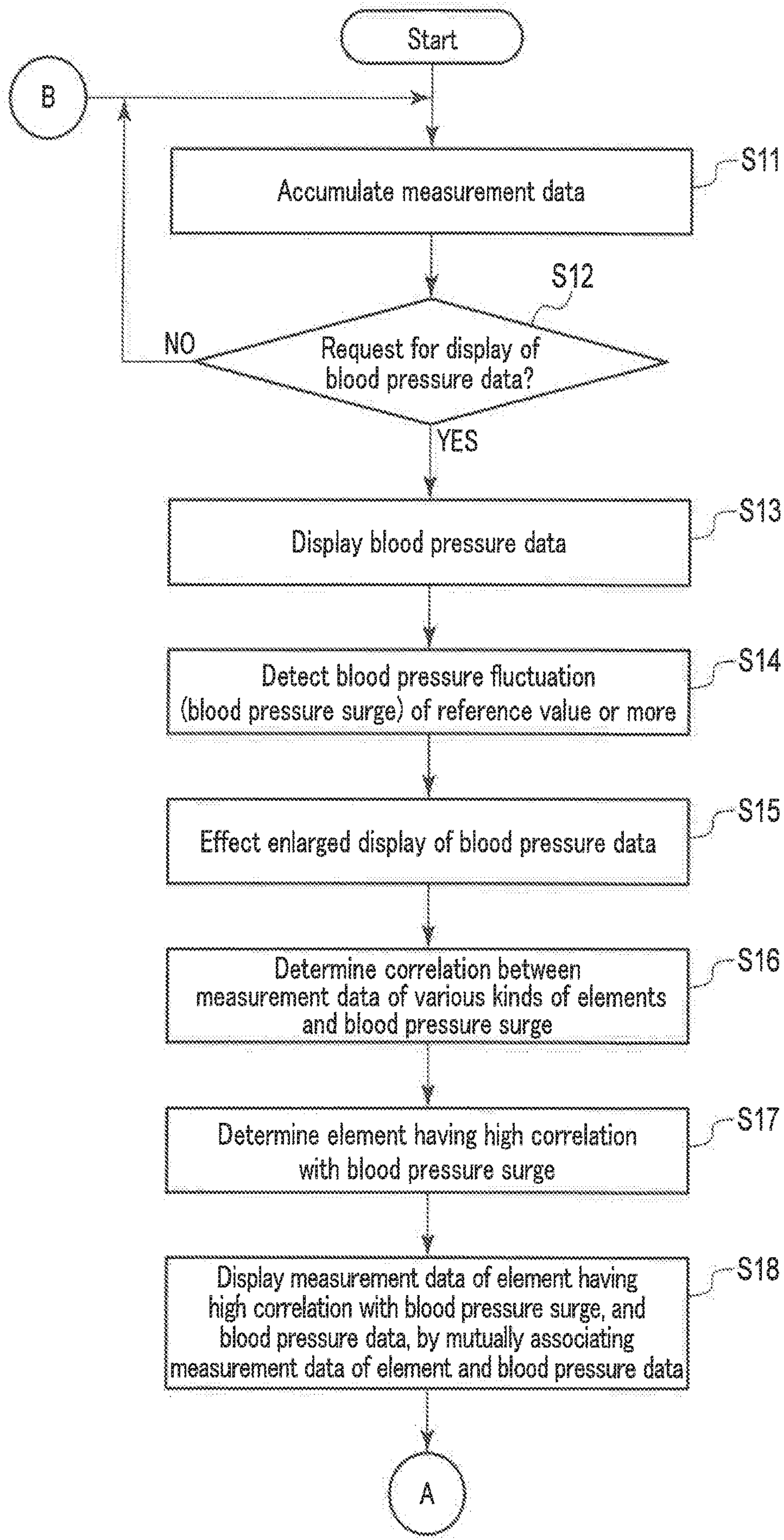
Start
B
Accumulate measurement data
S11
S12
Request for display of blood pressure data?
NO
YES
Display blood pressure data
S13
Detect blood pressure fluctuation (blood pressure surge) of reference value or more
S14
Effect enlarged display of blood pressure data
S15
Determine correlation between measurement data of various kinds of elements and blood pressure surge
S16
Determine element having high correlation with blood pressure surge
S17
Display measurement data of element having high correlation with blood pressure surge, and blood pressure data, by mutually associating measurement data of element and blood pressure data
S18
A

FIG. 10

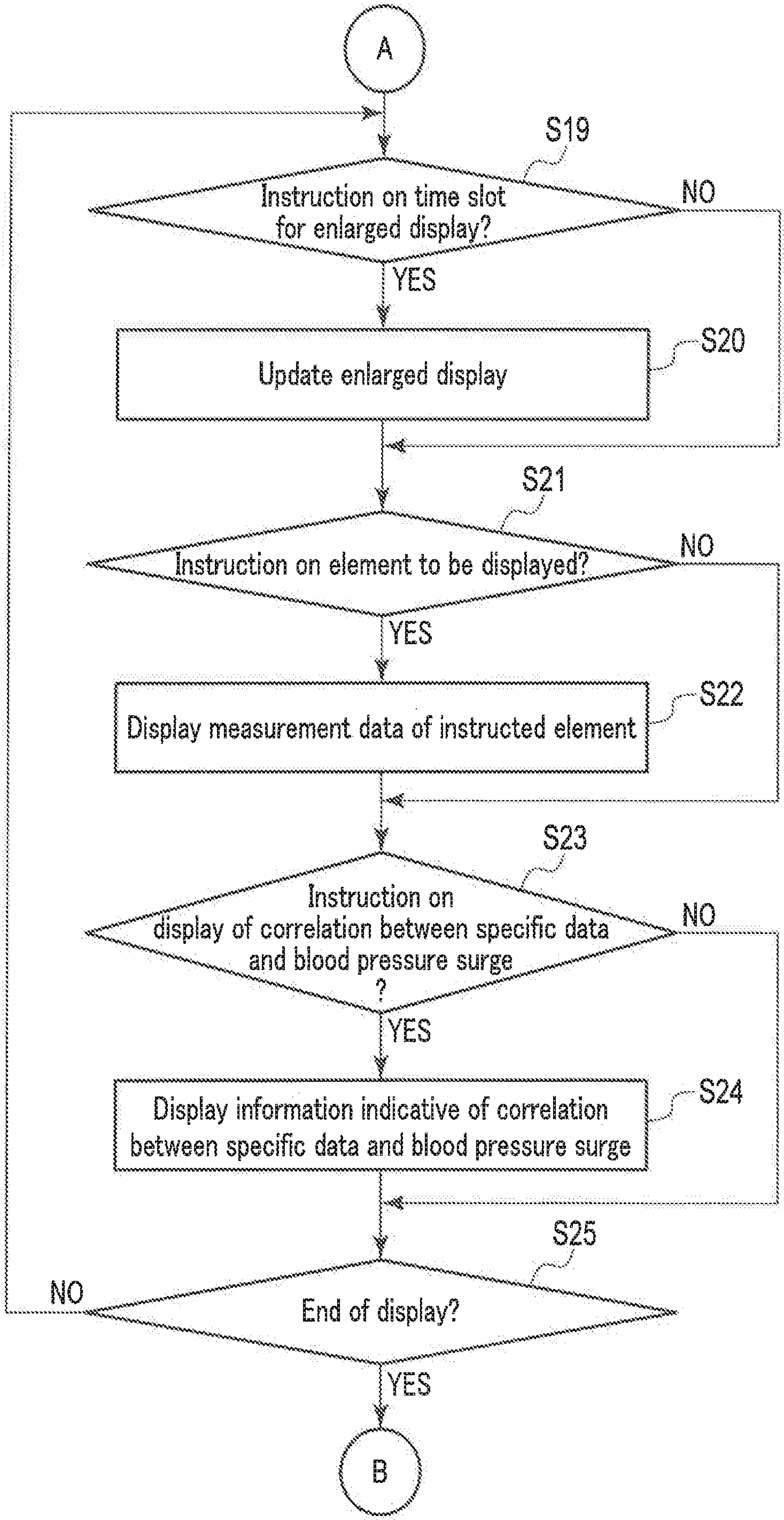
A
S19
Instruction on time slot for enlarged display?
NO
YES
S20
Update enlarged display
S21
Instruction on element to be displayed?
NO
YES
S22
Display measurement data of instructed element
S23
Instruction on display of correlation between specific data and blood pressure surge ?
NO
YES
S24
Display information indicative of correlation between specific data and blood pressure surge
S25
NO
End of display?
YES
B

FIG. 11

# INFORMATION PROCESSING APPARATUS AND INFORMATION PROCESSING PROGRAM

## CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a Continuation Application of PCT Application No. PCT/JP2018/004914, filed Feb. 13, 2018 and based upon and claiming the benefit of priority from Japanese Patent Application No. 2017-048725, filed Mar. 14, 2017, the entire contents of all of which are incorporated herein by reference.

## FIELD

[0002] The present invention relates to an information processing apparatus and an information processing program, and more specifically to an information processing apparatus and an information processing program, which display, on a display screen, information relating to a blood pressure of a subject to be measured.

## BACKGROUND

[0003] Conventionally, as an apparatus which displays information relating to a blood pressure of a subject to be measured, for example, as disclosed in Jpn. Pat. Appln. KOKAI Publication No. 2004-261452, there is proposed a blood pressure monitor which stores in a memory a measured blood pressure value, and measurement time information and a measurement condition by mutually associating the measured blood pressure value, and the measurement time information and measurement condition, calculates an average value which is acquired by averaging blood pressure values measured multiple times in a specified time slot, and calculates and displays a risk value, based on the calculated result.

[0004] In addition, in recent years, it is proposed that a blood pressure of a subject to be measured is successively measured for a long time (e.g. at night, or 24 hours) by a portable blood pressure monitor, and healthcare of the subject to be measured is performed based on the measured result.

## SUMMARY

[0005] An information processing apparatus according to a first aspect of the invention comprises an information acquisition circuit configured to acquire, from a specific subject to be measured, successively measured blood pressure data and measurement data of a plurality of elements other than a blood pressure, a blood pressure fluctuation detection circuit configured to detect a blood pressure fluctuation of a reference value or more from the successively measured blood pressure data which is acquired by the information acquisition circuit, and a display controller configured to cause a display device to display blood pressure data in an enlargement period including a time slot of the blood pressure fluctuation of the reference value or more, which the blood pressure fluctuation detection circuit detects, and measurement data of at least one of the elements other than the blood pressure in the enlargement period, by associating the blood pressure data in the enlargement period and the measurement data of the at least one of the elements.

[0006] In addition to the first aspect, the information processing apparatus according to a second aspect of the invention further comprises a correlation determination circuit configured to determine a correlation between measurement data of each of the elements other than the blood pressure, which the information acquisition circuit acquires, and the blood pressure fluctuation of the reference value or more, which the blood pressure fluctuation detection circuit detects, wherein the display controller is configured to cause the display device to display measurement data of an element determined by the correlation determination circuit to have a high correlation with the blood pressure fluctuation of the reference value or more, by associating the measurement data of the element with the blood pressure data in the enlargement period.

[0007] In addition to the second aspect, in the information processing apparatus according to a third aspect of the invention, the display controller is configured to update, in accordance with an instruction by an operator on an element that is to be displayed in the enlargement period, the element, which is displayed by being associated with the blood pressure data in the enlargement period, to the element which the operator designates.

[0008] In addition to any one of the first to third aspects, in the information processing apparatus according to a fourth aspect of the invention, the display controller is configured to update, in accordance with an instruction by an operator on an enlargement period, the enlargement period, which is displayed on the display device, to the enlargement period which the operator designates.

[0009] In addition to any one of the first to fourth aspects, the information processing apparatus according to a fifth aspect of the invention further comprises a correlation information generation circuit configured to generate correlation information which indicates a correlation between a specific element and the blood pressure fluctuation of the reference value or more, wherein the display controller is configured to cause the display device to display the correlation information which the correlation information generation circuit generates in accordance with a display instruction of an operator.

[0010] In addition to any one of the first to fifth aspects, in the information processing apparatus according to a sixth aspect of the invention, the information acquisition circuit is configured to acquire the successively measured blood pressure data by a blood pressure sensor of any one of a PTT method, a tonometry method, an optical method, a radio wave method, and ultrasonic method.

[0011] According to the first aspect of the present invention, the blood pressure data in the enlargement period, which is based on the detection result of the blood pressure fluctuation of the reference value or more with respect to an enormous amount of blood pressure data successively measured for a long time, can be enlargedly displayed. Further, measurement data of one element selected from a plurality of elements other than the blood pressure can be displayed by being associated with the enlargedly displayed blood pressure data. As a result, from among the enormous amount of measurement data, the blood pressure fluctuation to be noticed and the measurement data of other elements can be displayed in an easy-to-view state for persons, the load for medical treatment and healthcare of the subject to be measured can be reduced, and the improvement of the health condition of the subject to be measured can be supported.

**[0012]** According to the second aspect of the present invention, the correlation between the blood pressure fluctuation of the reference value or more and each of the elements other than the blood pressure can be determined, and the measurement data of the element determined to have a high correlation with the blood pressure fluctuation can be displayed on the display device by being associated with the blood pressure data. As a result, the load for medical treatment and healthcare of the subject to be measured can be reduced, and the improvement of the health condition of the subject to be measured can be supported.

**[0013]** According to the third aspect of the present invention, the operator can designate the element which is displayed by being associated with the blood pressure data. Thus, the correlation between the measurement data of the various elements and the blood pressure data can easily be confirmed, and the precision of diagnosis can be enhanced while the load for diagnosis by medical staff or the like is reduced.

**[0014]** According to the fourth aspect of the present invention, the operator can give an instruction on the enlargement period for enlargement display. Thus, the correlation between the blood pressure data and the measurement data of the element other than the blood pressure in the time slot designated by the operator can easily be visually confirmed, and the precision of diagnosis can be enhanced while the load for diagnosis by medical staff or the like is reduced.

**[0015]** According to the fifth aspect of the present invention, the correlation information indicative of the correlation between the specific element and the blood pressure surge can be displayed on the display device in accordance with the operator's instruction. Thus, the precision of diagnosis can be enhanced while the load for diagnosis by medical staff or the like is reduced.

**[0016]** According to the sixth aspect of the present invention, the successively measured blood pressure data is not limited to the data measured by the blood pressure sensor of a specific method. It is possible to provide information for understanding the health condition of the user, based on the blood pressure data measured by measuring devices of various methods.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0017]** FIG. **1** is a view schematically illustrating a configuration example of a management system of measurement data, which includes an information processing system functioning as an information processing apparatus according to an embodiment of the present embodiment.

**[0018]** FIG. **2** is a block diagram illustrating a configuration example of a measuring terminal illustrated in FIG. **1**.

**[0019]** FIG. **3** is a block diagram illustrating a configuration example of a user terminal illustrated in FIG. **1**.

**[0020]** FIG. **4** is a block diagram illustrating a configuration example of a server illustrated in FIG. **1**.

**[0021]** FIG. **5** is a block diagram illustrating a configuration example of a medical staff terminal illustrated in FIG. **1**.

**[0022]** FIG. **6** is a block diagram for explaining functions which the server illustrated in FIG. **1** includes.

**[0023]** FIG. **7** is a view illustrating a transition example of an operation screen which is displayed when measurement is performed in the measuring terminal illustrated in FIG. **1**.

**[0024]** FIG. **8** is a view illustrating a display example of blood pressure-related information based on measurement data which the information processing system displays.

**[0025]** FIG. **9** is a view illustrating a display example of blood pressure-related information based on measurement data which the information processing system displays.

**[0026]** FIG. **10** is a flowchart for explaining an operation example of the server functioning as the information processing system.

**[0027]** FIG. **11** is a flowchart for explaining an operation example of the server functioning as the information processing system.

## DETAILED DESCRIPTION

**[0028]** Hereinafter, embodiments according to the present invention will be described with reference to the accompanying drawing.

**[0029]** It is proposed that a blood pressure of a subject to be measured is successively measured for a long time (e.g. at night, or 24 hours) by a portable blood pressure monitor, and healthcare of the subject to be measured is performed based on the measured result.

**[0030]** However, even if an enormous amount of data of blood pressure values acquired by successive measurement over a long time is simply presented to a user, it is difficult for the user to correctly understand the health condition. In addition, even for a person (hereinafter referred to as "medical staff") such as a doctor, who has expertise in the field of medical practice and health, it is a great load for the person to understand the health condition of the subject to be measured, from the enormous amount of data of blood pressure values.

**[0031]** Besides, there are various conceivable factors in a sharp increase (surge) of a blood pressure, which is considered to have a close relation to a cerebral cardiovascular event. Thus, in order to determine the factors in the surge detected from the data of successively measured blood pressure values, it is necessary to collect many indices (many kinds of measurement data) and to analyze the relation to the surge with respect to each index. Even for the medical staff, it is not easy to analyze such factors in the surge.

**[0032]** The present invention has been made in consideration of the above-described circumstance, and the object of the invention is to provide an information processing apparatus and an information processing program, which can make it easier to understand the health condition of a subject to be measured, by measurement data of a plurality of kinds of information including data of successively measured blood pressure values.

**[0033]** FIG. **1** is a view schematically illustrating a configuration example of a management system of measurement data, which includes an information processing system **1** including an information processing apparatus according to an embodiment, a measuring terminal **2**, and a sensor **3**.

**[0034]** The management system of measurement data is a system including the information processing system (information processing apparatus) **1**, the measuring terminal **2**, and the sensor **3**. The information processing system **1** acquires measurement data of various elements from the measuring terminal **2** and sensor **3**, and analyzes the acquired measurement data. The information processing system **1** includes a user terminal **11**, a server **12** and a medical staff terminal **13**.

**[0035]** In the configuration example illustrated in FIG. **1**, the measuring terminal **2** and sensor **3** are connected to the user terminal **11**, and the user terminal **11** is communicably connected to the server **12** via a network. Further, the server **12** is communicably connected to the medical staff terminal **13** by wireless communication or wire communication. However, the configurations of the management system of measurement data and the information processing system **1** are not limited to the configurations illustrated in FIG. **1**.

**[0036]** For example, the measuring terminal **2** and sensor **3** may be communicably connected to the server **12**, without intervention of the user terminal **11**. In this case, the user terminal **11** can be omitted, and the operation of the user terminal **11**, which will be described later, may be implemented by the measuring terminal **2** or server **12**. In addition, the sensor **3** may be connected to not the user terminal **11** but the measuring terminal **2**. In this case, the sensor **3** may be configured to be communicable with the user terminal **11** or server **12** via the measuring terminal **2**. Further, the sensor **3** may be provided in the measuring terminal **2**.

**[0037]** Besides, some or all of the functions (processes), which the server **12** to be described later realizes, may be implemented by the user terminal **11** or medical staff terminal **13**, or may be implemented by the cooperation between the user terminal **11** or medical staff terminal **13**, and the server **12**. Further, some or all of the functions of the user terminal **11** to be described later, the functions of the server **12** and the functions of the medical staff terminal **13** may be implemented by the measuring terminal **2**. For example, the information which the server **12** provides may be displayed by a display unit of the user terminal **11** or may be displayed by a display unit of the measuring terminal **2**.

**[0038]** The measuring terminal **2** includes a function of successively measuring at least the blood pressure value of a subject to be measured (user). The measuring terminal **2** is, for example, a wearable terminal device such as a wristwatch-type terminal device. The measuring terminal **2** includes not only the function of successively measuring the user's blood pressure values, but also a function of measuring biological data such as an activity amount, the number of steps and a sleep state, and environmental data such as a temperature and humidity.

**[0039]** The measuring terminal **2** includes a plurality of sensors for measuring the biological data and environmental data. For example, the measuring terminal **2** includes a biological sensor group (biological sensors) including sensors for detecting signals indicative of values of various kinds of biological information, such as a blood pressure, in a state of being in contact with or in close proximity to a part of the body of the subject to be measured. A biological sensor that the measuring terminal **2** includes is configured to be put in contact with, or in close proximity to, a predetermined position on the subject to be measured, for example, by a band or the like. In addition, the measuring terminal **2** also includes environmental sensors (environmental sensor group) including sensors for detecting signals indicative of values of a temperature, humidity and the like, which represent the environment in which the subject to be measured is present.

**[0040]** The sensor **3** is a sensor which detects a signal indicative of a value of a specific element that is a target of measurement. The sensor **3** is, for example, a sensor which detects a value of arterial oxygen saturation (SPO2) indicative of the state of sleep apnea syndrome (SAS), and is worn on a predetermined part (e.g. a fingertip) of the subject to be measured. The sensor **3** includes a communication function for communication with the user terminal **11**, and sends measured data to the user terminal. The sensor **3** may be communicably connected to the measuring terminal **2**, or may include a function of a communicable connection to the server **12**. In the system configuration illustrated in FIG. **1**, one kind of sensor **3** is provided, but a plurality of kinds of sensors may be provided.

**[0041]** The user terminal **11** is an information communication terminal which an individual user uses. The user terminal **11** is, for example, a portable information communication terminal such as a smartphone, a mobile phone, a tablet PC, or a note PC. It should suffice if the user terminal **11** is capable of transferring at least data measured by the measuring terminal **2** and sensor **3** to the server **12**. In the management system of measurement data, the user terminal **11** is present at least for each user. In addition, an individual user may have a plurality of user terminals.

**[0042]** The server **12** includes a communication function with the user terminal **11**, and a communication function with the medical staff terminal **13**. In the configuration example illustrated in FIG. **1**, it is assumed that the server **12** communicates with the user terminal **11** via a wide area network, and communicates with the medical staff terminal **13** via a local area network. However, it should suffice if the server **12** can communicate with both the user terminal **11** and medical staff terminal **13**, and the method of communication and the mode of communication are not limited to specific ones. The server **12** acquires measurement data, which is measured by the measuring terminal **2** and sensor **3**, from the user terminal **11**, and analyzes the acquired measurement data. In addition, the server **12** provides the measurement data, the analysis result of measurement data and the like to the medical staff terminal **13**.

**[0043]** The medical staff terminal **13** is an information communication apparatus which medical staff uses who instructs a treatment policy to the user or proposes an improvement of a lifestyle to the user. The user terminal **11** is, for example, an information communication apparatus including an information display function, such as a desktop PC, a note PC, or a tablet PC. The medical staff terminal **13** displays, on a display device, information which is provided from the server **12**. In addition, the medical staff terminal **13** includes a function of requesting the server **12** to execute various processes (information display) in accordance with an operation by medical staff.

**[0044]** FIG. **2** is a block diagram illustrating a configuration example of the measuring terminal **2** illustrated in FIG. **1**.

**[0045]** The measuring terminal **2** includes a controller **21**, a communication unit **22**, a storage unit **23**, an operation unit **24**, a display unit **25**, an acceleration unit **26**, a biological sensor **27**, and an environmental sensor **28**.

**[0046]** The controller **21** includes at least one processor **21***a*, and a memory **21***b*. The processor **21***a* executes programs by using the memory **21***b*, and thereby the controller **21** realizes various kinds of operation control and data processing. The processor **21***a* is, for example, a CPU (Central Processing Unit) or an MPU (Micro Processing Unit) including arithmetic circuitry. The memory **21***b* includes a nonvolatile memory (a non-transitory computer-readable storage medium) which stores programs that the processor **21**_a_ executes, and a volatile memory such as a RAM which is used as a work memory. In addition, the controller **21** includes a clock (not shown) and includes a clock function which measures the present date/time.

**[0047]** In the controller **21**, the processor **21**_a_ executes programs which the memory **21**_b_ or storage unit **23** (a non-transitory computer-readable storage medium) stores, and thereby the processor **21**_a_ can execute control of respective components and data processing. Specifically, the processor **21**_a_ executes operational control of respective components according to operation signals from the operation unit **24**, and executes data processing on measurement data which the biological sensor **27** and environmental sensor **28** measure. For example, the controller **21** executes an operation in a mode (screening mode) which successively measures various kinds of information including a blood pressure value of a subject to be measured, in accordance with an instruction by the operation unit **24**.

**[0048]** The communication unit **22** is a communication interface for communicating with the user terminal **11**. The communication unit **22** transmits data to the user terminal **11**, and receives data from the user terminal **11**. The communication by the communication unit **22** may be either wireless communication or wire communication. In the present embodiment, the description is given on the assumption that the communication unit **22** communicates with the user terminal **11** by short-range wireless communication. However, aside from this, the communication unit **22** may communicate with the user terminal **11** by using a communication cable, or may communicate with the user terminal **11** via a network such as a LAN (Local Area Network).

**[0049]** The storage unit **23** stores data of programs for controlling the measuring terminal **2**, setup data for setting up various functions of the measuring terminal **2**, and measurement data which the acceleration sensor **26**, biological sensor **27** and environmental sensor **28** measure. In addition, the storage unit **23** may be configured to be used as a work memory when a program is executed.

**[0050]** The operation unit **24** is composed of operation devices such as a touch panel and operation buttons (operation keys). The operation unit **24** detects an operation by a user (a subject to be measured), and outputs an operation signal indicative of the content of the operation to the controller **21**. In addition, the operation unit **24** may include, for example, aside from the touch panel and operation buttons, a speech recognition unit which recognizes an operation instruction by the user's speech, a biological authentication unit which authenticates a biological part of the user, and an image recognition unit which recognizes the user's facial expression or gesture by an image acquired by photographing the user's face or body.

**[0051]** The display unit **25** includes, for example, a display screen (for example, an LCD (Liquid Crystal Display), EL (Electroluminescence) display or the like), an indicator, and the like, and displays information according to a control signal from the controller **21**. In the present embodiment, the description is given on the assumption that the operation unit **24** and display unit **25** are composed of a display including a touch panel.

**[0052]** The acceleration sensor **26** detects an acceleration which the main body of the measuring terminal **2** receives. For example, the acceleration sensor acquires acceleration data of three axes or six axes. The acceleration data can be used in order to estimate the activity amount (posture and/or motion) of the user wearing the measuring terminal **2**. The controller **21** can correlate the acceleration data, which the acceleration sensor **26** measures, with measurement time instants that are based on time instant information, and can output the correlated data as measurement data.

**[0053]** For example, when the user is sleeping, a change in posture of the subject to be measured, which can be estimated from the acceleration data, may become data indicative of the sleep state (depth of sleep) of the subject to be measured. The sleep state is information which may become a factor in the blood pressure fluctuation of the user. The controller **21** correlates the acceleration data, which the acceleration sensor **26** measures while the user is sleeping, with the measurement time instants, and outputs the correlated data as measurement data in the sleep state (measurement data of one element other than the blood pressure).

**[0054]** In addition, when the user is up, a change in motion, which can be estimated from the acceleration data, may become data indicative of the activity amount (e.g. activity amount by exercise such as walking or running) of the user. The activity amount is information which may become a factor in the blood pressure fluctuation of the user. The controller **21** correlates the acceleration data, which the acceleration sensor **26** measures while the user is up, with the measurement time instants, and outputs the correlated data as measurement data of the activity amount (measurement data of one element other than the blood pressure).

**[0055]** Note that whether the user is sleeping or up may be detected based on the user's motion which the acceleration sensor **26** detects, or whether the user is sleeping or up may be determined according to the user's operation. In the latter case, for example, the user may indicate that the user is in the sleep state before the user sleeps by the operation unit **24**, or may indicate that the user is up at the time of getting up by the operation unit **24**.

**[0056]** The biological sensor **27** measures biological information of the user, and outputs biological data that is measurement data of the biological information. The controller **21** outputs measurement data (biological data) in which each data output from the biological sensor **27** is correlated with measurement time instants which are set based on time instant information. The biological sensor **27** includes at least a blood pressure sensor **27**_a_. The blood pressure sensor **27**_a_ successively measures the blood pressure value of the user. The controller **21** outputs measurement data (blood pressure data) in which the blood pressure value that the blood pressure sensor **27**_a_ measures is correlated with the measurement time instants.

**[0057]** It is assumed that the biological data, which the biological sensor **27** acquires, are, aside from the blood pressure value, pulse wave data, pulse data, electrocardiographic data, heartbeat data and body temperature data. Sensors for measuring these biological data may be provided as the biological sensor **27**. The biological data may be output as measurement data of elements other than the blood pressure.

**[0058]** For example, brain waves are an index indicative of the sleep state of a human, and the sleep state of a human is conceivable as one of elements which cause a blood pressure fluctuation. Brain wave data which the biological sensor **27** measures is information which may become a factor in the blood pressure fluctuation of the user, and the brain wave data may be output as measurement data of an element other than the blood pressure. Aside from the brain wave data, when the pulse data, electrocardiographic data, heartbeat data, body temperature data or the like is conceivable as one of elements which cause the blood pressure fluctuation, such measurement data may be output as measurement data of an element other than the blood pressure.

**[0059]** The blood pressure sensor **27***a* is a blood pressure sensor of a successive measurement type. The blood pressure sensor **27***a* is a blood pressure sensor which can successively measure the values of the blood pressure (e.g. a systolic blood pressure and a diastolic blood pressure). The blood pressure sensor **27***a* may include a blood pressure sensor which can successively measure a blood pressure on a pulse-by-pulse basis, but the blood pressure sensor **27***a* is not limited to this.

**[0060]** For example, as the blood pressure sensor **27***a*, a successive measurement-type blood pressure sensor using a PTT method, tonometry method, optical method, radio wave method or ultrasonic method is applicable. The PTT method is a method of measuring a pulse transmit time (PTT), and estimating a blood pressure value from the measured PTT. The tonometry method is a method of putting a pressure sensor in direct contact with a biological part where an artery, such as a radial artery of the wrist, passes, and measuring a blood pressure value by using information which the pressure sensor detects. The optical method, radio wave method and ultrasonic method are methods of applying light, radio waves or ultrasonic waves to a blood vessel, and measuring a blood pressure value from the reflected waves.

**[0061]** Note that the blood pressure sensor of the successive measurement type can measure a blood pressure waveform of the user, can acquire blood pressure values, based on the measured blood pressure waveform, and can calculate a heart rate, based on the cycle of the measured blood pressure waveform. The heartbeat data may include, for example, a heart rate, but the heartbeat data is not limited to the heart rate. The heart rate may be measured by a heartbeat sensor, as well as by the successive measurement-type blood pressure sensor.

**[0062]** The environmental sensor **28** includes a sensor which measures environmental information of the surrounding of the user, and acquires measured environmental data. In the configuration example illustrated in FIG. **2**, it is assumed that the environmental sensor **28** includes an air temperature sensor **28***a*. However, the environmental sensor **28** may include, as well as the air temperature sensor, sensors which measure a temperature, humidity, sound, light, and the like. The environmental sensor **28** may include a sensor which measures environmental information (environmental data) that is assumed to have a direct or indirect relation to a fluctuation of the blood pressure value. Further, the controller **21** correlates measurement data, which the environmental sensor **28** measures, with measurement time instants which are set based on time instant information, and acquires the correlated data as measurement data (environmental data).

**[0063]** For example, an air temperature (a variation of an air temperature) is conceivable as one of elements which cause a blood pressure fluctuation of a human. Thus, the air temperature data which the environmental sensor **28** measures is information which may become a factor in the blood pressure fluctuation of the user, and may be output as measurement data of one element other than the blood pressure. Aside from the air temperature, when humidity, sound, light or the like is conceivable as one of the elements which cause the blood pressure fluctuation, the measurement data of the humidity, sound, light or the like may be output as measurement data of an element other than the blood pressure.

**[0064]** Next, a configuration of the user terminal **11** will be described.

**[0065]** FIG. **3** is a block diagram illustrating a configuration example of the user terminal **11** illustrated in FIG. **1**.

**[0066]** In the configuration example illustrated in FIG. **3**, the user terminal **11** includes a controller **31**, a storage unit **32**, a communication unit **33**, a display unit **34**, an operation unit **35**, and a sensor interface (I/F) **36**. In the present embodiment, the user terminal **11** is, for example, a portable communication terminal such as a smartphone or a tablet. Application software (program) is installed in the user terminal **11** such that a process to be described later is executable.

**[0067]** The controller **31** includes at least one processor **31***a*, and a memory **31***b*. The processor **31***a* executes programs by using the memory **31***b*, and thereby the controller **31** realizes various kinds of operation control and data processing. The processor **31***a* is, for example, a CPU or an MPU including arithmetic circuitry. The memory **31***b* includes a nonvolatile memory (a non-transitory computer-readable storage medium) which stores programs that the processor **31***a* executes, and a volatile memory such as a RAM which is used as a work memory. In addition, the controller **31** includes a clock (not shown) and includes a clock function which measures the present date/time.

**[0068]** The storage unit **32** is a data memory. The storage unit **32** is composed of, for example, a semiconductor memory (a memory card, an SSD (Solid State Drive) or a magnetic disk (HD (Hard Disk)). The storage unit **32** may store programs which the processor **31***a* of the controller **31** executes. In addition, the storage unit **32** may store measurement data which is supplied from the measuring terminal **2** and sensor **3**. Further, the storage unit **32** may also store display data which is displayed on the display unit.

**[0069]** The communication unit **33** is a communication interface for communicating with the server **12**. The communication unit **33** transmits data to the server **12** via a network, and receives data from the server **12**. The communication by the communication unit **33** may be either wireless communication or wire communication. In the present embodiment, the description is given on the assumption that the network is, for example, the Internet or the like. However, the network is not limited to this, and may be another kind of network such as a LAN, or the communication may be one-to-one communication using a communication cable such as a USB cable.

**[0070]** The display unit **34** includes a display screen (for example, an LCD, an EL display or the like). In the display unit **34**, the display content, which is displayed on the display screen, is controlled by the control of the controller **31**.

**[0071]** The operation unit **35** sends to the controller **31** an operation signal corresponding to an operation by the user (e.g. the subject to be measured). The operation unit **35** is, for example, a touch panel provided on the display screen of the display unit **34**. The operation unit **35** is not limited to the touch panel, and may be an operation button, a keyboard, a mouse, and the like. In addition, the operation unit **35** may include a speech recognition unit which recognizes an operation instruction by the user's speech, a biological authentication unit which authenticates a biological part of the user, or an image recognition unit which recognizes the user's facial expression or gesture.

**[0072]** The sensor I/F **36** is a communication interface for communicating with the measuring terminal **2** and sensor **3**. The sensor I/F **36** receives data from the measuring terminal **2** and sensor **3**, and transmits operation instructions to the measuring terminal **2** and sensor **3**. In addition, the sensor I/F **36** may include an interface for the measuring terminal **2**, and an interface for the sensor **3**. The communication by the sensor I/F **36** may be wireless communication or wire communication.

**[0073]** In the present embodiment, the description is given on the assumption of a mode in which the sensor I/F **36** communicates with the measuring terminal **2** and sensor **3** by short-range wireless communication. However, aside from this, the sensor I/F **36** may include an interface for communicating with the measuring terminal **2** or sensor **3** via a communication cable. In addition, the sensor I/F **36** may execute serial communication via a communication cable, or may execute communication via a network such as a LAN.

**[0074]** Note that the sensor **3** may supply to the sensor I/F **36** measurement data in which a sensed signal is associated with time instant information, or may supply a sensed signal as measurement data to the sensor I/F **36**. In the latter case, the controller **31** of the user terminal **11** may acquire measurement data in which data acquired from the sensor **3** is correlated with time instant information by the sensor I/F **36**.

**[0075]** In the present embodiment, the description is given on the assumption that the sensor **3** is a sensor which measures SPO2. SPO2 is also used as an index indicative of a respiratory state of a human, and serves as an index indicative of the state of sleep apnea syndrome (SAS) of a human that is sleeping. Since SAS is conceivable as one of elements which cause the blood pressure fluctuation, the measurement data of SPO2 which the sensor **3** measures may be output as measurement data of an element other than the blood pressure.

**[0076]** Next, a configuration of the server **12** will be described.

**[0077]** FIG. **4** is a block diagram illustrating a configuration example of the server **12** illustrated in FIG. **1**.

**[0078]** The server **12** includes a controller **41**, a storage unit **42** and a communication unit **43**. In the present embodiment, the description is given on the assumption that a program (software) is installed in the server **12** so as to cause a general-purpose computer apparatus to execute a process to be described later.

**[0079]** The controller **41** includes at least one processor **41***a*, and a memory **41***b*. The processor **41***a* executes programs by using the memory **41***b*, and thereby the controller **41** executes various kinds of operation control and data processing. The processor **41***a* is, for example, a CPU or an MPU including arithmetic circuitry. The memory **41***b* includes a nonvolatile memory which stores programs that the processor **41***a* executes, and a volatile memory such as a RAM which is used as a work memory. In addition, the controller **41** includes a clock (not shown) and includes a clock function which measures the present date/time.

**[0080]** The storage unit **42** is a data memory. The storage unit **42** is composed of, for example, a magnetic disk (HD), a semiconductor memory (a memory card, an SSD), an optical disc, a magneto-optical disc, or the like. The storage unit **42** stores various kinds of measurement data acquired from the user terminal **11**. In addition, the storage unit **42** may store programs which the processor **41***a* of the controller **41** executes.

**[0081]** The communication unit **43** is a communication interface for communicating with the user terminal **11** or medical staff terminal **13**. The communication unit **43** transmits data to the user terminal **11** or medical staff terminal **13** via a network, and receives data from the user terminal **11** or medical staff terminal **13**. The communication by the communication unit **43** may be either wireless communication or wire communication. In the present embodiment, the description is given on the assumption of a configuration in which the communication unit **43** communicates with the user terminal **11** via a network such as the Internet, and communicates with the medical staff terminal **13** via a LAN. However, the communication by the communication unit **43** is not limited to a specific communication method.

**[0082]** Next, a configuration of the medical staff terminal **13** will be described.

**[0083]** FIG. **5** is a block diagram illustrating a configuration example of the medical staff terminal **13** illustrated in FIG. **1**.

**[0084]** In the configuration example illustrated in FIG. **5**, the medical staff terminal **13** includes a controller **51**, a storage unit **52**, a communication unit **53**, a display unit **54** and an operation unit **55**. In the present embodiment, the description is given on the assumption that the medical staff terminal **13** is a PC in which application software (program) is installed so that a process to be described later can be executed. However, the medical staff terminal **13** may be, for example, a communication terminal such as a tablet PC or a smartphone.

**[0085]** The controller **51** includes at least one processor **51***a*, and a memory **51***b*. The processor **51***a* executes programs by using the memory **51***b*, and thereby the controller **51** executes various kinds of operation control and data processing. The processor **51***a* is, for example, a CPU or an MPU including arithmetic circuitry. The memory **51***b* includes a nonvolatile memory which stores programs that the processor **51***a* executes, and a volatile memory such as a RAM which is used as a work memory. In addition, the controller **51** includes a clock (not shown) and includes a clock function which measures the present date/time.

**[0086]** The storage unit **52** is a data memory. The storage unit **52** is composed of, for example, a magnetic disk, a semiconductor memory (a memory card, an SSD), an optical disc, a magneto-optical disc, or the like. The storage unit **52** may store programs which the processor **51***a* of the controller **51** executes.

**[0087]** The communication unit **53** is a communication interface for communicating with the server **12**. The communication unit **53** transmits data to the server **12** and receives data from the server **12**. The communication by the communication unit **53** may be either wireless communication or wire communication. In the present embodiment, the description is given on the assumption that the communication unit **53** communicates with the server **12** via another kind of network such as a LAN. However, aside from this, the communication may include serial communication using a communication cable.

**[0088]** The display unit **54** includes a display screen (for example, an LCD, an EL display or the like). In the display unit **54**, the display content, which is displayed on the display screen, is controlled by the control of the controller **51**.

**[0089]** The operation unit **55** sends to the controller **51** an operation signal corresponding to an operation by the user (e.g. the subject to be measured). The operation unit **55** is, for example, a touch panel provided on the display screen of the display unit **54**. The operation unit **55** is not limited to the touch panel, and may be an operation button, a keyboard, a mouse, and the like. In addition, the operation unit **55** may include a speech recognition unit which recognizes an operation instruction by the user's speech, a biological authentication unit which authenticates a biological part of the user, or an image recognition unit which recognizes the user's facial expression or gesture.

**[0090]** Next, functions which the controller **41** of the server **12** realizes will be described.

**[0091]** FIG. **6** is a block diagram illustrating functions which the controller **41** of the server **12** includes.

**[0092]** The controller **41** of the server **12** realizes various processing functions by the processor **41***a* executing programs stored in the memory **41***b*. As illustrated in FIG. **6**, the controller **41** of the server **12** includes, as main functions, an information acquisition unit **61** (information acquisition circuit), an operation sensing unit **62**, a blood pressure fluctuation detection unit **63** (blood pressure fluctuation detection circuit), a display controller **64**, a correlation determination unit **65** (correlation determination circuit), and a correlation information generation unit **66** (correlation information generation circuit).

**[0093]** The information acquisition unit **61** is a function of acquiring measurement data which the measuring terminal **2** and sensor **3** measure. The controller **41** executes, as the information acquisition unit **61**, a process of receiving various measurement data from the user terminal **11** via the communication unit **43**, and storing the received measurement data in the storage unit **42**. For example, the controller **41** may acquire measurement data which is transferred to the server **12** by a user's operation on the user terminal **11** or measuring terminal **2**. In addition, the controller **41** may acquire measurement data from the user terminal **11** or measuring terminal **2**, by requesting the user terminal **11** or measuring terminal **2** to transfer the measurement data.

**[0094]** The information acquisition unit **61** acquires, as the measurement data, successively measured blood pressure data and measurement data of a plurality of elements other than the blood pressure. As described above, as the measurement data of the plural elements, the information acquisition unit **61** acquires the measurement data of SPO2 which the sensor **3** measures, the acceleration data which the acceleration sensor **26** of the measuring terminal **2** measures, and the air temperature data that the air temperature sensor **28***a* of the measuring terminal **2** measures. Aside from these data, the information acquisition unit **61** may acquire the biological data which the sensor functioning as the biological sensor **27** measures, and the environmental data which the sensor functioning as the environmental sensor **28** measures.

**[0095]** The operation sensing unit **62** is a function of accepting an operation instruction from the user terminal **11** or medical staff terminal **13**. The controller **41** executes, as the operation sensing unit **62**, a process of receiving information indicative of the operation instruction from the user terminal **11** or medical staff terminal **13** via the communication unit **43**, and accepting the received operation instruction.

**[0096]** The blood pressure fluctuation detection unit **63** is a function of detecting a blood pressure fluctuation of a reference value or more from the successively measured blood pressure data. The controller **41** executes, as the blood pressure fluctuation detection unit **63**, a process of setting a reference value for a blood pressure fluctuation to be detected, and detecting a blood pressure fluctuation of the reference value or more, from the blood pressure data successively measured during a measurement period. In addition, the reference value for the blood pressure fluctuation may be set in multiple steps. In the present embodiment, for example, it is assumed that blood pressure surges of three-step risk degrees are detected as blood pressure fluctuations by three-step reference values.

**[0097]** Note that in the present embodiment, the description is given on the assumption that blood pressure surges of multiple-step risk degrees are detected as blood pressure fluctuations of reference values or more. However, a control ability to restore a raised blood pressure value to a normal value may be detected as the blood pressure fluctuation.

**[0098]** In addition, the reference value for detecting a blood pressure surge is set, for example, for a magnitude of a blood pressure fluctuation and a period required for the blood pressure fluctuation. Specifically, when a large blood pressure fluctuation occurs in a short period, a blood pressure surge with a higher risk degree is determined. In addition, the reference value for the blood pressure surge may be set as a value corresponding to the activity amount of the user. For example, when the activity amount is large during exercise or the like, it is considered that even if a blood pressure fluctuation is large, the blood pressure fluctuation is normal. Thus, when the blood pressure fluctuation becomes large in a situation of less exercise, a blood pressure surge with a higher risk degree may be detected.

**[0099]** The display controller **64** is a function of controlling content that is to be displayed on the display unit of the medical staff terminal **13**, user terminal **11** or measuring terminal **2**. The controller **41** executes, as the display controller **64**, a process of supplying display data, or data for display, to the medical staff terminal **13** or user terminal **11**, which is communicable via the communication unit **43**. The controller **41** executes, for example, display control of blood pressure-related information which is displayed on the display unit of the medical staff terminal **13**, such that the successively measured blood pressure data relating to a specific user is associated with the measurement data of elements other than the blood pressure. The content displayed by the display controller **64** will be described later in detail.

**[0100]** The correlation determination unit **65** is a function of determining the correlation between a blood pressure fluctuation and measurement data of elements other than the blood pressure. The controller **41** executes, as the correlation determination unit **65**, a process of determining the correlation between a blood pressure fluctuation of the reference value or more and measurement data of elements other than the blood pressure. The controller **41** determines the correlation with a blood pressure surge, based on the fluctuation of measurement data of each element in a period in which the blood pressure surge occurred as the blood pressure fluctuation of the reference value or more and in periods before and after the period in which the blood pressure surge occurred. As the association with the blood pressure surge is more conspicuous, the controller **41** determines that the correlation between the element and the blood pressure surge (the sensitivity of the element) is higher.

**[0101]** However, in the determination of the correlation, the correlation is determined based on not only the magnitude of the fluctuation of the measurement data of a certain element in the period corresponding to the blood pressure surge, but also the tendency of the fluctuation immediately before the occurrence of the blood pressure surge. For example, if a blood pressure surge occurs even when a variation is small, the correlation determination unit **65** may determine that the sensitivity of the element is high. In addition, the correlation determination unit **65** may determine a tendency that a blood pressure surge easily occurs due to a sharp change, rather than the magnitude of a fluctuation, or a tendency that a blood pressure surge easily occurs due to a large fluctuation even when a variation is gentle.

**[0102]** The correlation information generation unit **66** is a function of generating correlation information (e.g. a correlation graph) which indicates the correlation between the blood pressure fluctuation of the reference value or more and the measurement data of other elements. The controller **41** executes, as the correlation information generation unit **66**, a process of generating correlation information (e.g. a correlation graph) which indicates the correlation between the blood pressure fluctuation of the reference value or more and the measurement data of elements other than the blood pressure. For example, in accordance with an instruction to display the correlation between SPO2 and a blood pressure surge, the controller **41** creates a correlation graph as correlation information indicative of the correlation between the SPO2 and blood pressure surge. The controller **41** causes, by the display controller **64**, the display unit **54** of the medical staff terminal **13**, or the like, to display the created correlation graph.

**[0103]** Next, the operation of the management system of measurement data, which is configured as described above, will be described.

**[0104]** The user (the subject to be measured) instructs, by operating the measuring terminal **2**, measurement of various elements, including successive measurement of the blood pressure value. In accordance with the user's operation, the measuring terminal **2** executes successive measurement of various elements, and transfers measurement data, which is the measured result in the measurement period, to the server **12** via the user terminal **11**. In addition, the user terminal **11** also acquires measurement data which the sensor **3** measures in a period including at least a part of the measurement period in the measuring terminal **2**. The sensor **3** may execute measurement according to an instruction to start the measurement from the user terminal **11**, or may execute measurement upon receiving an instruction to start the measurement from the measuring terminal **2** via the user terminal **11**.

**[0105]** FIG. **7** is a view illustrating a transition example of an operation screen which the display unit **25** displays when the measuring terminal **2** executes measurement.

**[0106]** An operation screen **71** illustrated in FIG. **7** is a display example in a case of starting an operation mode of successive measurement (screening) in a measurement period. In the state in which the operation screen **71** is displayed, if the user touches "Screening" on the touch panel functioning as the operation unit **24**, the controller **21** causes the display unit **25** to display an operation screen **72**. The operation screen **72** is a confirmation screen for prompting the user to confirm the start of measurement in a measurement period that is set. Here, the measurement period may be a period from when the user instructs the start of measurement to when the user instructs the end of measurement, or may be a preset period. It is assumed that the measurement period is a period of sleep, a period of a specific activity, or a period of 24 hours. For example, when the period of sleep is set as the measurement period, the user instructs the start of measurement before sleep, and instructs the end of measurement after getting up.

**[0107]** If the user instructs the start of measurement on the operation screen **72** (i.e. instructs "OK"), the controller **21** starts measurement. Upon starting the measurement, the controller **21** accumulates in the storage unit **23** the data which various sensors measure during the measurement period. Note that the controller **21** may transfer the measured data to the user terminal **11** at times as appropriate (in real time or at short cycles), and the user terminal **11** may accumulate the measurement data. In addition, before the instruction to start measurement is input, the controller **21** may enable the input of a measurement condition or the like by the user. For example, the controller **21** may set the measurement period which the user instructs before starting the measurement, or may accept personal identification information which the user instructs.

**[0108]** While the measurement is being performed, the controller **21** accepts an instruction to end the measurement by the user. When the user ends the measurement (for example, after getting up), the user causes the display unit **25** to display an operation screen **73** by a predetermined operation. For example, the controller **21** may cause the display unit **25** to display the operation screen **73** when sensing a predetermined motion on the measuring terminal **2** by the acceleration sensor **26**, or may cause the display unit **25** to display the operation screen **73** when sensing a predetermined operation on the operation unit **24**. Besides, after a preset measurement period has passed, the controller **21** may notify, by an alarm or the like, that the measurement period has passed, and may cause the display unit **25** to display the operation screen **73** which accepts the instruction to end the measurement.

**[0109]** The operation screen **73** displays a "YES" key and "NO" key as an instruction screen of the end of measurement. When the "YES" key is instructed in the operation screen **73**, the controller **21** judges that the measurement is to be finished. When the "NO" key is instructed in the operation screen **73**, the controller **21** judges that the measurement is to be continued.

**[0110]** When the controller **21** has judged that the measurement is to be finished, the controller **21** causes the display unit **25** to display an operation screen **74** which indicates guidance of transfer of measurement data. The operation screen **74** gives guidance indicating that the measurement data as the result of measurement during the measurement period is being transferred to the user terminal **11** or server **12**. Here, it is assumed that the controller **21** stores in the storage unit **23** the measurement data measured during the measurement period (the measurement data in which the measurement values by the sensors are associated with the time instant information).

**[0111]** The controller **21** displays the operation screen **74** and transfers the measurement data during the measurement period, which is accumulated in the storage unit **23**, to the server **12** via the user terminal **11** (or not via the user terminal **11**) together with the personal identification information of the subject to be measured (or the measuring terminal **2**). Thereby, the server **12** can acquire the measurement data of each user from each measuring terminal **2** in the management system of measurement data. In addition, the server **12** can collect measurement data of various elements of the user in the measurement period, by acquiring via the user terminal **11** the measurement data which the sensor **3** measures, together with the measurement data from the measuring terminal **2**.

**[0112]** In the above-described example, it is assumed that, after the end of measurement, the measurement data during the measurement period is transferred to the server **12** via the user terminal **11**. However, the measuring terminal **2** may transfer the measurement data to the user terminal **11** or server **12** in real time (or at predetermined cycles). If the frequency of communication is decreased, the measuring terminal **2** can hold down power consumption. On the other hand, if the measurement data is transferred from the measuring terminal **2** in real time or at predetermined cycles, the user terminal **11** or server **12** can acquire measurement data in real time or at predetermined cycles, and can analyze the state of the user in real time or at predetermined cycles.

**[0113]** Next, a description will be given of display examples of blood pressure-related information based on measurement data including blood pressure data which the server **12** successively measures.

**[0114]** Here, it is assumed that the server **12** causes the display unit **54** of the medical staff terminal **13** to display the information based on the measurement data which the measuring terminal **2** and sensor **3** measure. The display controller **64** of the server **12** causes the display unit **54** to display the information (blood pressure-related information) including the measurement data including successively measured blood pressure data and an analysis result based on the measurement data. The information, which the server **12** causes the display unit **54** to display, is information for supporting the determination by medical staff of the factor in the blood pressure surge, which is based on the measurement data, and the medical treatment advice by medical staff. However, the display controller **64** of the server **12** may cause the display unit **34** of the user terminal **11** or the display unit **25** of the measuring terminal **2** to display the blood pressure-related information such as the measurement data and the analysis result based on the measurement data.

**[0115]** FIG. **8** and FIG. **9** are views illustrating display examples of blood pressure-related information, which the display controller **64** of the server **12** causes the display unit **54** of the medical staff terminal **13** to display.

**[0116]** FIG. **8** illustrates a display example of blood pressure-related information including measurement data in a specific measurement period of a certain user, and an analysis result relating to a blood pressure surge based on the measurement data.

**[0117]** A display screen illustrated in FIG. **8** includes a risk type display area **101**, an advice display area **102** and a data details display area **103**. In addition, the display screen illustrated in FIG. **8** displays physical personal information **104** relating to the user (the subject to be measured) and information **105** indicative of a comprehensive determination result relating to a blood pressure surge which is indicated in the measurement result.

**[0118]** The risk type display area **101** is an area which displays, as a risk type, a cause which induces a cerebral cardiovascular event, and the degree of influence (sensitivity) on the cause. Here, it is assumed that the risk type is a classification stratified by the cause which induces the cerebral cardiovascular event, and the degree of influence on the cause. For example, a blood pressure fluctuation (blood pressure surge) of a reference value or more, which may become a cause that induces a cerebral cardiovascular event, may occur due to SAS (sleep apnea syndrome), a temperature change, a change in sleep state, a change in activity amount, stress, etc.

**[0119]** In addition, the risk types are classified into, for example, "a type in which a sharp blood pressure surge tends to frequently occur due to a temperature change", and "a type in which a gentle blood pressure fluctuation tends to occur due to a temperature change". In the former, since it is highly possible that a sharp blood pressure surge occurs due to a temperature change, the cause of the blood pressure fluctuation is the temperature change. Thus, the former is determined to be a risk type in which the temperature sensitivity is high. On the other hand, in the latter, a gentle blood pressure fluctuation tends to occur due to a temperature change. Thus, although the cause of the blood pressure fluctuation is the temperature change, the latter is determined to be a risk type in which the temperature sensitivity is low.

**[0120]** It is assumed that the risk means a risk of the appearance of a cerebral cardiovascular event (cerebral infarction, cerebral hemorrhage, myocardial infarction, heart failure, or the like). In the present embodiment, the description is given on the assumption that the risk is determined by comprehensively considering elements such as a magnitude of a blood pressure fluctuation, a fluctuation time, and a change in fluctuation. For example, even if a difference in fluctuation is the same, it is considered that the risk is different between the case where the blood pressure fluctuates in several seconds and the case where the blood pressure fluctuates over a long time.

**[0121]** It should be noted, however, that the risk of the appearance of the cerebral cardiovascular event is determined based on various elements such as arterial sclerosis, gender, age, dietary contents, sleep and heredity, aside from the magnitude of the blood pressure fluctuation, fluctuation time, and change in fluctuation. Thus, the determination of the risk is not limited to the examples in the present embodiment, and the risk may be determined by taking into account various elements such as arterial sclerosis, gender, age, dietary contents, sleep and heredity.

**[0122]** The server **12** determines, by the correlation determination unit **65**, the correlation (sensitivity) between the blood pressure surge, which may become the cause of the appearance of the cerebral cardiovascular event, and the various kinds of elements, and displays, on the risk type display area **101**, the information indicative of the element that is determined to have a high correlation with the blood pressure surge. For example, when the server **12** determines that the correlation between the blood pressure surge and SAS is high, the server **12** displays that the risk type is a SAS sensitivity type.

[0123] In the example illustrated in FIG. **8**, the risk type display area **101** displays, as well as the information indicative of the risk type (SAS in the example of FIG. **8**), information indicative of the fluctuation of the element determined to have a high sensitivity (a maximum SAS surge in the example of FIG. **8**), information indicative of the correlation between the fluctuation of the element and the blood pressure surge (the number of maximum SAS surges in the example of FIG. **8**), and information indicative of the ratios of blood pressure surges according to risk degrees.

[0124] The advice display area **102** is an area which displays advice on medical treatment based on the state of occurrence of the blood pressure surge, and based on the correlation of each element with the blood pressure surge. For example, the advice display area **102** displays advice on a treatment method or the like, which corresponds to the measurement data of the element that is assumed to be the factor in the blood pressure surge.

[0125] In the example illustrated in FIG. **8**, the display example of the advice display area **102** is a display example in a case where the factor in the blood pressure surge is SAS. As the treatment method for the blood pressure surge (i.e. the treatment method of SAS), a plurality of choices ("Use of CPAP", "Lifestyle guidance" and "Medication") are displayed, and information indicative of one treatment method, which is recommended from the choices, is displayed on the advice display area **102**.

[0126] For example, the recommended treatment method may be determined in accordance with the risk degree of the blood pressure surge, in which SAS is assumed to be factor. For example, when the blood pressure surge, in which SAS is the factor, occurs frequently, or when the blood pressure fluctuation of the blood pressure surge, in which SAS is assumed to be the factor, is very large (i.e. when the risk degree of the blood pressure surge is very high), a treatment method for a person in a serious condition may be presented as advice.

[0127] The data details display area **103** is an area which displays actual measurement data in detail. In the example illustrated in FIG. **8**, the data details display area **103** displays, as the data details, a graph **111** of successively measured blood pressure data, a graph **112** in which a portion of the successively measured blood pressure data in a partial period is enlargedly displayed, a graph **113** in which measurement data of an element other than the blood pressure in the same period as in the graph **112** is enlargedly displayed, a select field **114** of graph display, and analysis instruction buttons **115** (**115***a* and **115***b*).

[0128] The graph **111** displays data of the blood pressure value successively measured during an entire measurement period in which successive measurement was conducted, or during a predetermined period (12 hours, 24 hours, or the like). The graph **111** displays an enlargement display slot **111***a* which indicates a period (enlargement period) for the enlarged display in the graphs **112** and **113**.

[0129] The graph **112** displays blood pressure data in the period indicated by the enlargement display slot **111***a* of the graph **111**. The graph **112** displays, by color coding, periods T**1**, T**2**, T**3** and T**4** which are detected as blood pressure surges.

[0130] The graph **113** displays measurement data of a selected element during the period indicated by the enlargement display slot **111***a* of the graph **111**. The graph **113** is displayed by being associated with the graph **112**. In the example illustrated in FIG. **8**, the graph **113** is displayed such that the measurement data of SPO2 is associated with the blood pressure data of the graph **112**.

[0131] The select field **114** of graph display indicates elements (indices) which are displayed as the graphs **112** and **113**. In addition, the select field **114** is also used as a field for the medical staff or user to designate elements which are displayed as the graphs **112** and **113**. The measurement data of the elements which are in the selected state in the select field **114** are displayed as the graph **112** and graph **113**. In the example illustrated in FIG. **8**, a successive blood pressure and SPO2 are in the selected state, and the graph **112** displays blood pressure data as the successive blood pressure, and the graph **113** displays the measurement data of SPO2. Items, which can be selected in the select field **114** at the same time, may be limited to items which can be displayed as the graphs **112** and **113**. It is assumed that in the select field **114** in the initial state, blood pressure data and measurement data of an element, which is assumed to be a factor in a blood pressure surge, are selected.

[0132] In addition, it should suffice if the elements that can be selected in the select field **114** are information which may become factors in the blood pressure fluctuation of the user, and are measurement data which the server **12** can acquire. In the example illustrated in FIG. **8**, as well as the blood pressure, such elements as SPO2, sleep, activity amount and air temperature can be selected in the select field **114**. In the above-described configuration example, the measurement data of SPO2 is measured by the sensor **3**. The measurement data of sleep may be acceleration data (posture) which the acceleration sensor **26** of the measuring terminal **2** measures in connection with the subject to be measured, who is sleeping, or may be brain wave data which a brain wave sensor functioning as one of biological sensors **27** of the measuring terminal **2** measures. Further, the measurement data of the activity amount is acceleration data which the acceleration sensor **26** of the measuring terminal **2** measures. Besides, the measurement data of air temperature is measured by the temperature sensor **28***a* of the measuring terminal **2**.

[0133] The analysis instruction buttons **115** are buttons for instructing specific analysis. In the example illustrated in FIG. **8**, an analysis instruction button **115***a*, which instructs ODI analysis, and an analysis instruction button **115***b*, which indicates correlation of the blood pressure surge with SPO2, are displayed. For example, the analysis instruction button **115***b* is a button which instructs display of correlation information (correlation graph) indicative of the correlation between SPO2, which is a specific element other than the blood pressure, and the blood pressure surge.

[0134] FIG. **9** is a view illustrating a display example of a correlation graph indicative of a correlation between SPO2 and a blood pressure surge. Specifically, when the analysis instruction button **115***b* illustrated in FIG. **8** is instructed, the controller **41** of the server **12** generates, by the correlation information generation unit **66**, a correlation graph between SPO2 and the blood pressure surge, and causes the display unit **54** to display the generated correlation graph. In the display example illustrated in FIG. **9**, a correlation graph between SPO2 and the blood pressure surge is displayed as a popup screen **120** on the display screen illustrated in FIG.

8. It is assumed that the correlation graph shown in FIG. 9 can be restored to the display state illustrated in FIG. 8 by an operator's operation.

[0135] According to the display as described above, the server 12 can present, based on the data that the measuring terminal and sensor measure, the state of occurrence of a blood pressure surge, various measurement data associated with blood pressure data, factors in the blood pressure surge, which are estimated from the measurement data, advance on medical treatment, and the like, to the medical staff or the user.

[0136] Next, a description will be given of a process of providing measurement data which the measuring terminal 2 and sensor 3 measure.

[0137] Here, an operation example is described in which the server 12 collects measurement data which the measuring terminal 2 and sensor 3 measure, and causes the medical staff terminal 13 to display the collected measurement data. However, such an operation may be implemented that a process, which the medical staff terminal 13 executes as will be described later, is replaced with a process which the user terminal 11 executes. In addition, a part or all of a process of the server 12, which will be described later, may be implemented by the user terminal 11 or measuring terminal 2.

[0138] FIG. 10 and FIG. 11 are flowcharts for explaining an operation example of the server 12.

[0139] When blood pressure-related information of a specific user is displayed on the display unit 54 of the medical terminal 13, the controller 51 of the medical staff terminal 13 transmits via the communication unit 53 a signal for requesting display information of blood pressure-related information from the server 12. For example, medical staff operates the operation unit 55 of the medical staff terminal 13 and instructs display of blood pressure-related information together with information for specifying the user (e.g. identification information of the user). If the display of the blood pressure-related information is instructed, the controller 51 of the medical staff terminal 13 transmits a signal for requesting, from the server 12, the display information of the blood pressure-related information together with the identification information of the user. At this time, the year/month/day (measurement period), in which the blood pressure-related information to be displayed was measured, may be designated, or items to be displayed may be preset.

[0140] The controller 41 of the server 12 acquires, by the information acquisition unit 61, measurement data from the measuring terminal 2 and sensor 3 via the user terminal 11, and accumulates the measurement data in the storage unit 42 (S11). The measurement data, which the information acquisition unit 61 acquires, includes successively measured blood pressure data and measurement data of a plurality of elements other than the blood pressure. In addition, the controller 41 executes a process of receiving identification information of the user together with the measurement data from the user terminal 11, and accumulating in the storage unit 42 the measurement data and the identification information of the user by correlating the measurement data and the identification information of the user.

[0141] In addition, while executing the process of storing the measurement data in the storage unit 42, the controller 41 accepts a display instruction of blood pressure-related information from the medical staff terminal 13. Upon receiving via the communication unit 43 a signal which requests the display of the blood pressure-related information (S12, YES), the controller 41 reads out the successively measured blood pressure data (blood pressure data during the measurement period of successive measurement, or blood pressure data successively measured in a predetermined period) corresponding to a designated user from the storage unit 42.

[0142] Upon reading out the successively measured blood pressure data of the designated user from the storage unit 42, the controller 41 causes, by the display controller 64, the display unit 54 of the medical staff terminal 13 to display the read-out blood pressure data (S13). For example, the controller 41 causes the display unit 54 to display the read-out successively measured blood pressure data as the graph 111 on the display screen as illustrated in FIG. 8.

[0143] In addition, the controller 41 detects, by the blood pressure fluctuation detection unit 63, a blood pressure fluctuation of a reference value or more in the read-out successively measured blood pressure data (S14). Here, it is assumed that blood pressure fluctuations of multiple-step reference values or more are detected as blood pressure surges according to risk degrees from the successively measured blood pressure data. If the controller 41 detects blood pressure surges, the controller 41 determines a time slot (enlargement period) for enlargedly displaying the successively measured blood pressure data, based on the detection result of the blood pressure surges, and executes enlargement display of the blood pressure data in the determined enlargement period (S15). For example, the controller 41 causes the display unit 54 to display the blood pressure data in the enlargement period as the graph 112 on the display screen as illustrated in FIG. 8. In addition, with respect to the blood pressure data in the enlargement period that is displayed as the graph 112, the controller 41 causes the display unit 54 to display the time slots of blood pressure surges detected according to risk degrees, by color-coding the time slots. Thereby, the fluctuations of the blood pressure value in the enlargement period can be easily visually recognized, and the detected blood pressure surges can be easily recognized.

[0144] Further, the controller 41 determines, by the correlation determination unit 65, the correlation between the detected blood pressure surges and the measurement data of elements other than the blood pressure (S16). In addition, based on the determination result of the correlation between the blood pressure surges and the measurement data of the respective elements, the controller 41 determines an element having a high correlation with the blood pressure surges (S17). If the controller 41 determines one element having a high correlation with the blood pressure surges, the controller 41 reads in the measurement data of this element in the enlargement period from the storage unit 42, and displays the read-in measurement data by associating the read-in measurement data with the blood pressure data in the enlargement period (S18). For example, on the display screen as illustrated in FIG. 8, the controller 41 sets the element, which is determined to have the high correlation with the blood pressure surges, in the selected state in the select field 114, and causes the display unit 54 to display, as the graph 113, the measurement data in the enlargement period of the element determined to have the high correlation with the blood pressure surges.

[0145] By the above process, the server 12 causes the display unit 54 of the medical staff terminal 13 to display the display screen as illustrated in FIG. 8. When this display screen is displayed, the server **12** detects, by the operation detection unit **62**, an operation by the operation unit **55** of the medical staff terminal **13**, and updates the display content which the display unit **54** displays, in accordance with the operation instruction.

**[0146]** For example, the controller **41** of the server **12** accepts an instruction on the time slot (enlargement period) for the enlargement display as the graphs **112** and **113** (S**19**). For example, the controller **41** accepts the instruction on the enlargement period according to a position instructed on the graph **111** of the display screen illustrated in FIG. **8**. If the enlargement period is designated by the operation unit **55** of the medical staff terminal **13** (S**19**, YES), the controller **41** of the server **12** updates the enlargement display slot **111***a* and the graphs **112** and **113** in accordance with the instructed enlargement period (S**20**). Specifically, the controller **41** displays the enlargement display slot **111***a*, which indicates the enlargement period, at a position instructed on the graph **111**. Further, the controller **41** newly sets the period, which the enlargement display slot **111***a* displays, as the enlargement period, and displays the measurement data in the enlargement period (the successively measured blood pressure data and the measurement data of the selected element other than the blood pressure) as the graphs **112** and **113**.

**[0147]** In addition, the controller **41** accepts a select instruction on an element that is displayed as the graph **113** (S**21**). For example, on the display screen illustrated in FIG. **8**, the controller **41** accepts a select instruction on the element that is displayed as the graph **113**, in accordance with an instruction in the select field **114**. When a change of the element to be displayed is instructed by the operation unit **55** of the medical staff terminal **13** (S**21**, YES), the server **12** changes the element that is displayed as the graph **113** to the instructed element, and displays the measurement data of the instructed element (S**22**). Further, the controller **41** of the server **12** changes the display such that the element instructed in the select field **114** is set in the selected state.

**[0148]** Besides, the controller **41** accepts, by the analysis display button **115**, a display instruction of correlation information indicative of the correlation between specific data and blood pressure surges (S**23**). For example, on the display screen illustrated in FIG. **8**, the controller **41** accepts, by the analysis display button **115***b*, a display instruction of a correlation graph indicative of the correlation between the measurement data of SPO2 and blood pressure surges. If the analysis display button **115***b* is designated by the operation unit **55** of the medical staff terminal **13** (S**23**, YES), the controller **41** of the server **12** creates, by the correlation information generation unit **66**, a graph (correlation graph) indicative of the correlation between the measurement data of SPO2 and the blood pressure surge, and causes the display unit **54** to display the created correlation graph (S**24**). For example, if the analysis display button **115***b* of FIG. **8** is instructed, the controller **41** causes the display **54** to display the correlation graph illustrated in FIG. **9**.

**[0149]** In addition, if the controller **41** of the server **12** accepts an operation for the end of display in the medical staff terminal **13** (S**25**, YES), the controller **41** ends the display of the information relating to the successively measured blood pressure data. If the display is ended, the controller **41** returns to S**11**, and collects measurement data and accepts a display instruction.

**[0150]** As described above, according to the display of the blood pressure-related information that is displayed on the display device, the server **12** functioning as the information processing apparatus causes the display device to display the successively measured blood pressure data of the subject to be measure, a partial period of the blood pressure data as the enlargement period, and the measurement data of at least one element other than the blood pressure by associating the measurement data of the at least one element with the blood pressure data of the enlargement period. Thereby, a part of an enormous amount of successively measured blood pressure data can be enlargedly displayed as the enlargement period, and the measurement data of one element selected from the elements other than the blood pressure can be displayed by being associated with the enlargedly displayed blood pressure data. As a result, the measurement data of the other element can easily be visually recognized by being associated with the blood pressure data in an easy-to-view state for persons, the load for medical treatment and healthcare of the subject to be measured can be reduced, and the improvement of the health condition of the subject to be measured can be supported.

**[0151]** The present invention is not limited directly to the above-described embodiments. In practice, the structural elements can be modified and embodied without departing from the spirit of the invention. Various inventions can be made by properly combining the structural elements disclosed in the embodiments. For example, some structural elements may be omitted from all the structural elements disclosed in the embodiments. Furthermore, structural elements in different embodiments may properly be combined.

**[0152]** A part or the entirety of the above-described embodiment can also be described as in the supplementary note below, but is not limited to the supplementary note.

**[0153]** (Supplementary Note 1)

**[0154]** An information processing apparatus including:

**[0155]** a memory; and

**[0156]** at least one processor which cooperates with the memory,

**[0157]** the processor being configured to:

**[0158]** acquire, from a specific subject to be measured, successively measured blood pressure data and measurement data of a plurality of elements other than a blood pressure;

**[0159]** detect a blood pressure fluctuation of a reference value or more from the successively measured blood pressure data which is acquired; and

**[0160]** cause a display device to display blood pressure data in an enlargement period including a time slot of the detected blood pressure fluctuation of the reference value or more, and measurement data of at least one of the elements other than the blood pressure in the enlargement period, by associating the blood pressure data in the enlargement period and the measurement data of the at least one of the elements.

1. An information processing apparatus comprising:

an information acquisition circuit configured to acquire, from a specific subject to be measured, successively measured blood pressure data and measurement data of a plurality of elements other than a blood pressure;

a blood pressure fluctuation detection circuit configured to detect a risk degree of a blood pressure fluctuation of a reference value or more from the successively measured blood pressure data which is acquired by the information acquisition circuit; and a display controller configured to cause a display device to graph-display blood pressure data in an enlargement period including a time slot of the blood pressure fluctuation of the reference value or more, which the blood pressure fluctuation detection circuit detects, and measurement data of at least one of the elements other than the blood pressure in the enlargement period, by associating, by a time axis, the blood pressure data in the enlargement period and the measurement data of the at least one of the elements, and by color-coding, according to the risk degree, the time slot of the blood pressure fluctuation of the reference value or more, which the blood pressure fluctuation detection circuit detects.

**2**. The information processing apparatus of claim **1**, further comprising:

a correlation determination circuit configured to determine a correlation between measurement data of each of the elements other than the blood pressure, which the information acquisition circuit acquires, and the blood pressure fluctuation of the reference value or more, which the blood pressure fluctuation detection circuit detects,

wherein the display controller is configured to cause the display device to display measurement data of an element determined by the correlation determination circuit to have a high correlation with the blood pressure fluctuation of the reference value or more, by associating the measurement data of the element with the blood pressure data in the enlargement period.

**3**. The information processing apparatus of claim **2**, wherein the display controller is configured to update, in accordance with an instruction by an operator on an element that is to be displayed in the enlargement period, the element, which is displayed by being associated with the blood pressure data in the enlargement period, to the element which the operator designates.

**4**. The information processing apparatus of claim **1**, wherein the display controller is configured to update, in accordance with an instruction by an operator on an enlargement period, the enlargement period, which is displayed on the display device, to the enlargement period which the operator designates.

**5**. The information processing apparatus of claim **1**, further comprising:

a correlation information generation circuit configured to generate correlation information which indicates a correlation between a specific element and the blood pressure fluctuation of the reference value or more,

wherein the display controller is configured to cause the display device to display the correlation information which the correlation information generation circuit generates in accordance with a display instruction of an operator.

**6**. The information processing apparatus of claim **1**, wherein the information acquisition circuit is configured to acquire the successively measured blood pressure data by a blood pressure sensor of any one of a PTT method, a tonometry method, an optical method, a radio wave method, and ultrasonic method.

**7**. A non-transitory computer-readable storage medium storing an information processing program for causing a computer to execute:

a function of acquiring, from a specific subject to be measured, successively measured blood pressure data and measurement data of a plurality of elements other than a blood pressure;

a function of detecting a risk degree of a blood pressure fluctuation of a reference value or more from the successively measured blood pressure data which is acquired; and

a function of causing a display device to graph-display blood pressure data in an enlargement period including a time slot of the detected blood pressure fluctuation of the reference value or more, and measurement data of at least one of the elements other than the blood pressure in the enlargement period, by associating, by a time axis, the blood pressure data in the enlargement period and the measurement data of the at least one of the elements, and by color-coding, according to the risk degree, the time slot of the detected blood pressure fluctuation of the reference value or more.

**8**. The information processing apparatus of claim **1**, wherein the blood pressure fluctuation detection circuit is configured to detect a plurality of blood pressure fluctuations of a reference value or more from the blood pressure data, and

the display controller is configured to cause a display device to graph-display blood pressure data in an enlargement period including a time slot of the blood pressure fluctuations, and measurement data of at least one of the elements other than the blood pressure in the enlargement period, by associating, by a time axis, the blood pressure data in the enlargement period and the measurement data of the at least one of the elements.

**9**. The non-transitory computer-readable storage medium of claim **7**, wherein the function of detecting is a function of detecting a plurality of blood pressure fluctuations of a reference value or more from the blood pressure data, and

the function of causing the display device to graph-display blood pressure data is a function of causing the display device to graph-display blood pressure data in an enlargement period including a time slot of the blood pressure fluctuations, and measurement data of at least one of the elements other than the blood pressure in the enlargement period, by associating, by a time axis, the blood pressure data in the enlargement period and the measurement data of the at least one of the elements.

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| 专利名称(译) | 信息处理设备和信息处理程序 | | |
| 公开(公告)号 | US20190374170A1 | 公开(公告)日 | 2019-12-12 |
| 申请号 | US16/549010 | 申请日 | 2019-08-23 |
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| 发明人 | INOUE, KOSUKE<br>ESHITA, SHUSUKE | | |
| IPC分类号 | A61B5/00 A61B5/0205 | | |
| CPC分类号 | A61B5/14542 A61B5/021 A61B8/04 A61B5/4818 A61B5/743 A61B5/0002 A61B3/16 A61B5/7246 A61B5/7275 A61B5/0205 A61B5/02125 A61B5/02 A61B5/022 G16H50/30 | | |
| 优先权 | 2017048725 2017-03-14 JP | | |
| 外部链接 | Espacenet USPTO | | |


摘要(译)

本发明的信息处理设备包括信息获取电路，该信息获取电路被配置为从要测量的特定对象获取相继测量的血压数据和除血压之外的多个元素的测量数据。 显示控制器，其从由信息获取电路获取的连续测量的血压数据中检测参考值或更大的血压波动，并且显示控制器被配置为使显示装置显示血压数据和测量数据。