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(54) **BLOOD PRESSURE MEASUREMENT STATE DETERMINATION METHOD, BLOOD PRESSURE MEASUREMENT STATE DETERMINING DEVICE, AND RECORDING MEDIUM**

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(21) Appl. No.: **16/185,214**

(22) Filed: **Nov. 9, 2018**

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(30) **Foreign Application Priority Data**

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Aug. 1, 2016 (JP) 2016-151310
Jul. 14, 2017 (JP) 2017-137633

Publication Classification

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G06K 9/00	(2006.01)
A61B 5/022	(2006.01)
G10L 25/51	(2006.01)
G06Q 40/08	(2006.01)

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

CPC ***A61B 5/1176*** (2013.01); ***A61B 5/7475*** (2013.01); ***A61B 5/7435*** (2013.01); *G06K 2009/00328* (2013.01); ***A61B 5/022*** (2013.01); ***G10L 25/51*** (2013.01); ***G06Q 40/08*** (2013.01); ***G06K 9/00288*** (2013.01)

(57) **ABSTRACT**

A method for determining a blood pressure measurement state, using a device that is held in a hand of a user to whom a blood pressure meter is mounted. The method includes: obtaining (i) image data including a face of the user by a camera that the device has, (ii) first information indicating an inclination angle of the determining device as to the gravitational direction, by an angle sensor that the device has, and (iii) second information indicating a position of the face of the user in the image data, and the proportion of the size of the face of the user in the image data; determining whether or not the user is correctly using the blood pressure meter based on the image data, the first information and the second information; and providing a notification indicating the determination result.

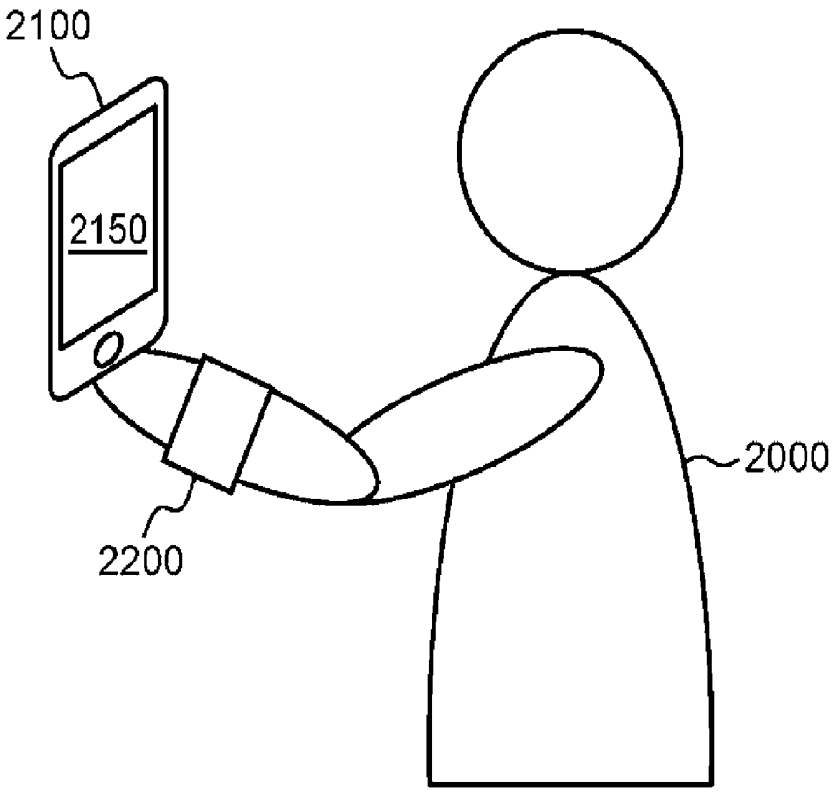


FIG. 1

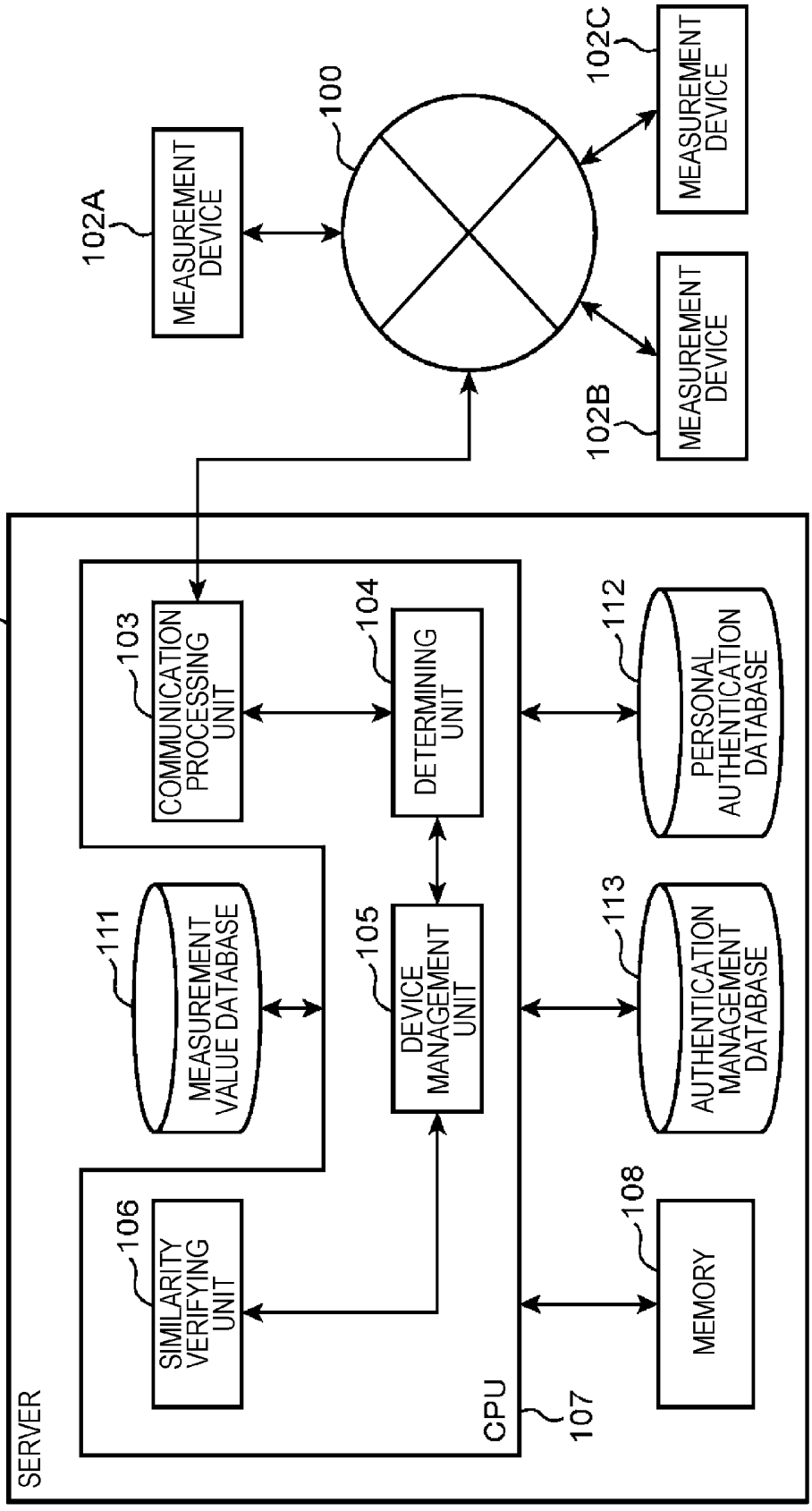

SERVER
101
CPU
107
COMMUNICATION PROCESSING UNIT
103
DETERMINING UNIT
104
DEVICE MANAGEMENT UNIT
105
SIMILARITY VERIFYING UNIT
106
MEASUREMENT VALUE DATABASE
111
PERSONAL AUTHENTICATION DATABASE
112
AUTHENTICATION MANAGEMENT DATABASE
113
MEMORY
108
100
MEASUREMENT DEVICE
102A
MEASUREMENT DEVICE
102B
MEASUREMENT DEVICE
102C

FIG. 2

200

201 TIME OF MEASUREMENT	202 MEASUREMENT DEVICE		203 MEASUREMENT VALUE	204 PERSONAL AUTHENTICATION INFORMATION		205 MEASUREMENT LOCATION
	211 TYPE OF MEASUREMENT	212 DEVICE ID		213 AUTHENTICATION METHOD	214 PERSONAL ID	
2016-07-27 18:21:00	STEPS	SMARTPHONE 0001	83	FINGERPRINT	USER A	34.738000 N, 135.573000 E
2016-07-27 18:21:00	STEPS	ACTIVITY MONITOR 0001	83	–	–	–
2016-07-27 18:22:00	STEPS	SMARTPHONE 0001	71	FINGERPRINT	USER A	34.738001 N, 135.573001 E
2016-07-27 18:22:00	STEPS	ACTIVITY MONITOR 0001	71	–	–	–
2016-07-27 18:23:00	STEPS	SMARTPHONE 0001	62	FINGERPRINT	USER A	34.738002 N, 135.573002 E
2016-07-27 18:23:00	STEPS	ACTIVITY MONITOR 0001	62	–	–	–
⋮	⋮	⋮	⋮	⋮	⋮	⋮
2016-07-27 20:45:13	SYSTOLIC BLOOD PRESSURE	BLOOD PRESSURE METER 0002	121	–	–	34.738555 N, 135.573580 E
2016-07-27 20:45:13	DIASTOLIC BLOOD PRESSURE	BLOOD PRESSURE METER 0002	83	–	–	34.738555 N, 135.573580 E
2016-07-27 20:45:13	PULSE	BLOOD PRESSURE METER 0002	68	–	–	34.738555 N, 135.573580 E

FIG. 3

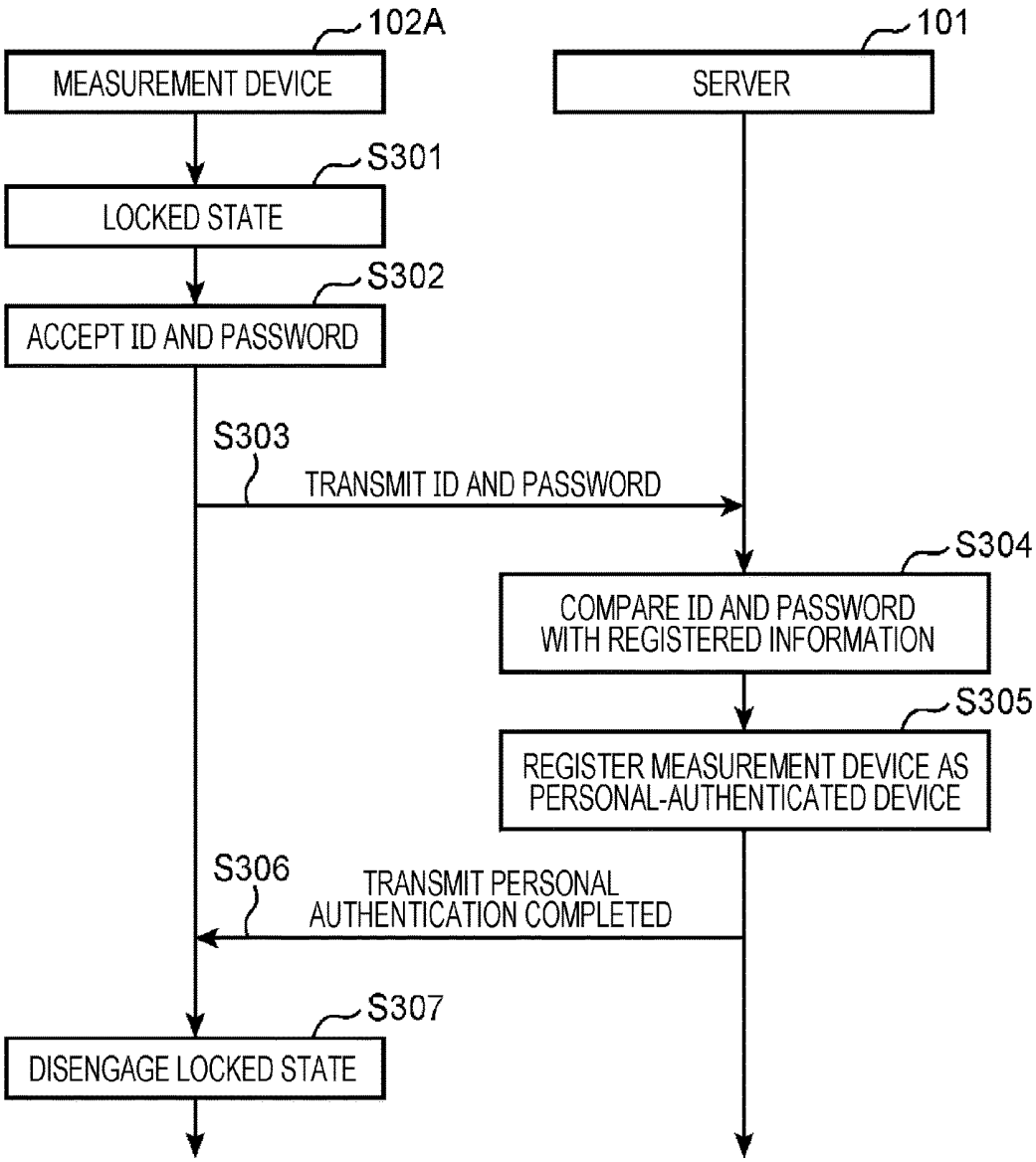

102A
MEASUREMENT DEVICE
101
SERVER
S301
LOCKED STATE
S302
ACCEPT ID AND PASSWORD
S303
TRANSMIT ID AND PASSWORD
S304
COMPARE ID AND PASSWORD WITH REGISTERED INFORMATION
S305
REGISTER MEASUREMENT DEVICE AS PERSONAL-AUTHENTICATED DEVICE
S306
TRANSMIT PERSONAL AUTHENTICATION COMPLETED
S307
DISENGAGE LOCKED STATE

FIG. 4

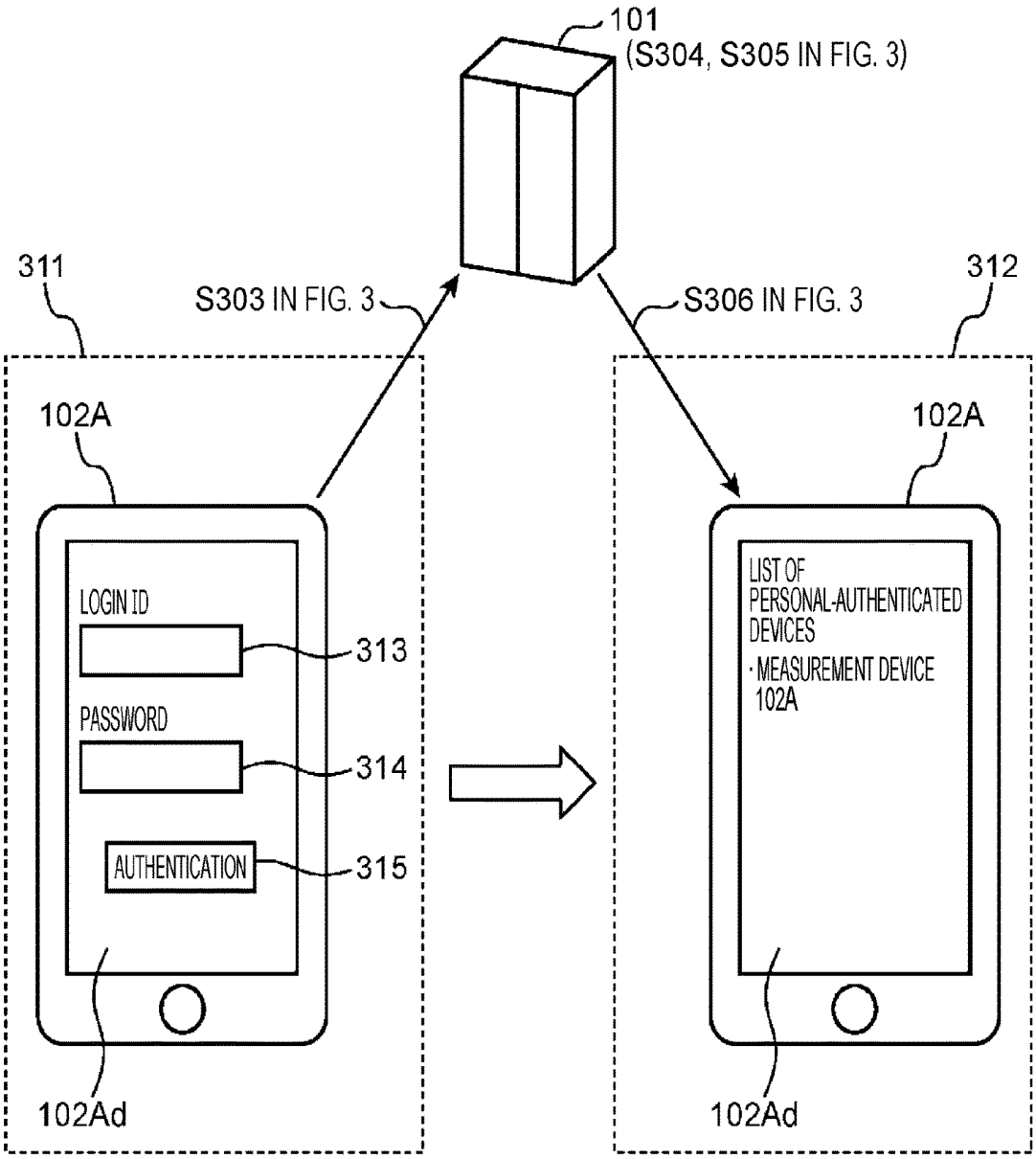

101
(S304, S305 IN FIG. 3)
311
312
S303 IN FIG. 3
S306 IN FIG. 3
102A
102A
LOGIN ID
313
PASSWORD
314
AUTHENTICATION
315
LIST OF PERSONAL-AUTHENTICATED DEVICES
· MEASUREMENT DEVICE 102A
102Ad
102Ad

FIG. 5

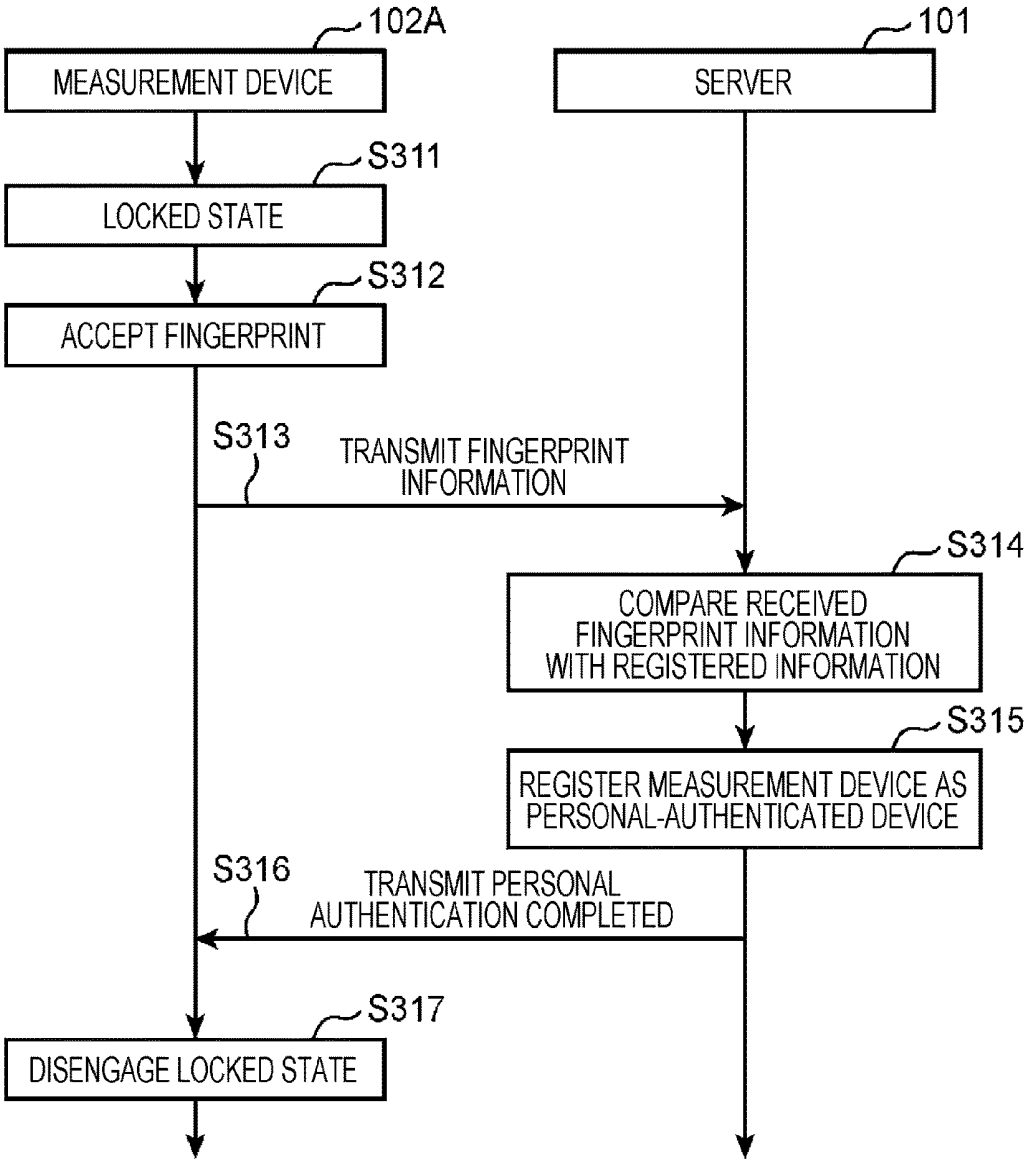

102A
MEASUREMENT DEVICE
101
SERVER
S311
LOCKED STATE
S312
ACCEPT FINGERPRINT
S313
TRANSMIT FINGERPRINT INFORMATION
S314
COMPARE RECEIVED FINGERPRINT INFORMATION WITH REGISTERED INFORMATION
S315
REGISTER MEASUREMENT DEVICE AS PERSONAL-AUTHENTICATED DEVICE
S316
TRANSMIT PERSONAL AUTHENTICATION COMPLETED
S317
DISENGAGE LOCKED STATE

FIG. 6

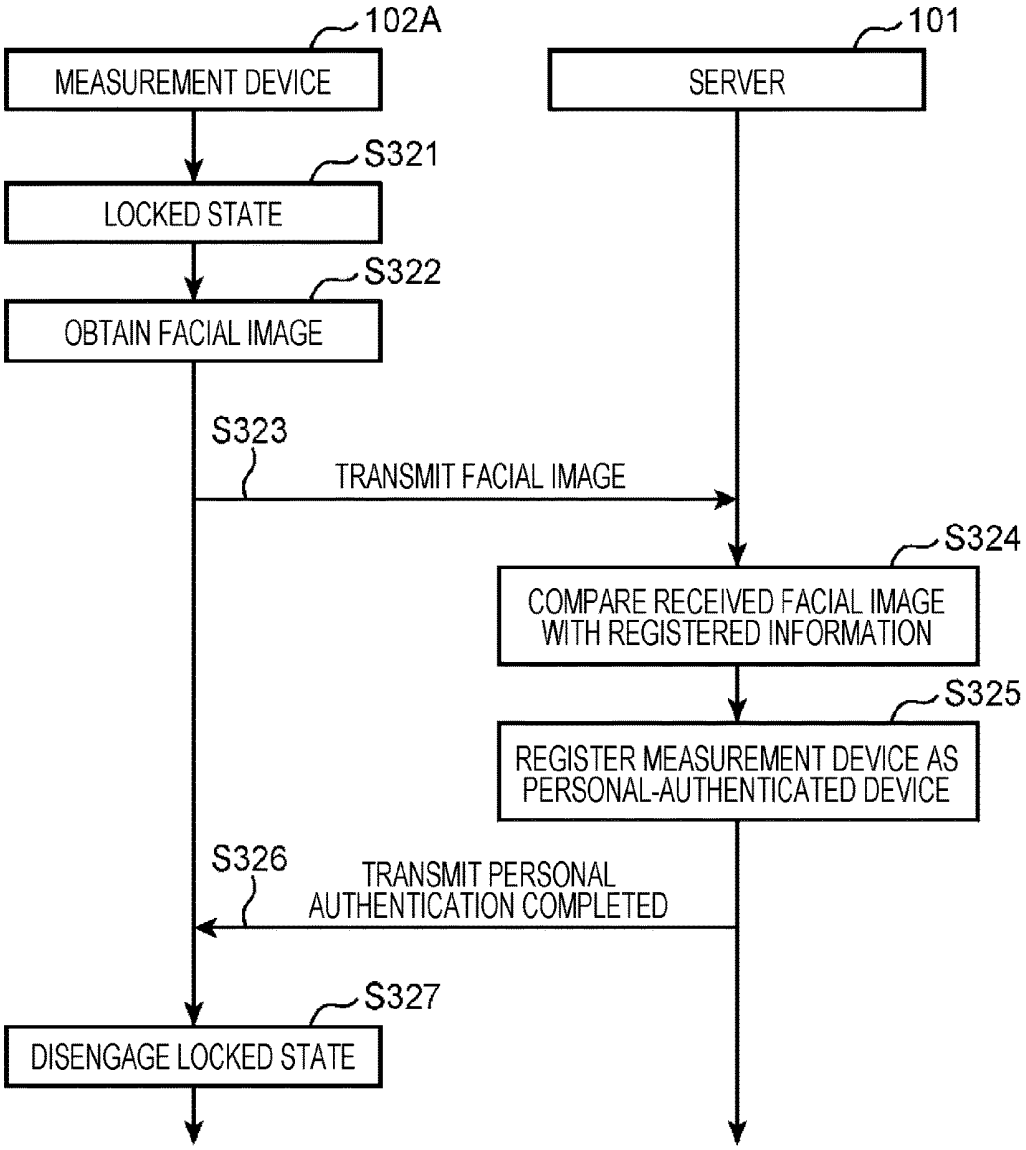

102A
MEASUREMENT DEVICE
101
SERVER
S321
LOCKED STATE
S322
OBTAIN FACIAL IMAGE
S323
TRANSMIT FACIAL IMAGE
S324
COMPARE RECEIVED FACIAL IMAGE WITH REGISTERED INFORMATION
S325
REGISTER MEASUREMENT DEVICE AS PERSONAL-AUTHENTICATED DEVICE
S326
TRANSMIT PERSONAL AUTHENTICATION COMPLETED
S327
DISENGAGE LOCKED STATE

FIG. 7

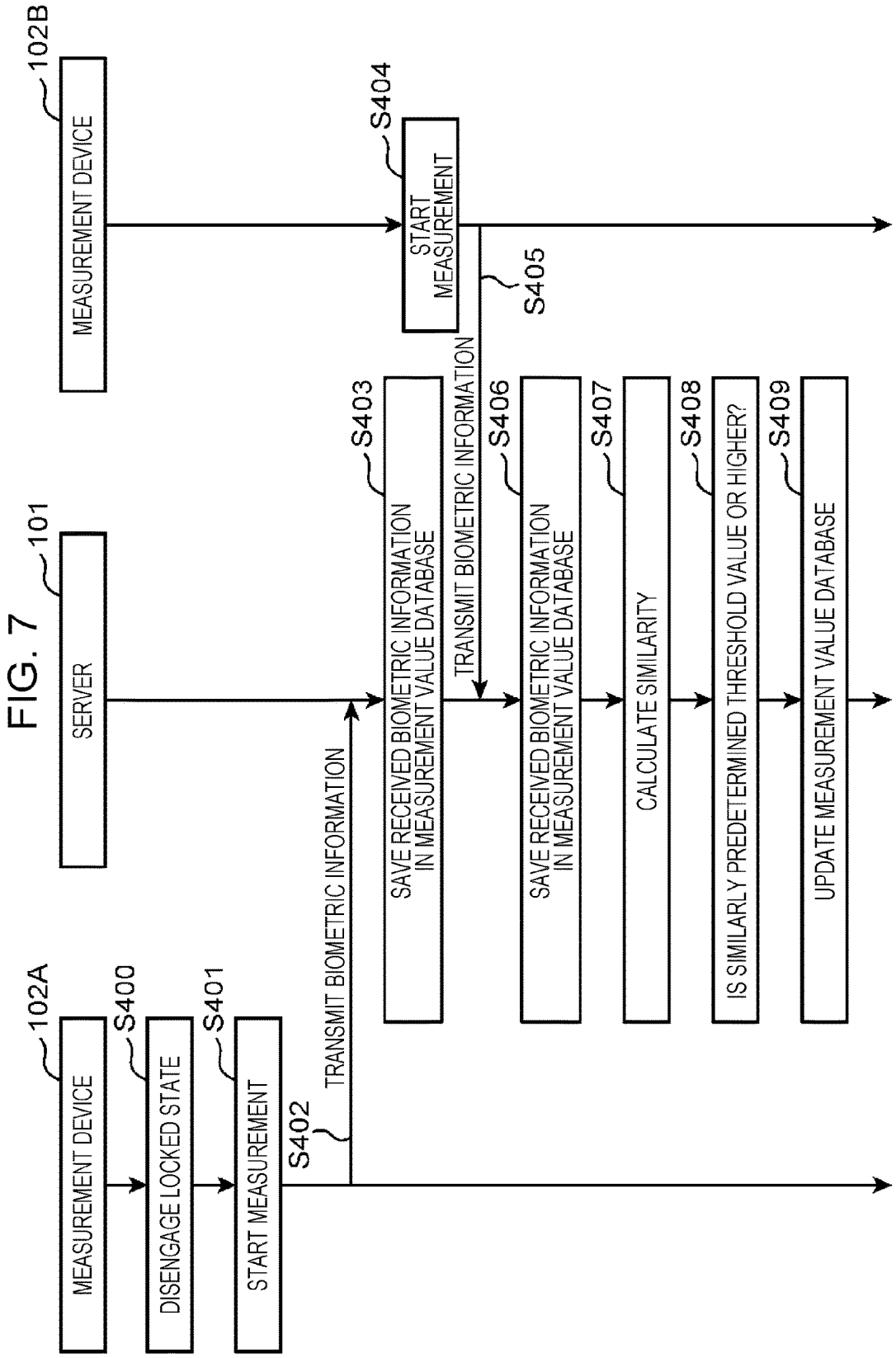

102A
MEASUREMENT DEVICE
S400
DISENGAGE LOCKED STATE
S401
START MEASUREMENT
S402
TRANSMIT BIOMETRIC INFORMATION
101
SERVER
S403
SAVE RECEIVED BIOMETRIC INFORMATION IN MEASUREMENT VALUE DATABASE
S404
START MEASUREMENT
102B
MEASUREMENT DEVICE
S405
TRANSMIT BIOMETRIC INFORMATION
S406
SAVE RECEIVED BIOMETRIC INFORMATION IN MEASUREMENT VALUE DATABASE
S407
CALCULATE SIMILARITY
S408
IS SIMILARLY PREDETERMINED THRESHOLD VALUE OR HIGHER?
S409
UPDATE MEASUREMENT VALUE DATABASE

FIG. 8

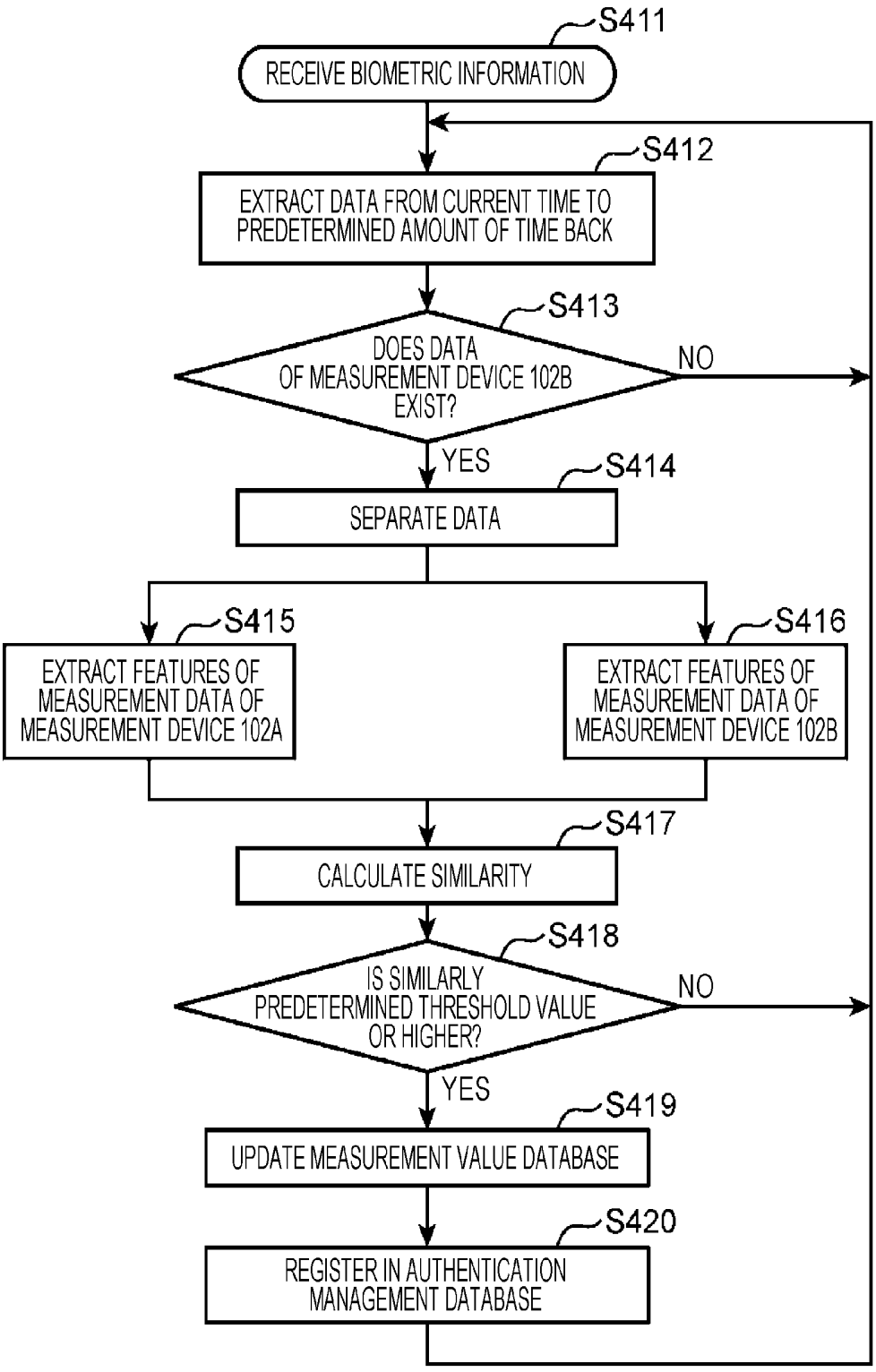

S411
RECEIVE BIOMETRIC INFORMATION
S412
EXTRACT DATA FROM CURRENT TIME TO PREDETERMINED AMOUNT OF TIME BACK
S413
DOES DATA OF MEASUREMENT DEVICE 102B EXIST?
NO
YES
S414
SEPARATE DATA
S415
EXTRACT FEATURES OF MEASUREMENT DATA OF MEASUREMENT DEVICE 102A
S416
EXTRACT FEATURES OF MEASUREMENT DATA OF MEASUREMENT DEVICE 102B
S417
CALCULATE SIMILARITY
S418
IS SIMILARLY PREDETERMINED THRESHOLD VALUE OR HIGHER?
NO
YES
S419
UPDATE MEASUREMENT VALUE DATABASE
S420
REGISTER IN AUTHENTICATION MANAGEMENT DATABASE

FIG. 9

200

TIME OF MEASUREMENT (201)	MEASUREMENT DEVICE (202)		MEASUREMENT VALUE (203)	PERSONAL AUTHENTICATION INFORMATION (204)		MEASUREMENT LOCATION (205)
	TYPE OF MEASUREMENT (211)	DEVICE ID (212)		AUTHENTICATION METHOD (213)	PERSONAL ID (214)	
2016-07-27 18:21:00	STEPS	SMARTPHONE 0001	83	FINGERPRINT	USER A	34.738000 N, 135.573000 E
2016-07-27 18:21:00	STEPS	ACTIVITY MONITOR 0001	83	–	–	–
2016-07-27 18:22:00	STEPS	SMARTPHONE 0001	71	FINGERPRINT	USER A	34.738001 N, 135.573001 E
2016-07-27 18:22:00	STEPS	ACTIVITY MONITOR 0001	71	–	–	–
2016-07-27 18:23:00	STEPS	SMARTPHONE 0001	62	FINGERPRINT	USER A	34.738002 N, 135.573002 E
2016-07-27 18:23:00	STEPS	ACTIVITY MONITOR 0001	62	–	–	–
⋮	⋮	⋮	⋮	⋮	⋮	⋮
2016-07-27 20:45:13	PULSE	SMARTPHONE 0001	68	FINGERPRINT	USER A	34.738555 N, 135.573580 E
⋮	⋮	⋮	⋮	⋮	⋮	⋮
2016-07-27 20:45:13	PULSE	SMARTPHONE 0002	68	ID, PW	USER B	35.681181 N, 139.767402 E
⋮	⋮	⋮	⋮	⋮	⋮	⋮
2016-07-27 20:45:13	SYSTOLIC BLOOD PRESSURE	BLOOD PRESSURE METER 0002	121	–	–	34.738555 N, 135.573580 E
2016-07-27 20:45:13	DIASTOLIC BLOOD PRESSURE	BLOOD PRESSURE METER 0002	83	–	–	34.738555 N, 135.573580 E
2016-07-27 20:45:13	PULSE	BLOOD PRESSURE METER 0002	68	–	–	34.738555 N, 135.573580 E

FIG. 10

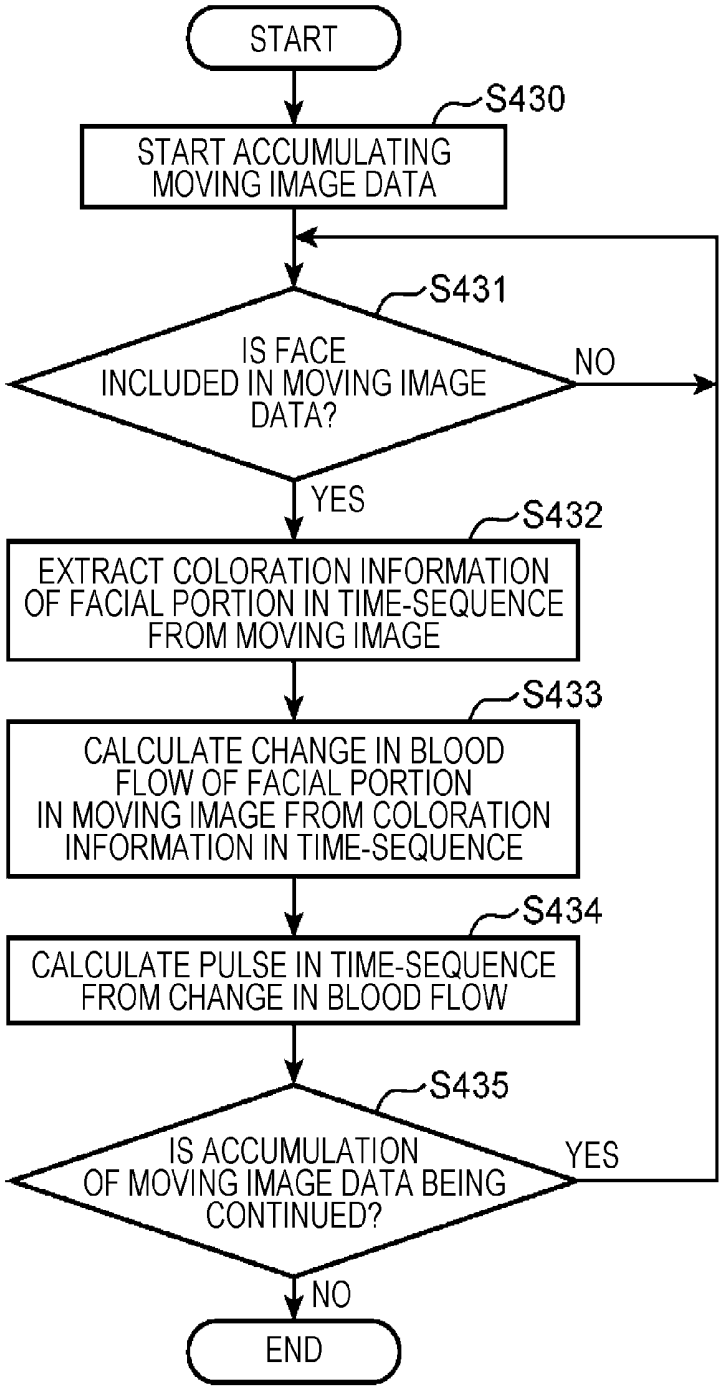

START
S430
START ACCUMULATING MOVING IMAGE DATA
S431
IS FACE INCLUDED IN MOVING IMAGE DATA?
NO
YES
S432
EXTRACT COLORATION INFORMATION OF FACIAL PORTION IN TIME-SEQUENCE FROM MOVING IMAGE
S433
CALCULATE CHANGE IN BLOOD FLOW OF FACIAL PORTION IN MOVING IMAGE FROM COLORATION INFORMATION IN TIME-SEQUENCE
S434
CALCULATE PULSE IN TIME-SEQUENCE FROM CHANGE IN BLOOD FLOW
S435
IS ACCUMULATION OF MOVING IMAGE DATA BEING CONTINUED?
YES
NO
END

FIG. 11

200

201 TIME OF MEASUREMENT	202 MEASUREMENT DEVICE		203 MEASUREMENT VALUE	204 PERSONAL AUTHENTICATION INFORMATION		205 MEASUREMENT LOCATION
	211 TYPE OF MEASUREMENT	212 DEVICE ID		213 AUTHENTICATION METHOD	214 PERSONAL ID	
2016-07-27 18:21:00	STEPS	SMARTPHONE 0001	83	FINGERPRINT	USER A	34.738000 N, 135.573000 E
2016-07-27 18:21:00	STEPS	ACTIVITY MONITOR 0001	83	SUCCESSION (SMARTPHONE 0001)	USER A	–
2016-07-27 18:22:00	STEPS	SMARTPHONE 0001	71	FINGERPRINT	USER A	34.738001 N, 135.573001 E
2016-07-27 18:22:00	STEPS	ACTIVITY MONITOR 0001	71	SUCCESSION (SMARTPHONE 0001)	USER A	–
2016-07-27 18:23:00	STEPS	SMARTPHONE 0001	62	FINGERPRINT	USER A	34.738002 N, 135.573002 E
2016-07-27 18:23:00	STEPS	ACTIVITY MONITOR 0001	62	SUCCESSION (SMARTPHONE 0001)	USER A	–
⋮	⋮	⋮	⋮	⋮	⋮	⋮
2016-07-27 20:45:13	SYSTOLIC BLOOD PRESSURE	BLOOD PRESSURE METER 0002	121	–	–	34.738555 N, 135.573580 E
2016-07-27 20:45:13	DIASTOLIC BLOOD PRESSURE	BLOOD PRESSURE METER 0002	83	–	–	34.738555 N, 135.573580 E
2016-07-27 20:45:13	PULSE	BLOOD PRESSURE METER 0002	68	–	–	34.738555 N, 135.573580 E

FIG. 12

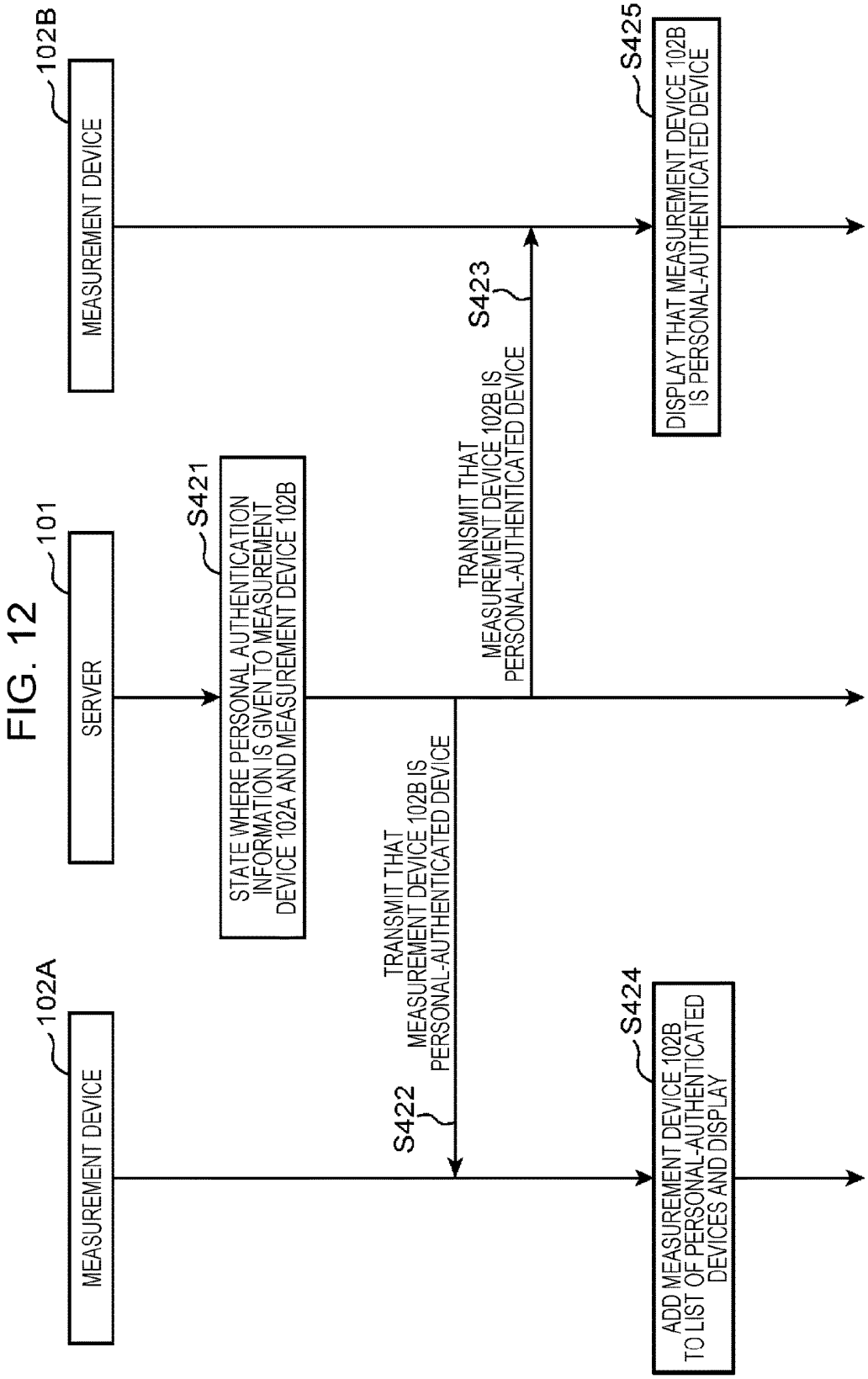

102A
MEASUREMENT DEVICE
101
SERVER
102B
MEASUREMENT DEVICE
S421
STATE WHERE PERSONAL AUTHENTICATION INFORMATION IS GIVEN TO MEASUREMENT DEVICE 102A AND MEASUREMENT DEVICE 102B
S422
TRANSMIT THAT MEASUREMENT DEVICE 102B IS PERSONAL-AUTHENTICATED DEVICE
S423
TRANSMIT THAT MEASUREMENT DEVICE 102B IS PERSONAL-AUTHENTICATED DEVICE
S424
ADD MEASUREMENT DEVICE 102B TO LIST OF PERSONAL-AUTHENTICATED DEVICES AND DISPLAY
S425
DISPLAY THAT MEASUREMENT DEVICE 102B IS PERSONAL-AUTHENTICATED DEVICE

FIG. 13

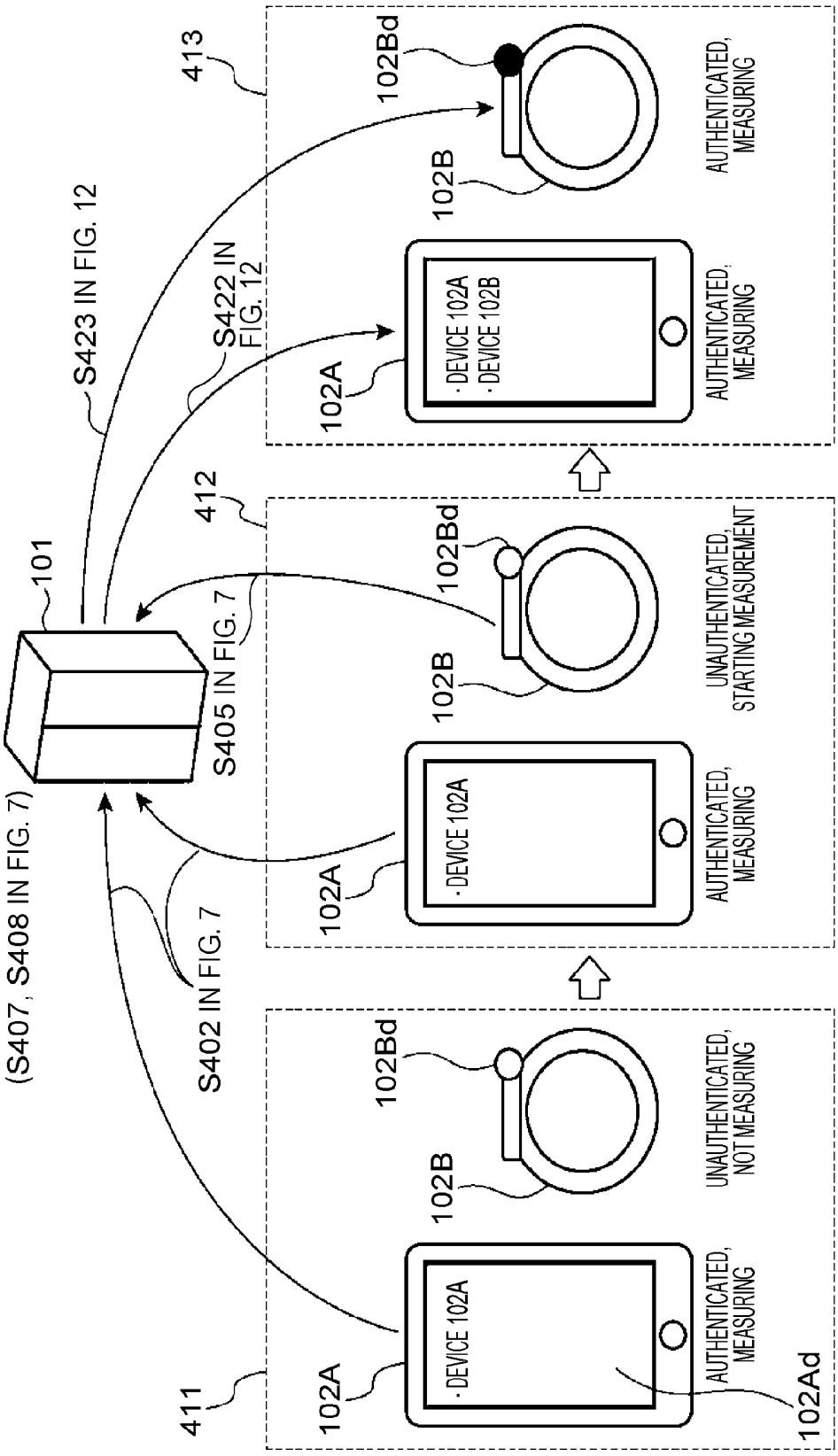

411
412
413
101
102A
102B
102Bd
102Ad
·DEVICE 102A
·DEVICE 102B
AUTHENTICATED, MEASURING
UNAUTHENTICATED, NOT MEASURING
UNAUTHENTICATED, STARTING MEASUREMENT
(S407, S408 IN FIG. 7)
S402 IN FIG. 7
S405 IN FIG. 7
S422 IN FIG. 12
S423 IN FIG. 12

FIG. 14

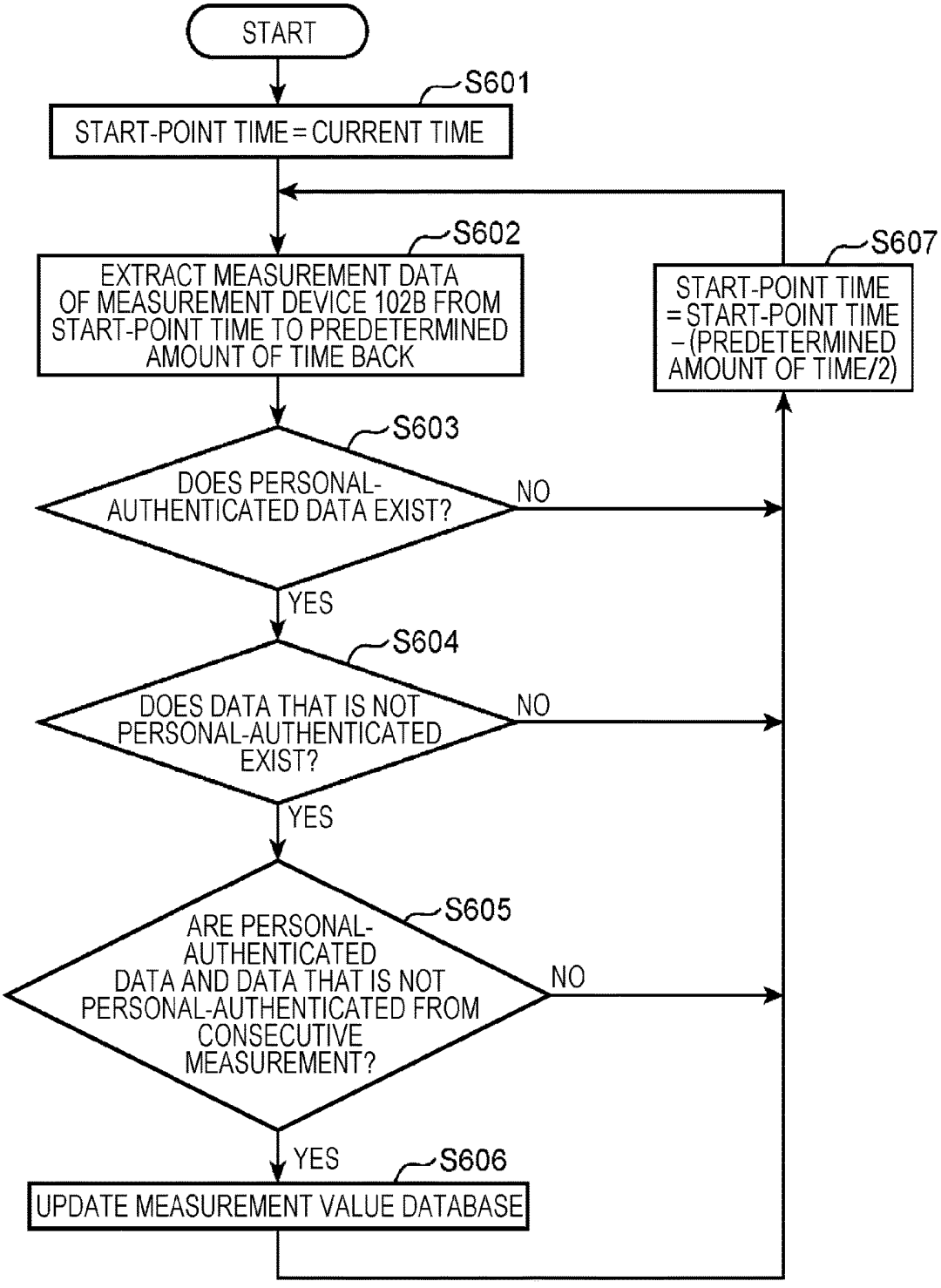

START
S601
START-POINT TIME = CURRENT TIME
S602
EXTRACT MEASUREMENT DATA OF MEASUREMENT DEVICE 102B FROM START-POINT TIME TO PREDETERMINED AMOUNT OF TIME BACK
S603
DOES PERSONAL-AUTHENTICATED DATA EXIST?
NO
YES
S604
DOES DATA THAT IS NOT PERSONAL-AUTHENTICATED EXIST?
NO
YES
S605
ARE PERSONAL-AUTHENTICATED DATA AND DATA THAT IS NOT PERSONAL-AUTHENTICATED FROM CONSECUTIVE MEASUREMENT?
NO
YES
S606
UPDATE MEASUREMENT VALUE DATABASE
S607
START-POINT TIME = START-POINT TIME − (PREDETERMINED AMOUNT OF TIME/2)

FIG. 15

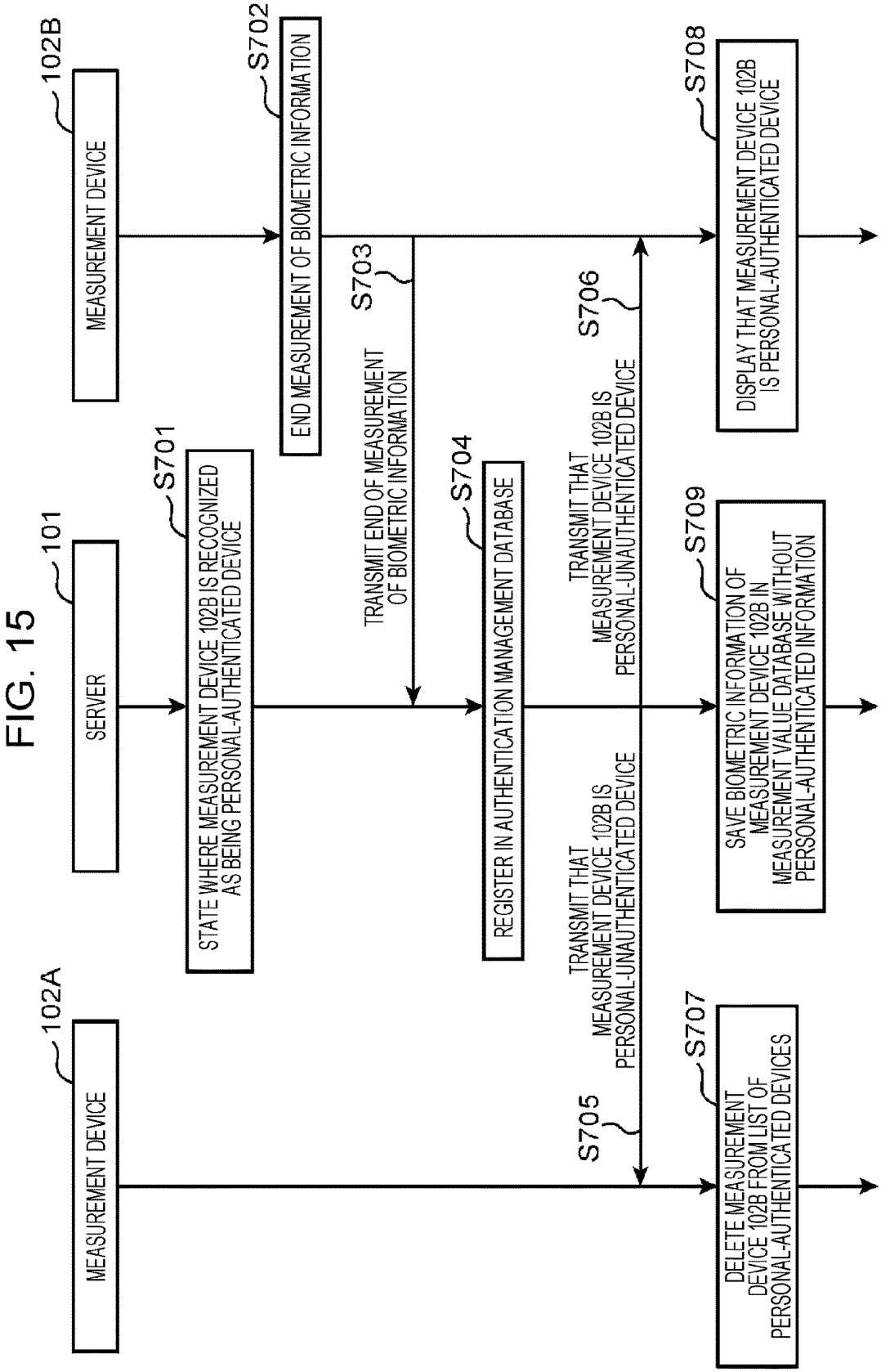

102B
MEASUREMENT DEVICE
S702
END MEASUREMENT OF BIOMETRIC INFORMATION
S708
DISPLAY THAT MEASUREMENT DEVICE 102B IS PERSONAL-AUTHENTICATED DEVICE
101
SERVER
S701
STATE WHERE MEASUREMENT DEVICE 102B IS RECOGNIZED AS BEING PERSONAL-AUTHENTICATED DEVICE
S703
TRANSMIT END OF MEASUREMENT OF BIOMETRIC INFORMATION
S704
REGISTER IN AUTHENTICATION MANAGEMENT DATABASE
S706
TRANSMIT THAT MEASUREMENT DEVICE 102B IS PERSONAL-UNAUTHENTICATED DEVICE
S709
SAVE BIOMETRIC INFORMATION OF MEASUREMENT DEVICE 102B IN MEASUREMENT VALUE DATABASE WITHOUT PERSONAL-AUTHENTICATED INFORMATION
102A
MEASUREMENT DEVICE
S705
TRANSMIT THAT MEASUREMENT DEVICE 102B IS PERSONAL-UNAUTHENTICATED DEVICE
S707
DELETE MEASUREMENT DEVICE 102B FROM LIST OF PERSONAL-AUTHENTICATED DEVICES

FIG. 16

1600

1601 DEVICE ID	1602 TIME	1603 PERSONAL ID	1604 AUTHENTICATION FLAG
SMARTPHONE 0001	2016-07-27 18:20:00	USER A	AUTHENTICATION STARTED
ACTIVITY MONITOR 0001	2016-07-27 18:23:00	USER A	AUTHENTICATION STARTED
SMARTPHONE 0001	2016-07-27 18:30:00	USER A	AUTHENTICATION ENDED
BLOOD PRESSURE METER 0002	2016-07-27 19:10:00	USER A	AUTHENTICATION STARTED
BLOOD PRESSURE METER 0003	2016-07-27 19:11:00	USER A	AUTHENTICATION ENDED
ACTIVITY MONITOR 0001	2016-07-27 22:40:00	USER A	AUTHENTICATION ENDED
⋮	⋮	⋮	⋮

FIG. 17

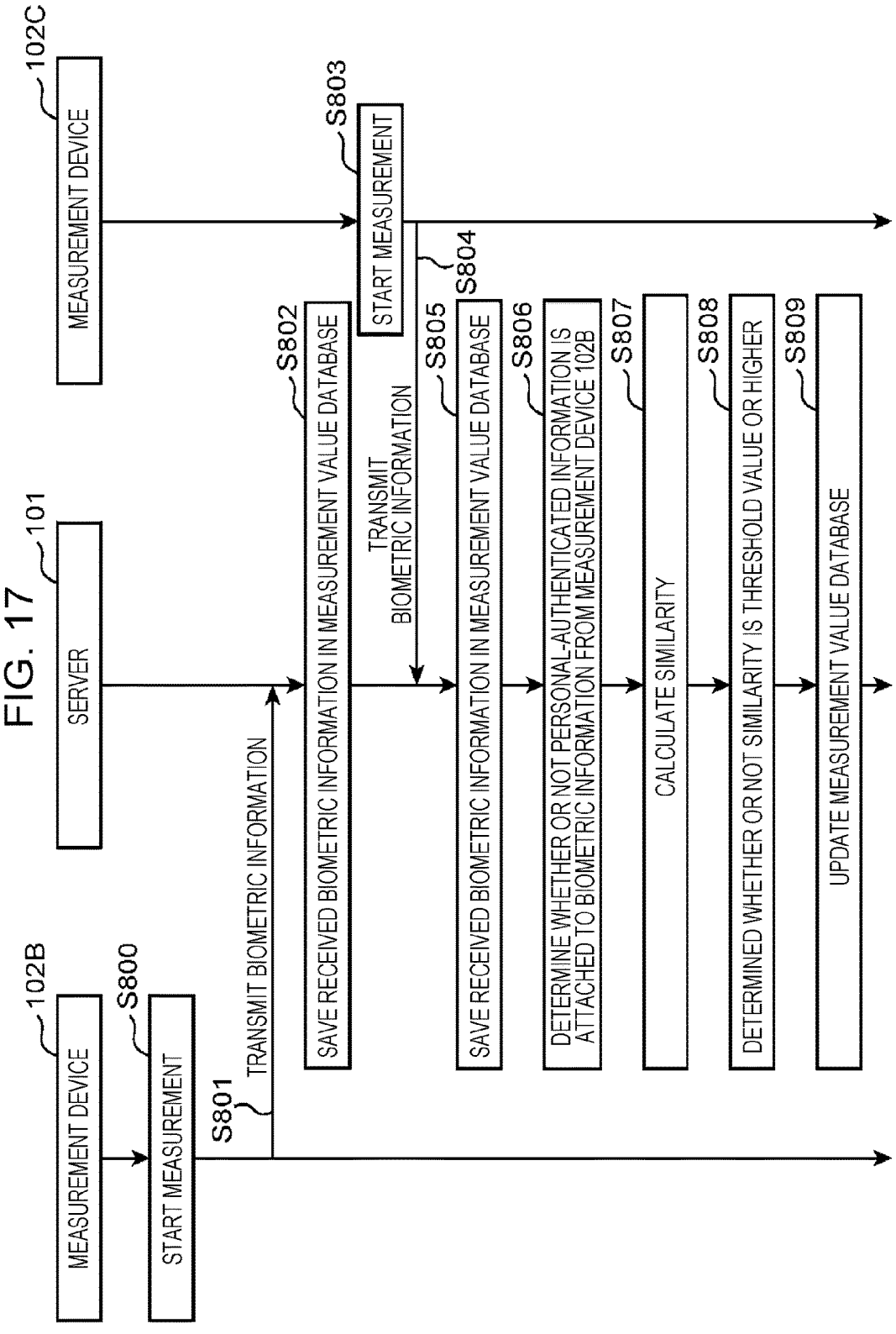

102B
MEASUREMENT DEVICE
S800
START MEASUREMENT
S801
TRANSMIT BIOMETRIC INFORMATION
101
SERVER
S802
SAVE RECEIVED BIOMETRIC INFORMATION IN MEASUREMENT VALUE DATABASE
S803
START MEASUREMENT
102C
MEASUREMENT DEVICE
S804
TRANSMIT BIOMETRIC INFORMATION
S805
SAVE RECEIVED BIOMETRIC INFORMATION IN MEASUREMENT VALUE DATABASE
S806
DETERMINE WHETHER OR NOT PERSONAL-AUTHENTICATED INFORMATION IS ATTACHED TO BIOMETRIC INFORMATION FROM MEASUREMENT DEVICE 102B
S807
CALCULATE SIMILARITY
S808
DETERMINED WHETHER OR NOT SIMILARITY IS THRESHOLD VALUE OR HIGHER
S809
UPDATE MEASUREMENT VALUE DATABASE

FIG. 18

200

201 TIME OF MEASUREMENT	211 MEASUREMENT DEVICE: TYPE OF MEASUREMENT	212 MEASUREMENT DEVICE: DEVICE ID	203 MEASUREMENT VALUE	213 PERSONAL AUTHENTICATION INFORMATION: AUTHENTICATION METHOD	214 PERSONAL AUTHENTICATION INFORMATION: PERSONAL ID	205 MEASUREMENT LOCATION
2016-07-27 18:21:00	STEPS	SMARTPHONE 0001	83	FINGERPRINT	USER A	34.738000 N, 135.573000 E
2016-07-27 18:21:00	STEPS	ACTIVITY MONITOR 0001	83	SUCCESSION (SMARTPHONE 0001)	USER A	–
2016-07-27 18:22:00	STEPS	SMARTPHONE 0001	71	FINGERPRINT	USER A	34.738001 N, 135.573001 E
2016-07-27 18:22:00	STEPS	ACTIVITY MONITOR 0001	71	SUCCESSION (SMARTPHONE 0001)	USER A	–
2016-07-27 18:23:00	STEPS	SMARTPHONE 0001	62	FINGERPRINT	USER A	34.738002 N, 135.573002 E
2016-07-27 18:23:00	STEPS	ACTIVITY MONITOR 0001	62	SUCCESSION (SMARTPHONE 0001)	USER A	–
⋮	⋮	⋮	⋮	⋮	⋮	⋮
2016-07-27 20:45:13	SYSTOLIC BLOOD PRESSURE	BLOOD PRESSURE METER 0002	121	SUCCESSION (ACTIVITY MONITOR 0001)	USER A	34.738555 N, 135.573580 E
2016-07-27 20:45:13	DIASTOLIC BLOOD PRESSURE	BLOOD PRESSURE METER 0002	83	SUCCESSION (ACTIVITY MONITOR 0001)	USER A	34.738555 N, 135.573580 E
2016-07-27 20:45:13	PULSE	BLOOD PRESSURE METER 0002	68	SUCCESSION (ACTIVITY MONITOR 0001)	USER A	34.738555 N, 135.573580 E
2016-07-27 20:45:13	PULSE	ACTIVITY MONITOR 0001	68	SUCCESSION (SMARTPHONE 0001)	USER A	–

FIG. 19

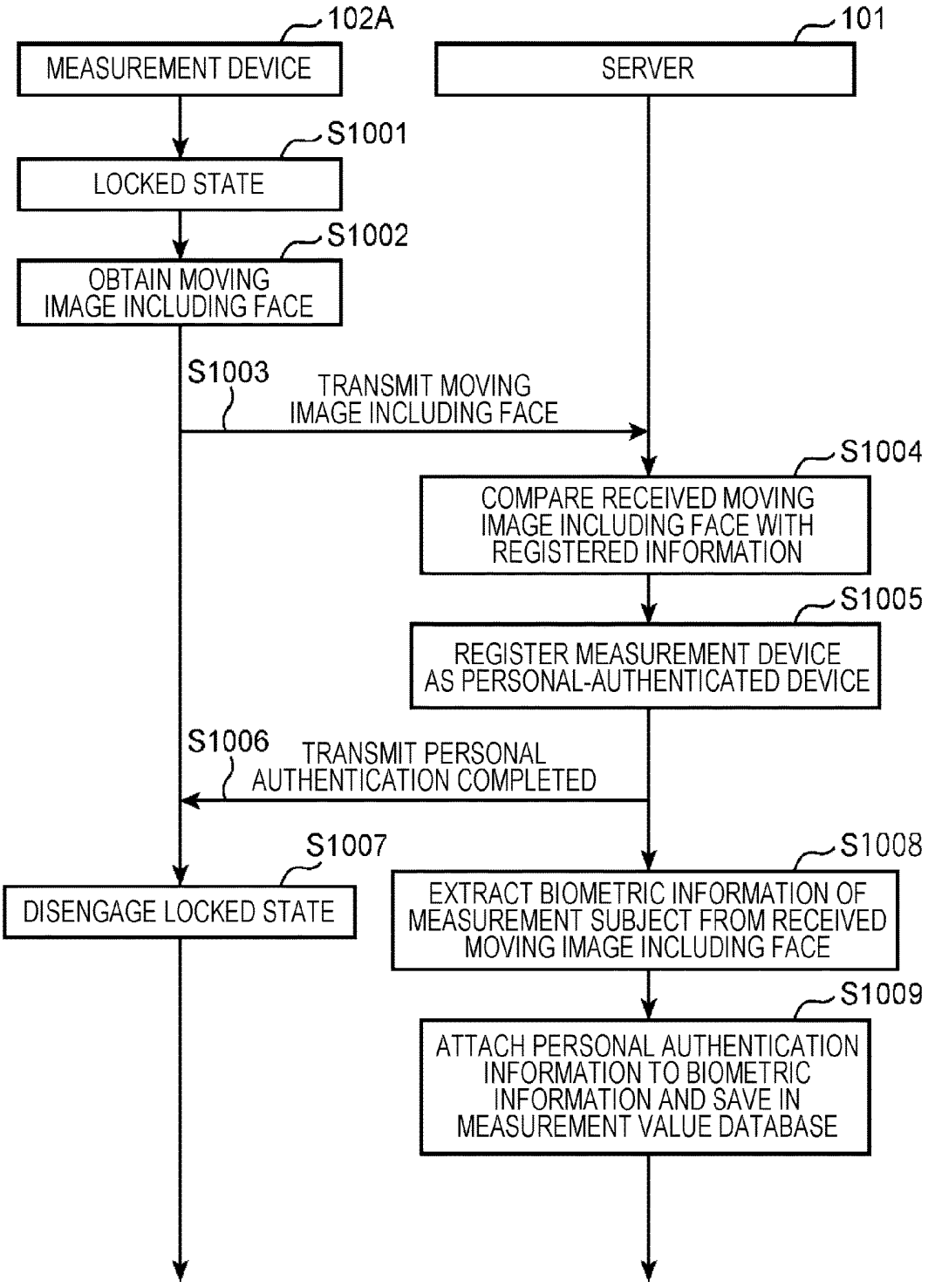

102A
MEASUREMENT DEVICE
101
SERVER
S1001
LOCKED STATE
S1002
OBTAIN MOVING IMAGE INCLUDING FACE
S1003
TRANSMIT MOVING IMAGE INCLUDING FACE
S1004
COMPARE RECEIVED MOVING IMAGE INCLUDING FACE WITH REGISTERED INFORMATION
S1005
REGISTER MEASUREMENT DEVICE AS PERSONAL-AUTHENTICATED DEVICE
S1006
TRANSMIT PERSONAL AUTHENTICATION COMPLETED
S1007
DISENGAGE LOCKED STATE
S1008
EXTRACT BIOMETRIC INFORMATION OF MEASUREMENT SUBJECT FROM RECEIVED MOVING IMAGE INCLUDING FACE
S1009
ATTACH PERSONAL AUTHENTICATION INFORMATION TO BIOMETRIC INFORMATION AND SAVE IN MEASUREMENT VALUE DATABASE

FIG. 20

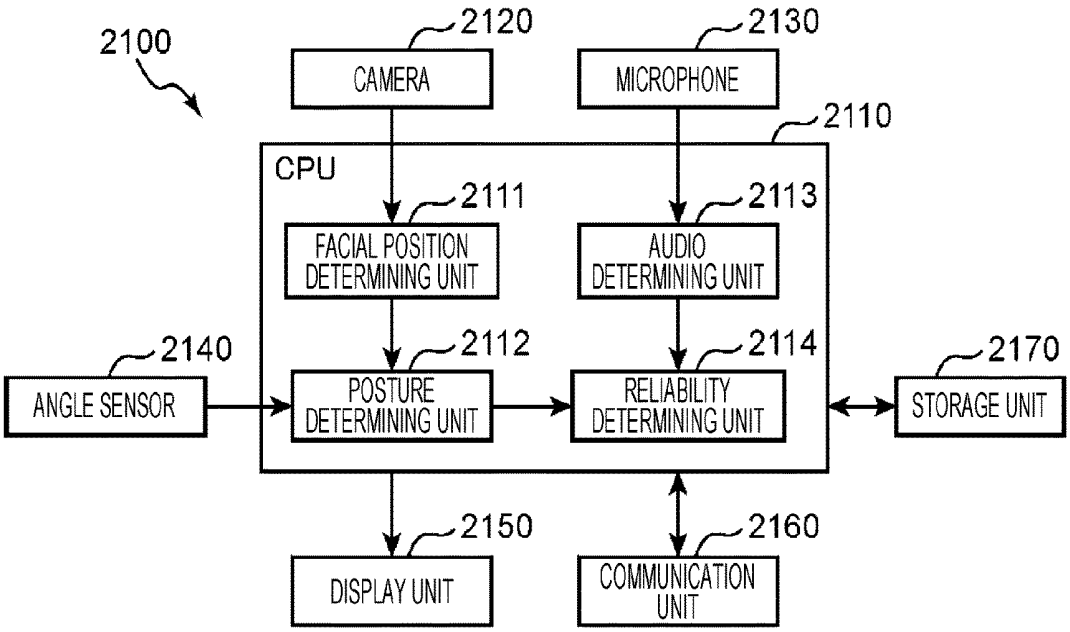

2100
2120
CAMERA
2130
MICROPHONE
2110
CPU
2111
FACIAL POSITION DETERMINING UNIT
2113
AUDIO DETERMINING UNIT
2140
ANGLE SENSOR
2112
POSTURE DETERMINING UNIT
2114
RELIABILITY DETERMINING UNIT
2170
STORAGE UNIT
2150
DISPLAY UNIT
2160
COMMUNICATION UNIT

FIG. 21

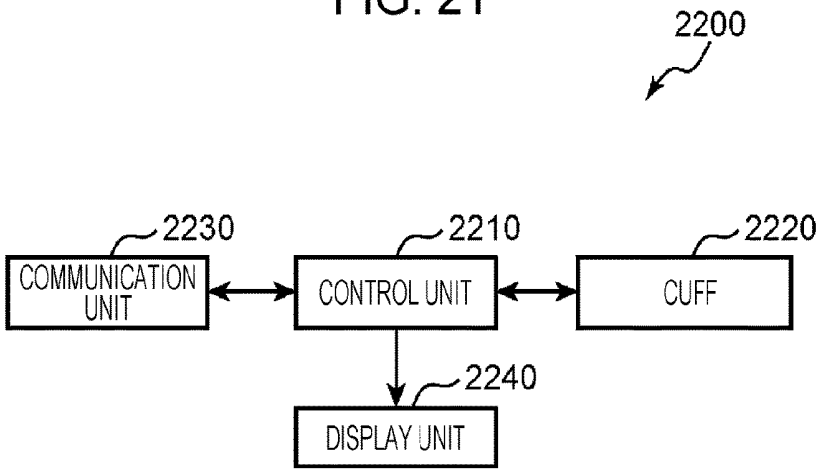

2200
2230
COMMUNICATION UNIT
2210
CONTROL UNIT
2220
CUFF
2240
DISPLAY UNIT

FIG. 22

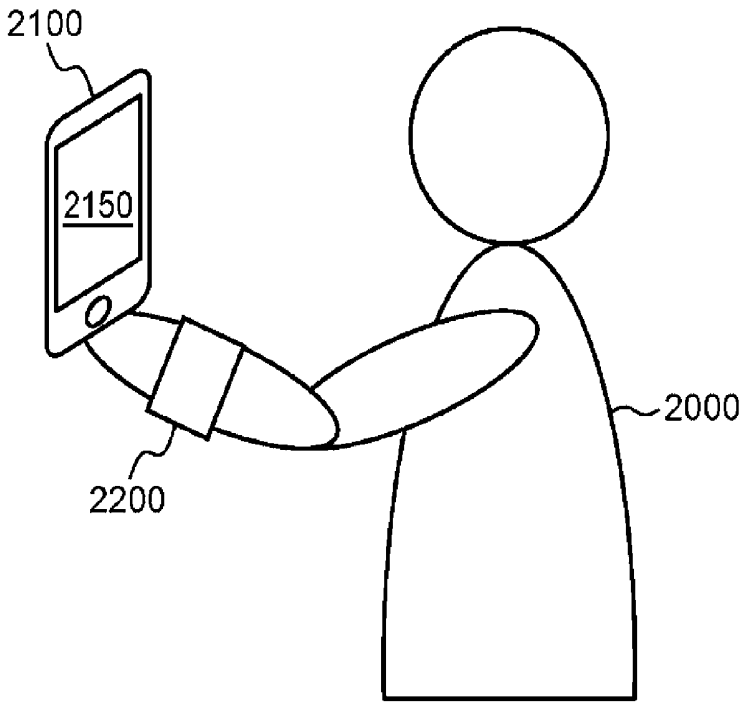


FIG. 23

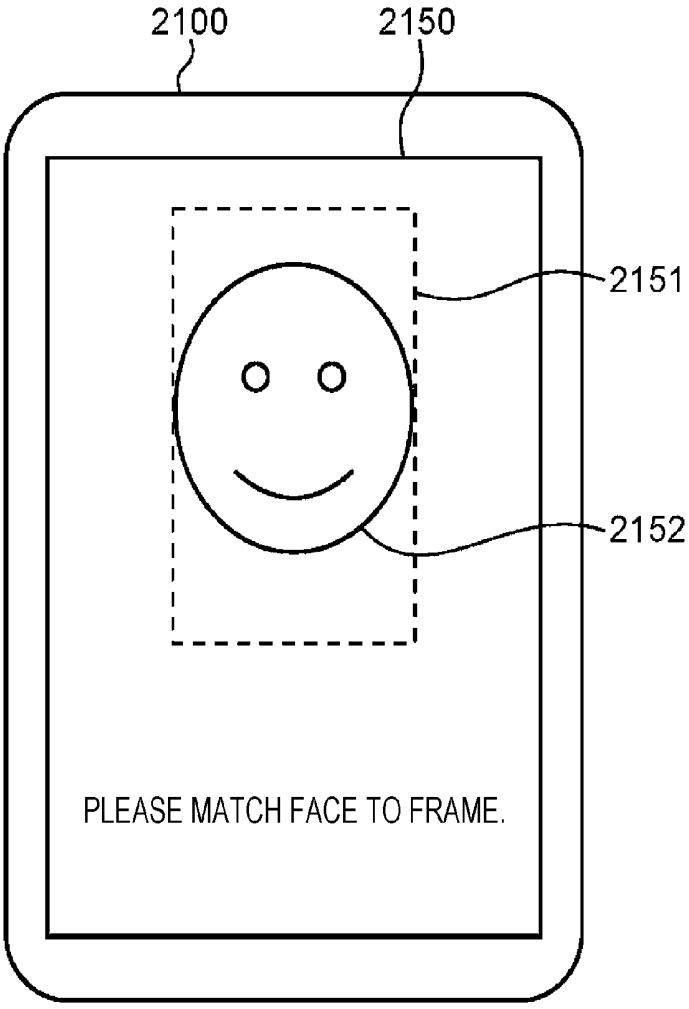


FIG. 24

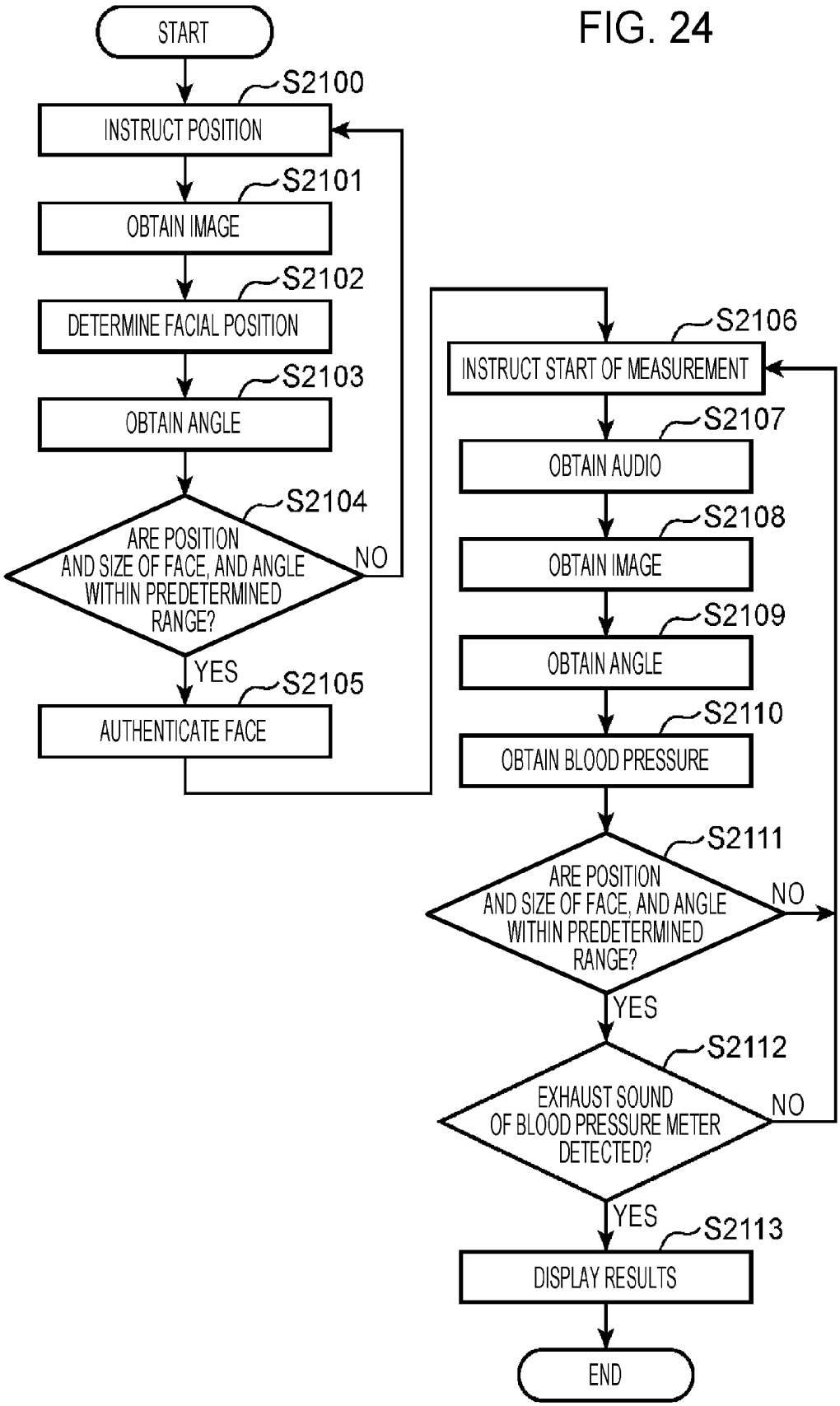

START
S2100
INSTRUCT POSITION
S2101
OBTAIN IMAGE
S2102
DETERMINE FACIAL POSITION
S2103
OBTAIN ANGLE
S2104
ARE POSITION AND SIZE OF FACE, AND ANGLE WITHIN PREDETERMINED RANGE?
NO
YES
S2105
AUTHENTICATE FACE
S2106
INSTRUCT START OF MEASUREMENT
S2107
OBTAIN AUDIO
S2108
OBTAIN IMAGE
S2109
OBTAIN ANGLE
S2110
OBTAIN BLOOD PRESSURE
S2111
ARE POSITION AND SIZE OF FACE, AND ANGLE WITHIN PREDETERMINED RANGE?
NO
YES
S2112
EXHAUST SOUND OF BLOOD PRESSURE METER DETECTED?
NO
YES
S2113
DISPLAY RESULTS
END

FIG. 25

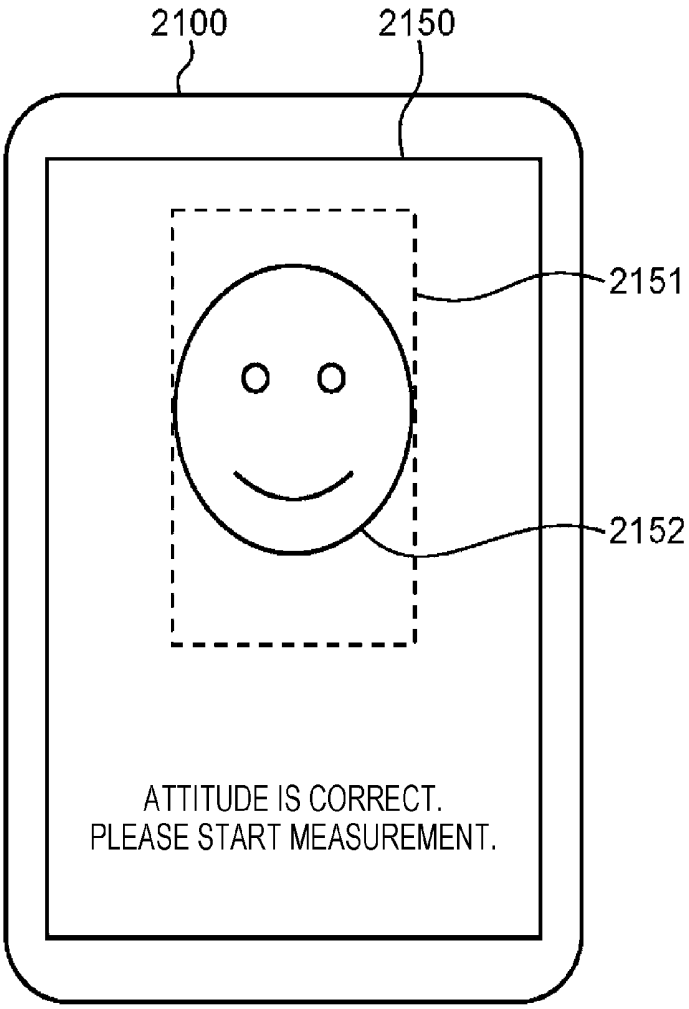

2100
2150
2151
2152
ATTITUDE IS CORRECT.
PLEASE START MEASUREMENT.

FIG. 26

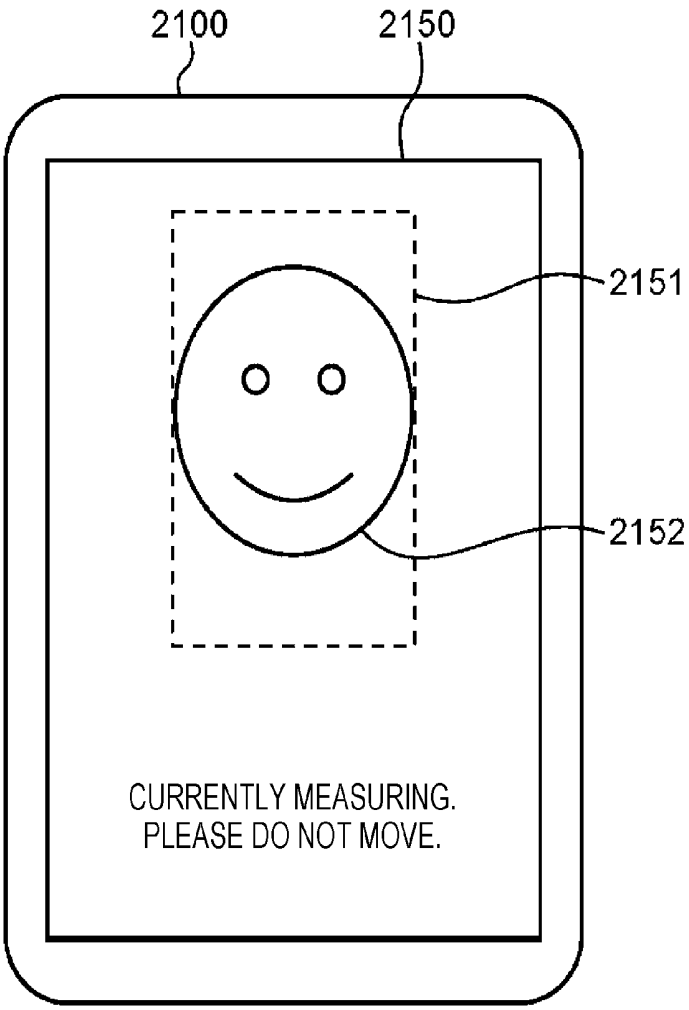


FIG. 27

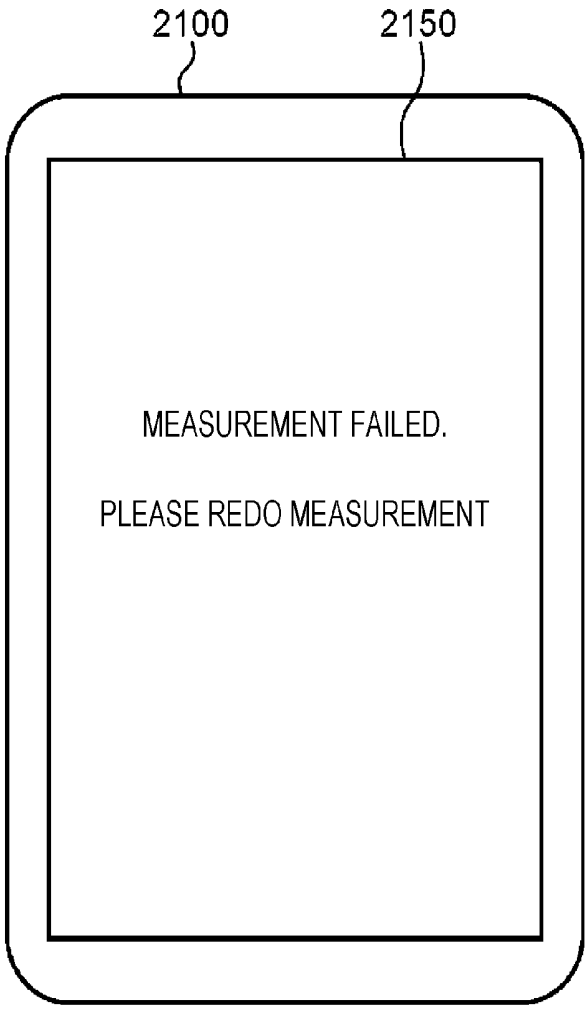


FIG. 28

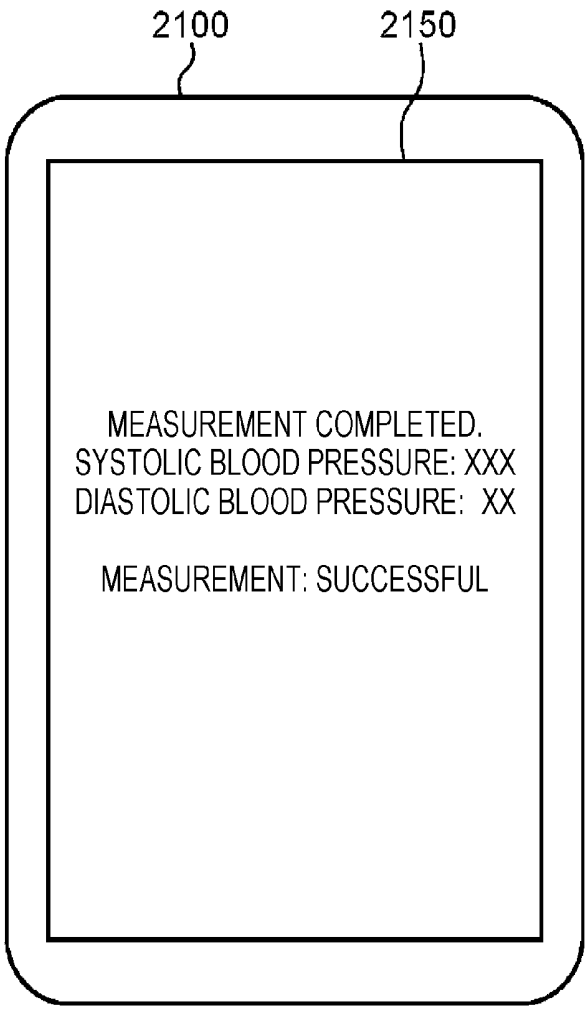

2100
2150
MEASUREMENT COMPLETED.
SYSTOLIC BLOOD PRESSURE: XXX
DIASTOLIC BLOOD PRESSURE: XX
MEASUREMENT: SUCCESSFUL

FIG. 29

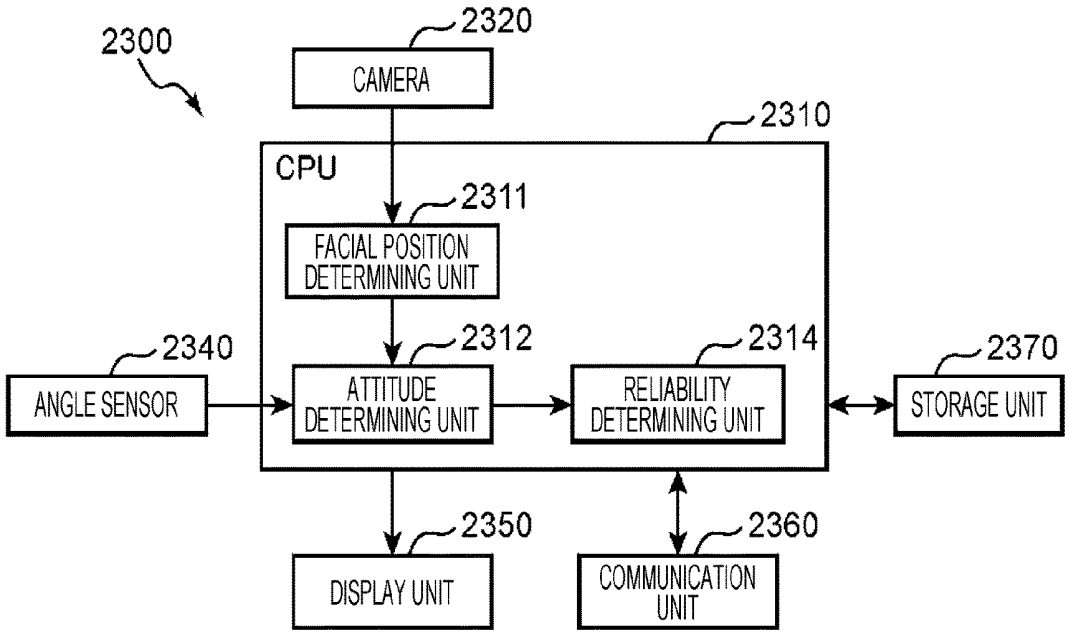

2300
2320
CAMERA
2310
CPU
2311
FACIAL POSITION DETERMINING UNIT
2340
ANGLE SENSOR
2312
ATTITUDE DETERMINING UNIT
2314
RELIABILITY DETERMINING UNIT
2370
STORAGE UNIT
2350
DISPLAY UNIT
2360
COMMUNICATION UNIT

FIG. 30

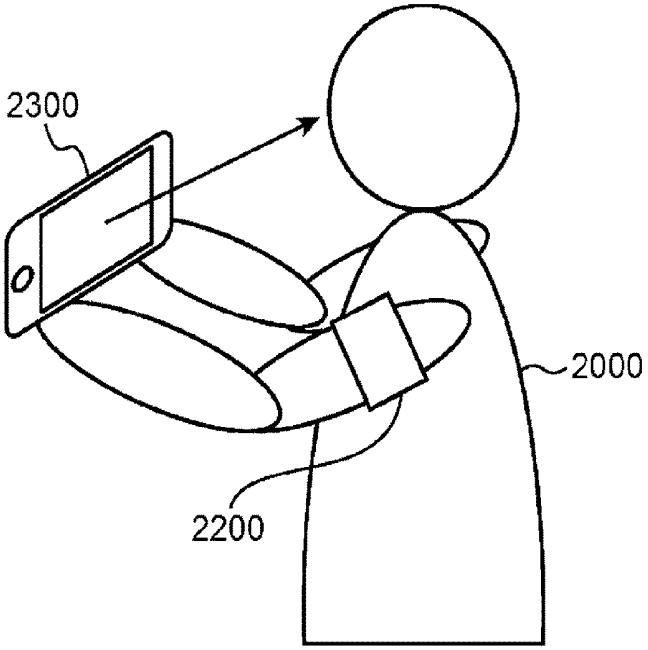

2300
2000
2200

FIG. 31

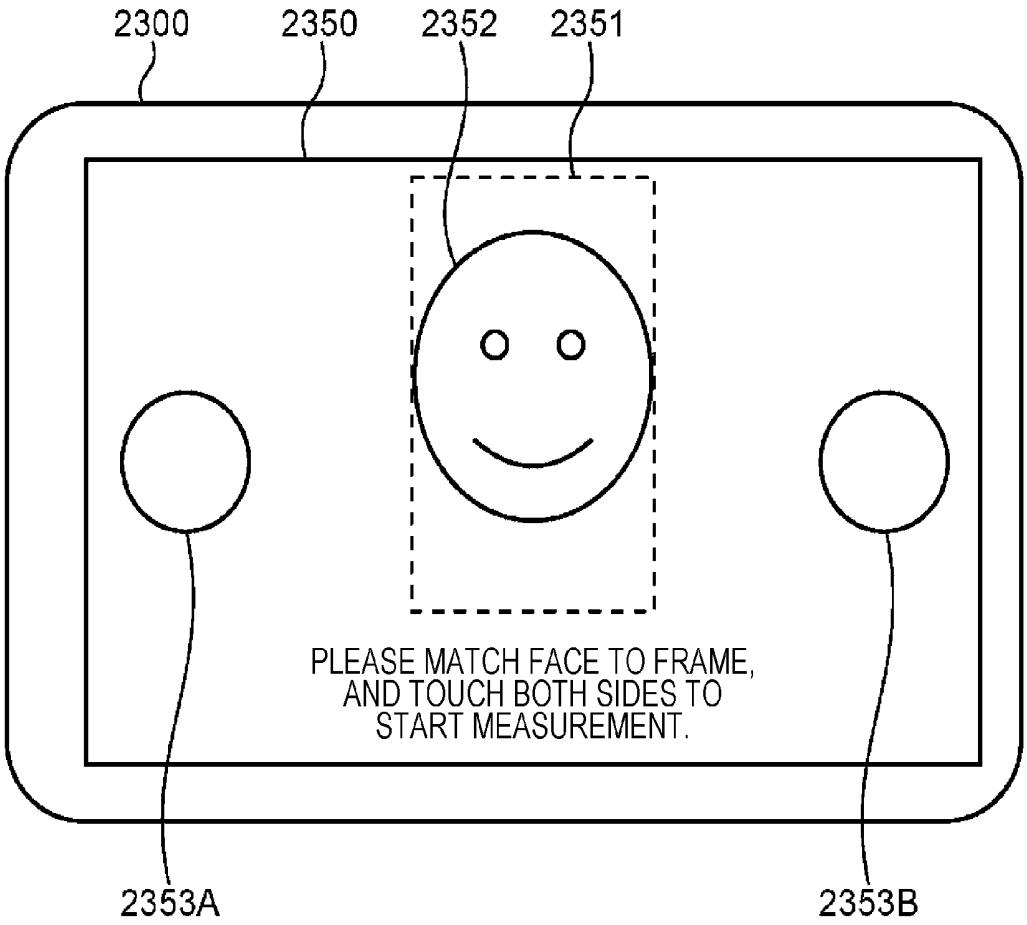

2300
2350
2352
2351
PLEASE MATCH FACE TO FRAME,
AND TOUCH BOTH SIDES TO
START MEASUREMENT.
2353A
2353B

FIG. 32

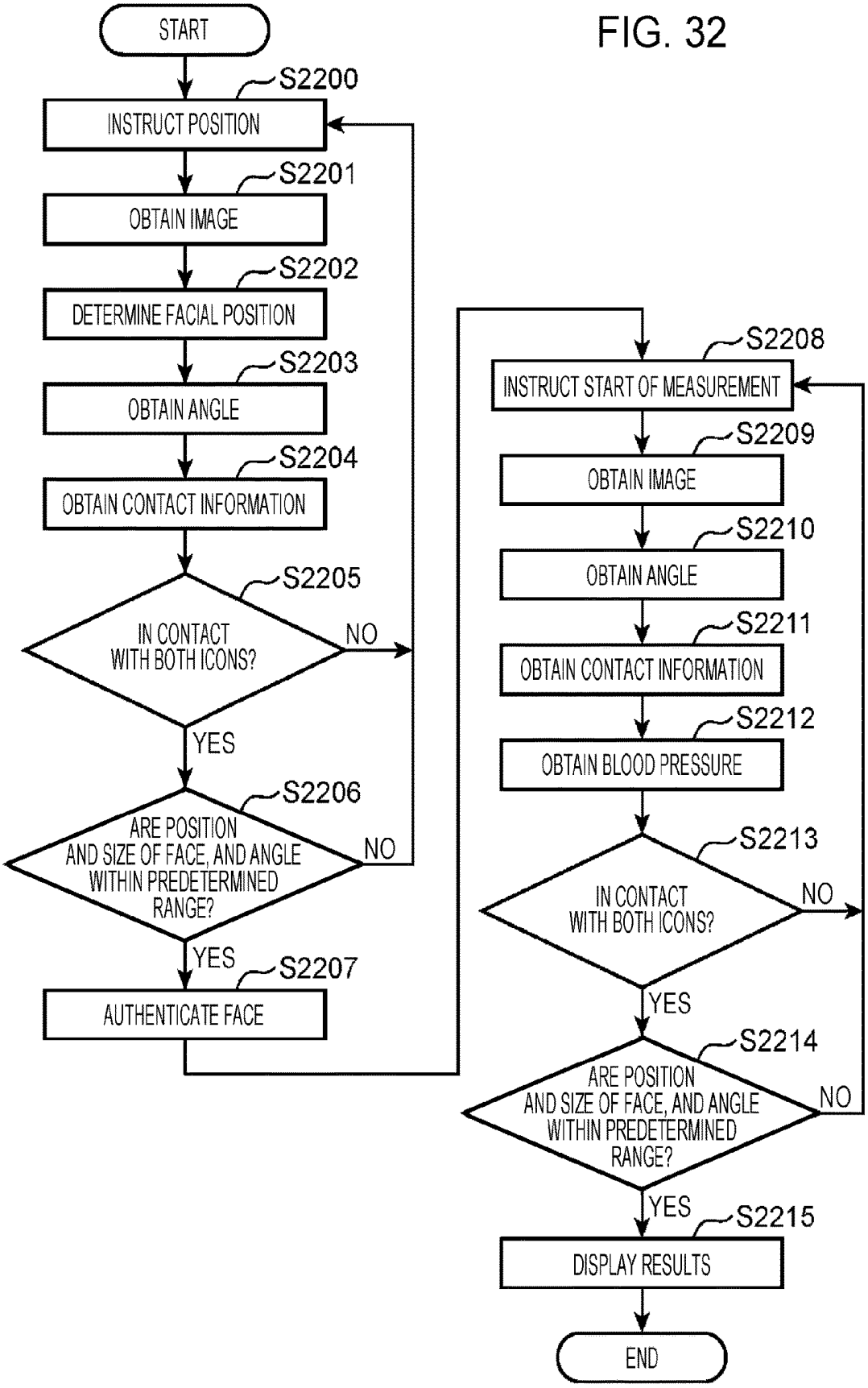

START
S2200
INSTRUCT POSITION
S2201
OBTAIN IMAGE
S2202
DETERMINE FACIAL POSITION
S2203
OBTAIN ANGLE
S2204
OBTAIN CONTACT INFORMATION
S2205
IN CONTACT WITH BOTH ICONS?
NO
YES
S2206
ARE POSITION AND SIZE OF FACE, AND ANGLE WITHIN PREDETERMINED RANGE?
NO
YES
S2207
AUTHENTICATE FACE
S2208
INSTRUCT START OF MEASUREMENT
S2209
OBTAIN IMAGE
S2210
OBTAIN ANGLE
S2211
OBTAIN CONTACT INFORMATION
S2212
OBTAIN BLOOD PRESSURE
S2213
IN CONTACT WITH BOTH ICONS?
NO
YES
S2214
ARE POSITION AND SIZE OF FACE, AND ANGLE WITHIN PREDETERMINED RANGE?
NO
YES
S2215
DISPLAY RESULTS
END

FIG. 33

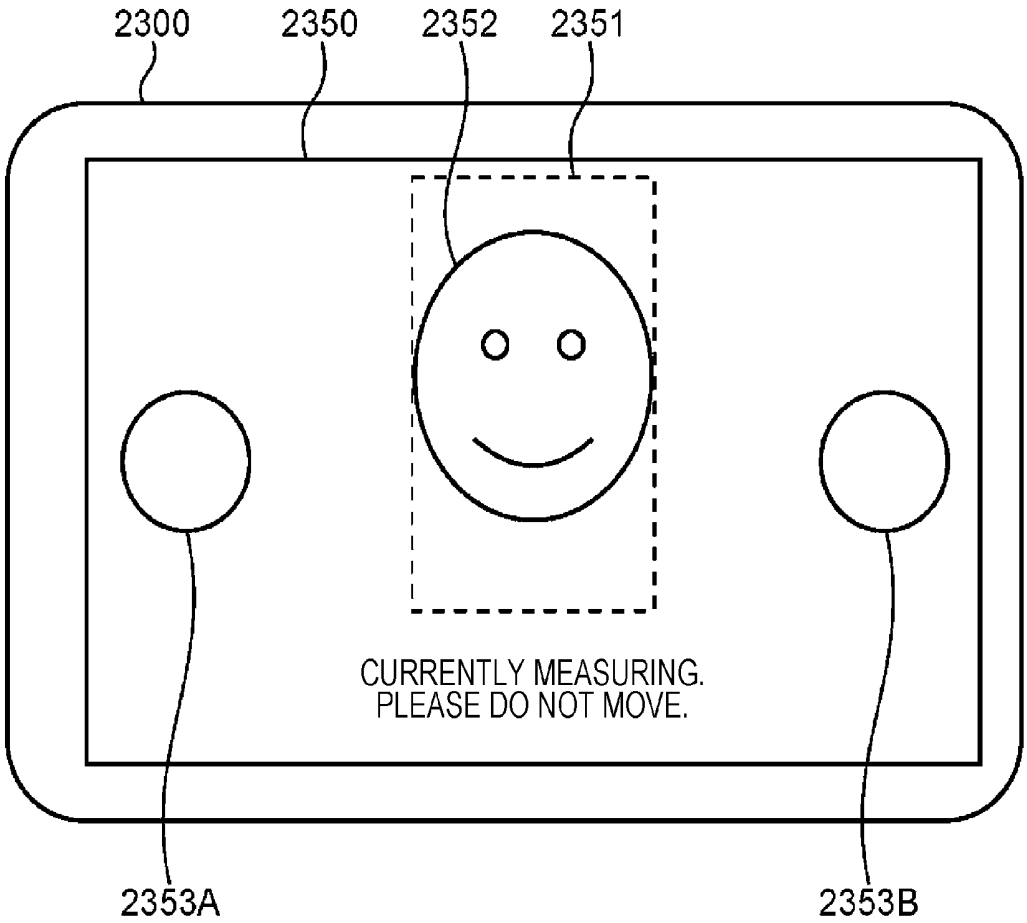

2300
2350
2352
2351
CURRENTLY MEASURING.
PLEASE DO NOT MOVE.
2353A
2353B

FIG. 34

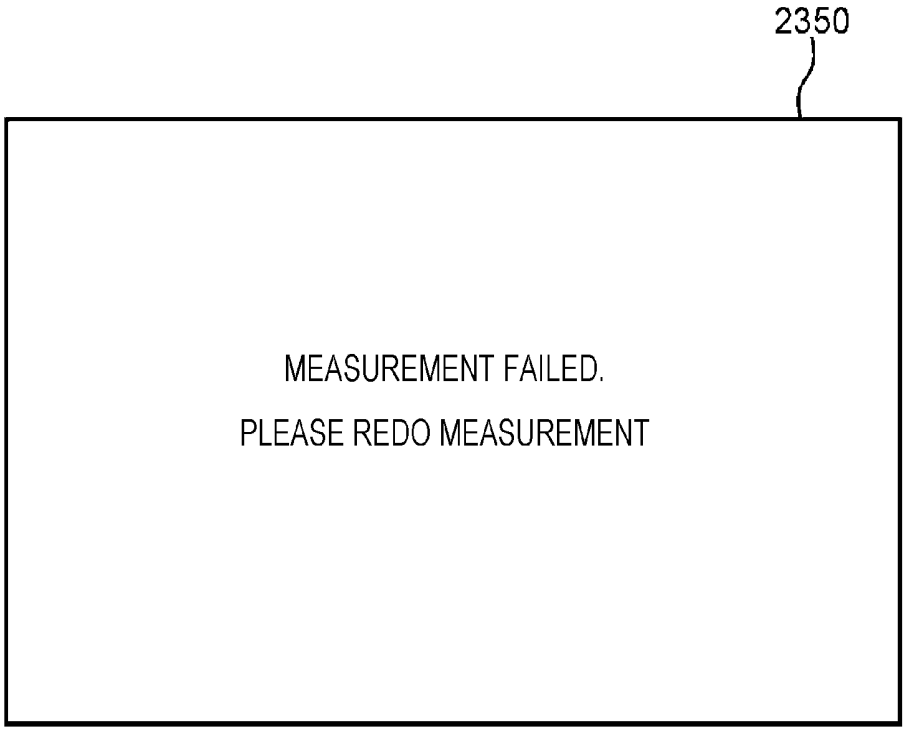

2350
MEASUREMENT FAILED.
PLEASE REDO MEASUREMENT

FIG. 35

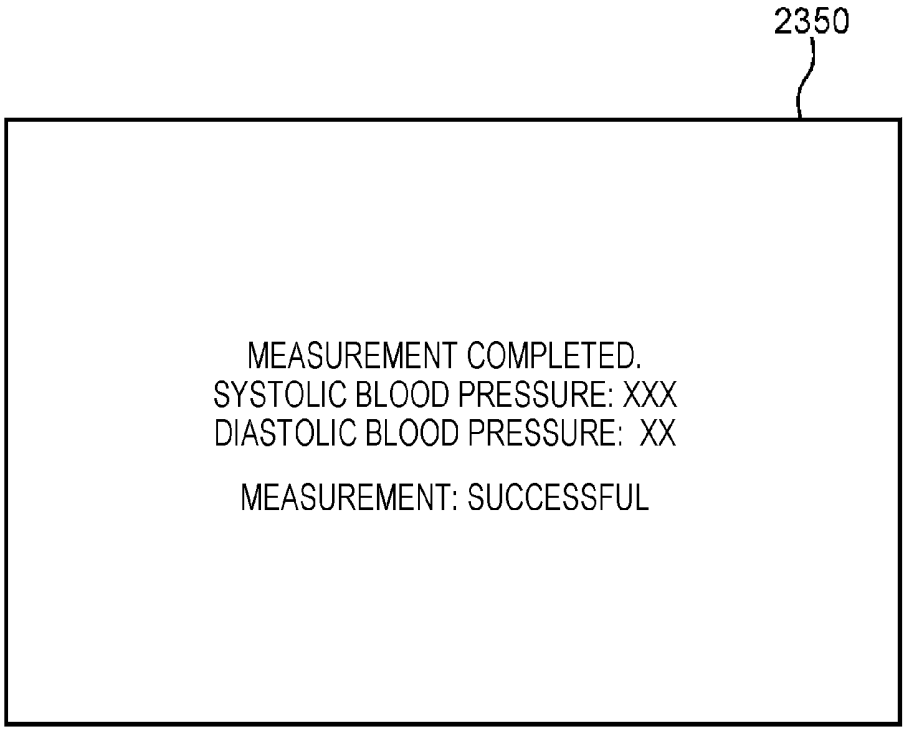

2350
MEASUREMENT COMPLETED.
SYSTOLIC BLOOD PRESSURE: XXX
DIASTOLIC BLOOD PRESSURE: XX
MEASUREMENT: SUCCESSFUL

FIG. 36

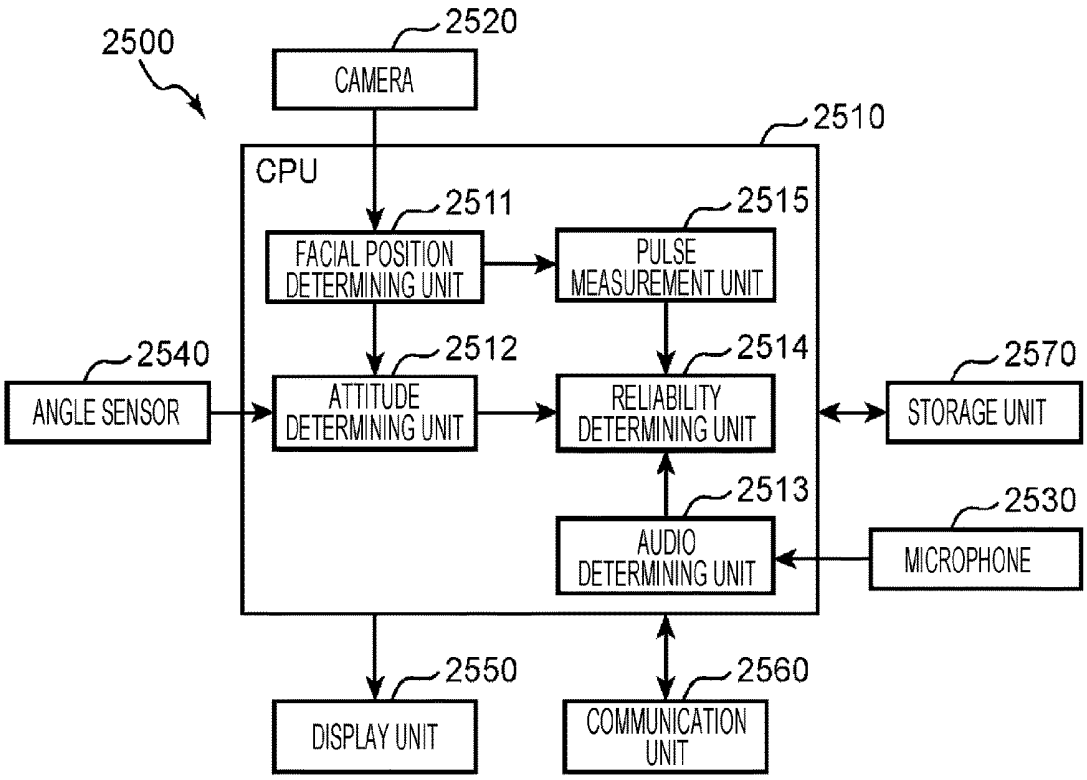

2500
2520
CAMERA
2510
CPU
2511
FACIAL POSITION DETERMINING UNIT
2515
PULSE MEASUREMENT UNIT
2540
ANGLE SENSOR
2512
ATTITUDE DETERMINING UNIT
2514
RELIABILITY DETERMINING UNIT
2570
STORAGE UNIT
2513
AUDIO DETERMINING UNIT
2530
MICROPHONE
2550
DISPLAY UNIT
2560
COMMUNICATION UNIT

FIG. 37

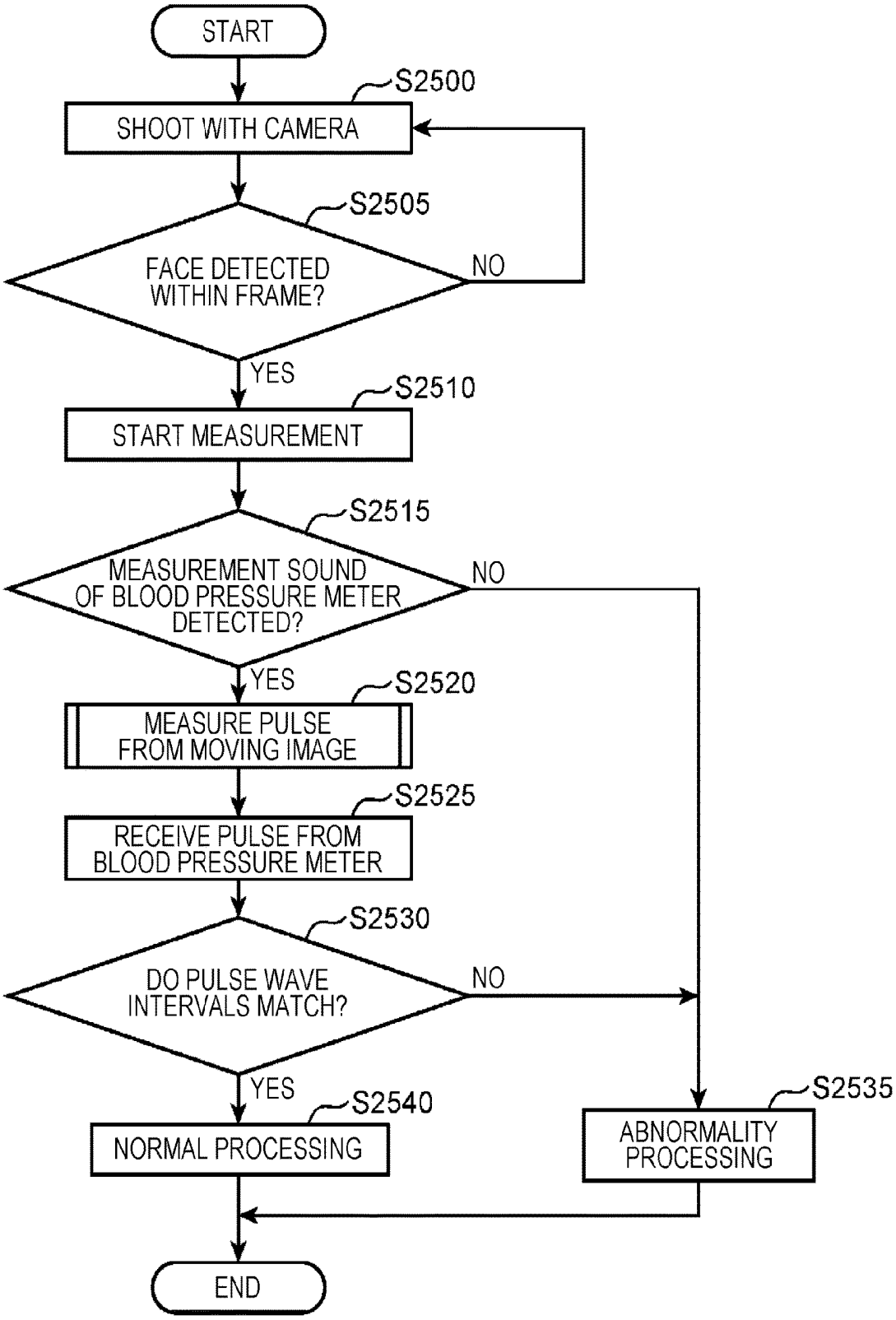
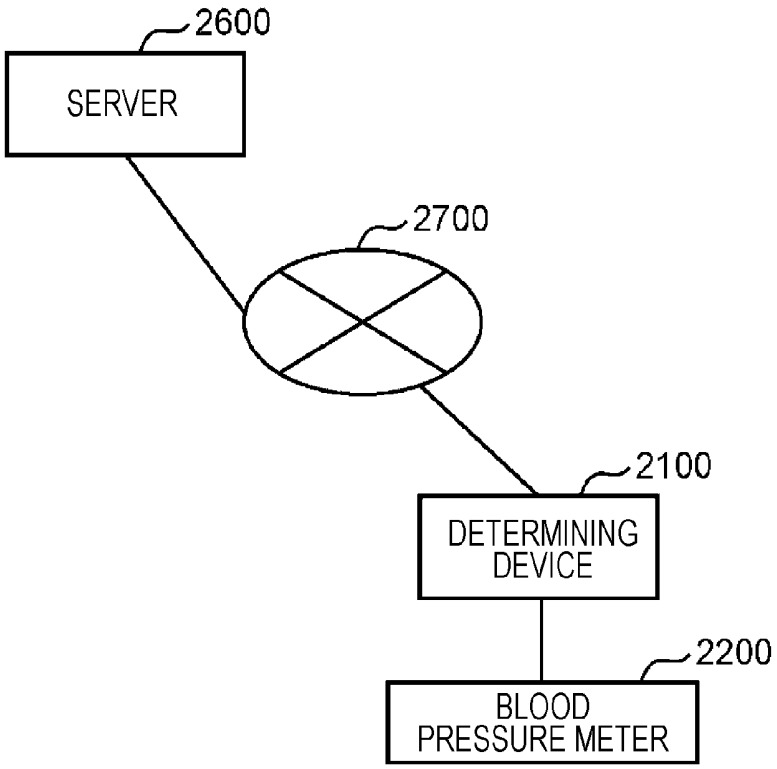

START
S2500
SHOOT WITH CAMERA
S2505
FACE DETECTED WITHIN FRAME?
NO
YES
S2510
START MEASUREMENT
S2515
MEASUREMENT SOUND OF BLOOD PRESSURE METER DETECTED?
NO
YES
S2520
MEASURE PULSE FROM MOVING IMAGE
S2525
RECEIVE PULSE FROM BLOOD PRESSURE METER
S2530
DO PULSE WAVE INTERVALS MATCH?
NO
YES
S2540
NORMAL PROCESSING
S2535
ABNORMALITY PROCESSING
END

FIG. 38


2600
SERVER
2700
2100
DETERMINING DEVICE
2200
BLOOD PRESSURE METER

BLOOD PRESSURE MEASUREMENT STATE DETERMINATION METHOD, BLOOD PRESSURE MEASUREMENT STATE DETERMINING DEVICE, AND RECORDING MEDIUM

BACKGROUND

1. Technical Field

[0001] The present disclosure relates to a technology for identifying a measurement subject of a measurement device that measures biometric information, and determining a blood pressure measurement state.

2. Description of the Related Art

[0002] Insurance products called risk-segmented insurance, where premiums are set in accordance with health risks of the insured person, are being sold in the medical insurance and life insurance sectors. Periodically obtaining biometric information is desirable in risk-segmented insurance, in order to set appropriate premiums and to promote health of the insured person.

[0003] Devices in general households for measuring biometric information of the human body that are in widespread use include blood pressure meters, bathroom scales, body composition meters, activity monitors, and so forth. In order to use these measurement devices to compute insurance premiums, personal authentication needs to be performed in order to authenticate the person who has been measured to obtain the measured data (i.e., the measurement subject) is the insured person.

[0004] Technology that is usable as a way to provide personal authentication information with regard to measurement devices that do not have personal authentication functions, such as blood pressure meters, bathroom scales, and so forth, is being proposed (see International Publication No. 2014/115605). Technology where personal authentication information is succeeded, by comparing positional information of each of a measurement device having personal authentication functions and a measurement device to which attaching personal authentication information is desired, is disclosed in International Publication No. 2014/115605.

[0005] There also is a need for measurement values to accurately express biometric information of the measurement subject in order to use measurement values of devices in general households capable of measuring biometric information, such as blood pressure meters or the like, to compute insurance premiums. For example, with regard to technology to improve the accuracy of biometric information measurement at home, Japanese Patent Application Publication No. 2010-131305 discloses a blood pressure meter using an angle sensor, and Japanese Patent No. 5,249,273 discloses a measurement device equipped with a camera.

SUMMARY

[0006] The following first problem is found in International Publication No. 2014/115605. That is to say, in a case where there are multiple users in a range where succession of personal authentication information is set to be enabled based on positional information, it is difficult for individual users to be identified by the technology in International Publication No. 2014/115605. Accordingly, a problem occurs where, in a case of a male and female living in the same house, and the male using the blood pressure meter and the female using the activity monitor at the same time, the measurement values of the blood pressure meter and the measurement values of the activity meter are personal-authenticated as being measurement values of the same person.

[0007] The following second problem is found in Japanese Patent Application Publication No. 2010-131305 and Japanese Patent No. 5,249,273. That is to say, in a case of measuring biometric information at home using household measurement devices, it is difficult to guarantee that the measured biometric information is accurate. On the other hand, traveling to a medical institution to measure biometric information places too great a burden on the measurement subject. Further, currently-available biometric information measurement devices assume that the user will use the devices to perform correct measurements, so it is difficult to prevent the user from intentionally performing incorrect measurements. For example, the technology in Japanese Patent Application Publication No. 2010-131305 that estimates the posture of the measurement subject using an angle sensor cannot tell the posture of the subject other than for the arm.

[0008] In one general aspect, the techniques disclosed here feature a blood pressure measurement state determination method for determining a blood pressure measurement state, using a determining device that determines a blood pressure measurement state and is held in a hand of a user to whom a blood pressure meter is mounted. The method includes: obtaining (i) image data including a face of the user by a camera that the device has, (ii) first information indicating an inclination angle of the determining device as to the gravitational direction, by an angle sensor that the device has, and (iii) second information indicating a position of the face of the user in the image data, and the proportion of the size of the face of the user in the image data; determining whether or not the user is correctly using the blood pressure meter based on the image data, the first information and the second information; and providing a notification indicating the determination result.

[0009] According to the present disclosure, personal authentication information can be succeeded from a first measurement device having personal authentication functions to a second measurement device not having personal authentication functions. Further, the posture of the user can be estimated more accurately as compared to posture estimation of the user using a conventional angle sensor, so the accuracy of measurement results is improved.

[0010] These general and specific aspects may be implemented using a system, a method, and a computer program, and any combination of systems, methods, and computer programs.

[0011] Additional benefits and advantages of the disclosed embodiments will become apparent from the specification and drawings. The benefits and/or advantages may be individually obtained by the various embodiments and features of the specification and drawings, which need not all be provided in order to obtain one or more of such benefits and/or advantages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. **1** is a block diagram schematically illustrating the configuration of a measurement subject identifying system according to a first embodiment;

[0013] FIG. **2** is a diagram schematically illustrating an example of measurement data stored in a measurement data database;

[0014] FIG. **3** is a sequence diagram schematically illustrating an example of authentication procedures by ID and password;

[0015] FIG. **4** is a diagram schematically illustrating exchange of signals between a server and measurement device and a display example on a measurement device;

[0016] FIG. **5** is a sequence diagram schematically illustrating an example of authentication procedures by fingerprint;

[0017] FIG. **6** is a sequence diagram schematically illustrating an example of authentication procedures by facial image;

[0018] FIG. **7** is a sequence diagram schematically illustrating an example of succession procedures for personal authentication information;

[0019] FIG. **8** is a flowchart schematically illustrating an example of operation procedures of a similarity verifying unit of a server;

[0020] FIG. **9** is a diagram schematically illustrating an example of measurement data stored in a measurement value database that differs from the example in FIG. **2**;

[0021] FIG. **10** is a flowchart schematically illustrating an example of procedures for detecting pulse from a moving image.

[0022] FIG. **11** is a diagram illustrating an example of updating a measurement value database in a case where personal authentication information has been succeeded;

[0023] FIG. **12** is a sequence diagram of procedures notifying use as a personal-authenticated device;

[0024] FIG. **13** is a diagram schematically illustrating exchange of signals between a server and measurement device and a display example on a measurement device;

[0025] FIG. **14** is a flowchart schematically illustrating another example of procedures for attaching personal authentication information;

[0026] FIG. **15** is a sequence diagram schematically illustrating operations when a measurement device that has succeeded personal authentication information has ended measurement of biometric information;

[0027] FIG. **16** is a diagram schematically illustrating an example of authentication management information;

[0028] FIG. **17** is a sequence diagram schematically illustrating an example of personal authentication information succession procedures according to a second embodiment;

[0029] FIG. **18** is a diagram illustrating a specific updating example of a measurement value database in the second embodiment;

[0030] FIG. **19** is a sequence diagram schematically illustrating an example of personal authentication information attaching procedures according to a third embodiment;

[0031] FIG. **20** is a block diagram schematically illustrating an example of the configuration of a determining device according to a fourth embodiment;

[0032] FIG. **21** is a block diagram schematically illustrating an example of the configuration of a blood pressure meter;

[0033] FIG. **22** is a diagram schematically illustrating a measurement state when a user uses the blood pressure meter;

[0034] FIG. **23** is a diagram schematically illustrating an example of a screen displayed on a display unit before starting measurement;

[0035] FIG. **24** is a flowchart schematically illustrating operations of the determining device according to the fourth embodiment;

[0036] FIG. **25** is a diagram schematically illustrating an example of a screen displayed on the display unit when measuring blood pressure;

[0037] FIG. **26** is a diagram schematically illustrating an example of a screen displayed on the display unit when measuring blood pressure;

[0038] FIG. **27** is a diagram schematically illustrating an example of a screen displayed on the display unit when measuring blood pressure;

[0039] FIG. **28** is a diagram schematically illustrating an example of a screen displayed on the display unit when measuring blood pressure;

[0040] FIG. **29** is a block diagram schematically illustrating an example of the configuration of a determining device according to a fifth embodiment;

[0041] FIG. **30** is a diagram schematically illustrating a measurement state when a user uses the blood pressure meter;

[0042] FIG. **31** is a diagram schematically illustrating an example of a screen displayed on a display unit before starting measurement;

[0043] FIG. **32** is a flowchart schematically illustrating operations of the determining device according to the fifth embodiment;

[0044] FIG. **33** is a diagram schematically illustrating an example of a screen displayed on the display unit when measuring blood pressure;

[0045] FIG. **34** is a diagram schematically illustrating an example of a screen displayed on the display unit when measuring blood pressure;

[0046] FIG. **35** is a diagram schematically illustrating an example of a screen displayed on the display unit when measuring blood pressure;

[0047] FIG. **36** is a block diagram schematically illustrating an example of the configuration of a determining device according to a sixth embodiment;

[0048] FIG. **37** is a flowchart schematically illustrating operations of a determining device according to the sixth embodiment; and

[0049] FIG. **38** is a block diagram illustrating an example of the configuration of a system having a determining device and a server.

DETAILED DESCRIPTION

Underlying Knowledge Forming Basis of the Present Disclosure

[0050] There is being studied technology in the life insurance and medical insurance sector where the health state of an insured person is accurately analyzed and comprehended by measuring biometric information of the insured person by measurement devices, and thereby computing insurance premiums appropriated for the insured person. There are measurement devices capable of measuring biometric information of an insured person that do not have functions to guarantee that the measured biometric information is that of the insured person themselves.

[0051] For example, a type of medical insurance will be considered where an insurance provider distributes activity monitors to insured persons, measures the number of steps walked by the insured person along with the pulse, and reduces the insurance premium in a case where the number of steps walked exceeds 10,000 every day. A situation can be conceived in this medical insurance where the insured person gives the activity monitor distributed from the insurance provider to a person other than the insured person. In this case, if the insured person does not walk 10,000 steps every day but the person who was given the activity monitor does walk 10,000 steps every day, a situation will occur where the insurance premium of the insured person is erroneously reduced.

[0052] As another example, a type of medical insurance will be considered where an insurance provider distributes blood pressure meters to insured persons, and in a case an insured person whose systolic blood pressure was 140 mmHg or higher, which is the borderline for diagnosis of high blood pressure, was able to be reduced to 129 mmHg or lower, which is in a normal blood pressure range through healthy living, while being insured, the insurance premium is reduced. It is important for this health insurance that the blood pressure value to be correctly measured without falsification. However, many existing blood pressure meters will measure the blood pressure value lower than it actually is, by the user raising the wrist or upper arm wearing the compression sleeve (hereinafter also referred to as "cuff") where the blood pressure is measured above the height of the heart when measuring. Accordingly, there is a possibility that a situation will occur where insurance premiums are reduced for insured persons who should not receive reduction in insurance premiums.

[0053] In the above examples, no function exists in the activity monitors or blood pressure meters distributed by the insurance providers to identify that the measurement subject is the insured person. Accordingly, a situation can occur where measurement values by measurement subjects other than the insured person are erroneously used for computation of insurance premiums. Thus, there is a problem in that the biometric information has to be identified as having been measured by the insured person, in order to apply the measured biometric information to computation of insurance premiums.

[0054] International Publication No. 2014/115605 proposes, as an individual authentication technology capable of solving such problems, propagating authentication information in a personal-authenticated measurement device to a measurement device where personal authentication is not performed, by comparing positional information of each measurement device among multiple measurement devices, and handling as personal-authenticated measuring device. It is difficult to determine whether or not positional information among the multiple measurement devices precisely matches, as stated in International Publication No. 2014/115605. Accordingly, a configuration is made in International Publication No. 2014/115605 where personal authentication information can be propagated when the locational positions of the respective measurement devices are within a predetermined range.

[0055] In a case where succession of personal authentication information is to be performed among multiple measurement devices that measure biometric information, based on positional information between a blood pressure meter and activity monitor for example, succession of personal authentication information is performed in a case where the blood pressure meter and the activity monitor exist within a range that has been set to enable succession of personal authentication information. However, simply having the blood pressure meter and activity monitor within the range that has been set to enable succession of personal authentication information cannot guarantee that the subject of measurement of these two measurement devices is the same person. Thus, International Publication No. 2014/115605 has not sufficiently studied a way to guarantee that that the subject of measurement is the same person for multiple measurement devices regarding which succession of personal authentication information is desired, situated within the range that has been set to enable succession of personal authentication information.

[0056] In order to solve this problem, the Present Inventor has studied the following improvements.

[0057] (1) A first aspect of the present disclosure is a measurement subject identifying method for identifying a measurement subject at a measurement device that is connected to a network and that measures vital data of the measurement subject,

[0058] wherein first vital data measured at a first measurement device capable of personal authentication of a user, and personal authentication information of the user personal-authenticated by the first measurement device, are received from the first measurement device via the network, the first vital data including measurement data of at least one measurement type,

[0059] wherein second vital data measured at a second measurement device that is different from the first measurement device is received from the second measurement device via the network, the second vital data including measurement data of at least the measurement type included in the first vital data,

[0060] wherein a first value indicating the degree of matching of each measurement data of the mutually common measurement type included in the first vital data and the second vital data is calculated,

[0061] wherein determination is made regarding whether the first value is greater than a first threshold value set beforehand,

[0062] and wherein, in a case where the first value is greater than the first threshold value, the second vital data is identified as being measurement data of the user of the first measurement device personal-authenticated by the first measurement device, and is stored in memory with the second vital data and the personal authentication information correlated.

[0063] According to this aspect, personal authentication information can be succeeded from the first measurement device capable of personal authentication to the second measurement device that does not have personal authentication functions, based on the first vital data and the second vital data of the user personal-authenticated by the first measurement device.

[0064] (2) In the above-described first aspect, for example, the at least one measurement type may include at least one of blood pressure, number of steps walked, pulse, heart rate, electrocardiogram, respiratory rate, weight, and depth of sleep.

[0065] (3) In the above-described first aspect, the received personal authentication information may include, for

example, at least one of user identification information and password, fingerprint of user, and facial image of user.

[0066] According to this aspect, succeeded personal information can be made to be correct.

[0067] (4) In the above-described first aspect, for example, a command to display information indicating that the measurement subject using the second measurement device has been identified as a user of the first measurement device, may be transmitted to the second measurement device via the network.

[0068] According to this aspect, when information indicating that the measurement subject using the second measurement device has been identified as a user of the first measurement device is displayed, the measurement subject using the second measurement device can know that personal authentication has been succeeded.

[0069] (5) In the above-described first aspect, for example, third vital data measured at a third measurement device that differs from the first measurement device and the second measurement device may further be received from the third measurement device via the network. The third vital data may include measurement data of a measurement type included in at least the second vital data. A second value indicating the degree of matching of each measurement data of the mutually common measurement type included in the second vital data and the third vital data may be calculated. Determination may be made regarding whether the second value is greater than a second threshold value set beforehand. In a case where the second value is greater than the second threshold value, the third vital data may be identified as being measurement data of the user of the first measurement device personal-authenticated by the first measurement device, and may be stored in memory with the third vital data and the personal authentication information correlated.

[0070] According to this aspect, personal authentication information of the user personal-authenticated by the first measurement device can be further succeeded by the third measurement device, by comparing measurement data of a measurement type measured in common between the second measurement device and third measurement device.

[0071] (6) A second aspect of the present disclosure is a measurement subject identifying system that identifies a measurement subject at a measurement device that is connected to a network and measures vital data of the measurement subject, including

[0072] a first measurement device that is connected to the network and that measures a first vital data including at least one measurement type of measurement data of the measurement subject,

[0073] a second measurement device that is different from the first measurement device, that is connected to the network, and that measures a second vital data including at least measurement data of a measurement type included in the first vital data of the measurement subject, and

[0074] a management device connected to the network,

[0075] wherein the management device includes

[0076] a reception unit that receives, via the network, the first vital data measured at the first measurement device from the first measurement device, personal identification information of the user personal-authenticated by the first measurement device, and the second vital data measured at the second measurement device from the second measurement device via the network,

[0077] a processing unit, and

[0078] memory,

[0079] and wherein the processing unit includes

[0080] a calculating unit that calculates a first value indicating the degree of matching of each measurement data of a mutually common measurement type included in the first vital data and the second vital data,

[0081] a determining unit that determines whether the first value is greater than a first threshold value set beforehand and stored in the memory,

[0082] a management unit that, in a case where the first value is greater than the first threshold value, identifies the second vital data as being measurement data of the user of the first measurement device personal-authenticated by the first measurement device, and stores in the memory with the second vital data and the personal authentication information correlated.

[0083] (7) In the above-described second aspect, for example, the at least one measurement type may include at least one of blood pressure, number of steps walked, pulse, heart rate, electrocardiogram, respiratory rate, weight, and depth of sleep.

[0084] Also, the medical insurance using the blood pressure meter exemplified in the Present Underlying Knowledge, a way to confirm that blood pressure is being measured in a state where the compression sleeve of the blood pressure meter is situated at the height of the heart is necessary. The technology of Japanese Patent Application Publication No. 2010-131305 estimates the height of the position where the cuff is mounted, by attaching an angle sensor to the cuff of a wrist-measurement blood pressure meter. Assuming that the upper arm is fixed in a natural posture, the height of the cuff is decided by the angle of the forearm, so the height of the cuff can be estimated by detecting the angle of the forearm by the angle sensor. The blood pressure measurement results are dependent on the height of the cuff, so the height of the cuff can be made to be constant and thereby improve reliability of the results of blood pressure measurement.

[0085] Also, in the technology described in Japanese Patent No. 5,249,273, personal authentication of the user can be performed by facial recognition, by mounting a camera on the measurement device of biometric information, of which a blood pressure meter is representative. According to this method, measurement results and measurement device settings can be associated with the person, thereby facilitating management of measurement data.

[0086] However, the technologies in Japanese Patent Application Publication No. 2010-131305 and Japanese Patent No. 5,249,273 assume that the user will use the measurement devices to measure correct values. Accordingly, it has been easy to intentionally perform measurement by incorrect measurement methods, and obtain fraudulent measurement values. In the technology described in the above Japanese Patent Application Publication No. 2010-131305, changing the position of the forearm enables the actual height of the cuff worn on the wrist to be changed, without changing the height of the cuff estimated by the blood pressure meter. As a result, the measurement values of blood pressure can be intentionally raised or lowered. Also, in the technology described in Japanese Patent No. 5,249,273, the position and orientation of the camera cannot be fixed, so posture estimation cannot be made other than when sitting, such as regarding lying down or the like. As a result, it is easy to intentionally perform incorrect measurements.

[0087] Accordingly, the Present Inventor has studied the following improvements.

[0088] (8) A third aspect of the present disclosure is a blood pressure measurement state determination method for determining a blood pressure measurement state, using a determining device that determines a blood pressure measurement state and is held in a hand of a user to whom a blood pressure meter is mounted, the method including

[0089] obtaining image data including a face of the user by a camera that the determining device has,

[0090] obtaining first information indicating an inclination angle of the determining device as to the gravitational direction, by an angle sensor that the determining device has,

[0091] obtaining second information indicating a position of the face of the user in the image data, and the proportion of the size of the face of the user in the image data,

[0092] determining whether or not the angle indicated in the first information is within a first range,

[0093] determining whether or not the position of the face of the user indicated in the second information is within a second range,

[0094] determining whether or not the proportion of the size of the face of the user indicated in the second information is within a third range,

[0095] determining whether or not the user is correctly using the blood pressure meter,

[0096] notifying the user that the blood pressure meter is being correctly used upon determination being made that the user is correctly using the blood pressure meter, and

[0097] prompting the user to use the blood pressure meter correctly upon determination being made that the user is not correctly using the blood pressure meter,

[0098] wherein in the determination regarding whether or not the user is correctly using the blood pressure meter, determination is made that the user is correctly using the blood pressure meter when the angle indicated in the first information is determined to be within the first range, the position of the face of the user indicated in the second information is determined to be within the second range, and the proportion of the size of the face of the user indicated in the second information is determined to be within the third range.

[0099] According to this third aspect, using the image of the camera that the determining device held in the hand of the user has enables the posture of the user to be estimated more accurately as compared to posture estimation of the user by a conventional angle sensor alone, and the precision of measurement results is improved.

[0100] Also, an image of the face of the user is used, so difference in postures that the angle sensor alone cannot estimate can be detected, making it more difficult for the user to intentionally make fraudulent measurements. As a result, fraudulence that is readily conceivable, such as raising the arm or measuring while lying down or the like can be eliminated, thereby enabling fraudulent measurements to be suppressed.

[0101] Further, correct usage of the blood pressure meter can be quantitatively expressed by angle information of the determining device, the position of the face in image data, and the proportion of the face in the image data. Consequently, measures to take for the user to correctly use can be easily instructed.

[0102] (9) In the above-described third aspect, for example, audio around the determining device may further be obtained. Determination may be performed regarding whether or not the obtained audio and audio emitted by the blood pressure meter, stored in a storage unit beforehand, agree. In the determining of whether or not the user is correctly using the blood pressure meter correctly, determination may further be made that the user is using the blood pressure meter correctly if determination is made that the obtained audio and audio emitted by the blood pressure meter stored in the storage unit agree.

[0103] According to this aspect, comparing the obtained audio with the audio emitted by the blood pressure meter enables confirmation to be made whether measurement is being performed by the blood pressure meter near the determining device. As a result, the reliability of determination regarding whether or not the blood pressure meter is being correctly used improves. For example, in a case where wearing the blood pressure meter on the same arm as the hand holding the determining device is recommended, fraudulent measurement such as mounting the blood pressure meter to the other arm as the hand holding the determining device can be prevented.

[0104] (10) In the above-described third aspect, for example, further, a command instructing to start measurement of blood pressure of the user may be transmitted to the blood pressure meter upon determination being made that the user is using the blood pressure meter correctly.

[0105] According to this aspect, blood pressure measurement can be started without the user having to move, so it is easier for the user to maintain a correct posture. As a result, precision of measurement can be improved, and the load on the user can be reduced.

[0106] (11) In the above-described third aspect, for example, further, determination may be made again regarding whether or not the user is using the blood pressure meter correctly, after a predetermined amount of time has elapsed after transmitting the command.

[0107] According to this aspect, in a case where the user has ceased to correctly use the blood pressure meter after starting measurement, this is detected, whereby determination precision of the blood pressure measurement state can be improved.

[0108] (12) In the above-described third aspect, for example, further, determination may be made again regarding whether or not the user is using the blood pressure meter correctly, upon receiving a notification is received from the blood pressure meter indicating that blood pressure measurement of the user has ended.

[0109] According to this aspect, in a case where the user has ceased to correctly use the blood pressure meter at the time of ending the blood pressure measurement, this is detected, whereby determination precision of the blood pressure measurement state can be improved.

[0110] (13) In the above-described third aspect, for example, further, a first icon indicating the position to hold the determining device with one hand out of the left hand and right hand of the user, and a second icon indicating the position to hold the determining device with other hand out of the left hand and right hand of the user, may be displayed on a touch panel display unit provided to the determining device. In the determination regarding whether or not the user is using the blood pressure meter correctly, further, determination may be made that the user is using the blood

pressure meter correctly if detecting that the one hand of the user is in contact with the first icon and that the other hand of the user is in contact with the second icon.

[0111] According to this aspect, the postures that the user can assume can be restricted by causing the user to hold the determining device at predetermined position with both hands. As a result, the user can be naturally led to correctly use the blood pressure meter in the correct posture.

[0112] (14) In the above-described third aspect, for example, further, determination may be made regarding whether or not the image data matches image data of the user of the determining device stored in the storage unit beforehand. In the determination regarding whether or not the user is using the blood pressure meter correctly, further, determination may be made that the user is using the blood pressure meter correctly if detecting that the image data matches image data of the user of the determining device stored in the storage unit.

[0113] According to this aspect, performing personal authentication of the user enables the measurement value of blood pressure to be associated with an individual, and can be used for purposes requiring measurement values of particular individuals, such as computation of insurance premiums or the like.

[0114] (15) In the above-described third aspect, for example, further, a notification indicating that the user is correctly using the blood pressure meter may be transmitted to a server connected to the determining device upon determination being made that the user is using the blood pressure meter correctly.

[0115] According to this aspect, appropriate diagnosis and insurance premium calculation in accordance with the reliability of measurement values is enabled by externally transmitting reliability of blood pressure values to medical institutions, insurance providers, and so forth, such as ignoring measurement values with low reliability or the like.

[0116] (16) A fourth aspect of the present disclosure is a blood pressure measurement state determining device for determining a blood pressure measurement state that is held in a hand of a user to whom a blood pressure meter is mounted, the determining device including

[0117] a camera that obtains image data including a face of the user,

[0118] an angle sensor that obtains first information indicating an inclination angle of the determining device as to the gravitational direction,

[0119] a processing unit, and

[0120] and a display unit,

[0121] wherein the processing unit includes

[0122] a facial position determining unit that obtains second information indicating a position of the face of the user in the image data, and the proportion of the size of the face of the user in the image data,

[0123] a posture determining unit that determines whether or not the angle indicated in the first information is within a first range, determines whether or not the position of the face of the user indicated in the second information is within a second range, and determines whether or not the proportion of the size of the face of the user indicated in the second information is within a third range, and

[0124] a reliability determining unit that determines that the user is correctly using the blood pressure meter if determination is made that the angle indicated in the first information is within a first range, determination is made that the position of the face of the user indicated in the second information is within a second range, and determination is made that the proportion of the size of the face of the user indicated in the second information is within a third range,

[0125] and wherein the display unit

[0126] displays a notification to the user indicating that the blood pressure meter is being correctly used upon determination being made that the user is correctly using the blood pressure meter, and

[0127] displays a notification prompting the user to use the blood pressure meter correctly upon determination being made that the user is not correctly using the blood pressure meter.

[0128] (17) A fifth aspect of the present disclosure is a blood pressure measurement state determination program for determining a blood pressure measurement state, using a determining device that determines a blood pressure measurement state and is held in a hand of a user to whom a blood pressure meter is mounted,

[0129] the blood pressure measurement state determination program causing a computer of the determining device to execute

[0130] obtaining image data including a face of the user by a camera that the determining device has,

[0131] obtaining first information indicating an inclination angle of the determining device as to the gravitational direction, by an angle sensor that the determining device has,

[0132] obtaining second information indicating a position of the face of the user in the image data, and the proportion of the size of the face of the user in the image data,

[0133] determining whether or not the angle indicated in the first information is within a first range,

[0134] determining whether or not the position of the face of the user indicated in the second information is within a second range,

[0135] determining whether or not the proportion of the size of the face of the user indicated in the second information is within a third range,

[0136] determining whether or not the user is correctly using the blood pressure meter,

[0137] notifying the user that the blood pressure meter is being correctly used upon determination being made that the user is correctly using the blood pressure meter, and

[0138] prompting the user to use the blood pressure meter being upon determination being made that the user is not correctly using the blood pressure meter,

[0139] wherein in the determination regarding whether or not the user is correctly using the blood pressure meter, determination is made that the user is not correctly using the blood pressure meter when the angle indicated in the first information is determined to be within the first range, the position of the face of the user indicated in the second information is determined to be within the second range, and the proportion of the size of the face of the user indicated in the second information is determined to be within the third range.

[0140] These general or specific aspects may be implemented as a method where feature configurations included in the above-described device are carried out as steps, or as a

computer program where feature configurations included in the above-described device are executed by a computer. These may also be realized by a computer-readable non-transitory recording medium such as a CD-ROM in which such a computer program is recorded, may be distributed via a communication network such as the Internet or the like, or may be constructed as a cloud computing system where multiple computers operate in a decentralized manner. Further, these may be realized by any combination of a system, method, integrated circuit, computer program, and recording medium.

[0141] Embodiments for carrying out the present disclosure will be described below with reference to the drawings. In all of the following drawings, same reference symbols denote the same object, unless specifically indicated otherwise. Note that the embodiments described below are all specific examples of the present disclosure. Values, shapes, components, steps, the order of steps, and so forth, illustrated in the following embodiments, are only exemplary, and do not restrict the present disclosure. Components in the following embodiments which are not included in an independent Claim are described as being optional components. The contents of each and all of the embodiments may be combined.

First Embodiment

[0142] FIG. **1** is a block diagram schematically illustrating the configuration of a measurement subject identifying system according to a first embodiment. The measurement subject identifying system illustrated in FIG. **1** includes a server **101** and multiple measurement devices **102**A, **102**B, and **102**C. The server **101** and multiple measurement devices **102**A, **102**B, and **102**C are each connected via a network **100**. The server **101** causes personal authentication information to be succeeded among the multiple measurement devices **102**A, **102**B, and **102**C. The multiple measurement devices **102**A, **102**B, and **102**C each measure vital data of a measurement subject. Specific examples of vital data will be described later.

[0143] The server **101** (equivalent to an example of a management device) includes a central processing unit (CPU) **107**, memory **108**, a measurement value database **111**, a personal authentication database **112**, and an authentication management database **113**, as illustrated in FIG. **1**. The server **101** may be configured of a personal computer.

[0144] The memory **108** is made up of semiconductor memory or the like, for example. The memory **108** includes, for example, read-only memory (ROM), random access memory (RAM), electrically erasable programmable read-only memory (EEPROM), and so forth. The ROM of the memory **108** stores a control program according to the present embodiment to operate the CPU **107**.

[0145] The CPU **107** (equivalent to an example of a processing unit) has the functions of a communication processing unit **103**, a determining unit **104**, a device management unit **105**, and a similarity verifying unit **106**, by operating following the control program of the present embodiment, stored in the memory **108**. The functions of the parts of the CPU **107** will be described later. Note that the server **101** may have other hardware that realizes the same functions, instead of the CPU **107**.

[0146] The measurement value database **111**, personal authentication database **112**, and authentication management database **113** are configured of a hard disk or semiconductor memory or the like. Data stored in the measurement value database **111**, personal authentication database **112**, and authentication management database **113** will be described later. The measurement value database **111**, personal authentication database **112**, and authentication management database **113** may each be configured of mutually different media. Alternatively, the measurement value database **111**, personal authentication database **112**, and authentication management database **113** may be configured of a single medium of which the storage region has been partitioned.

[0147] The communication processing unit **103** (equivalent to an example of a reception unit) has communication functions of communicating with the measurement devices **102**A, **102**B, and **102**C via the network **100**. The communication processing unit **103** receives measurement data transmitted from the measurement devices **102**A, **102**B, and **102**C. The communication processing unit **103** stores the received measurement data in the measurement value database **111**.

[0148] FIG. **2** is a diagram schematically illustrating an example of measurement data **200** stored in the measurement value database **111** (equivalent to an example of memory). The measurement data **200** includes a time-of-measurement space **201**, a measurement device space **202**, a measurement value space **203**, a personal authentication information space **204**, and a measurement location space **205**. The measurement device space **202** has a type-of-measurement space **211** and a device ID space **212**. The personal authentication information space **204** includes an authentication method space **213**, and a personal ID space **214**.

[0149] The time-of-measurement space **201** records time of measurement. The type-of-measurement space **211** of the measurement device space **202** stores types of vital data. The device ID space **212** of the measurement device space **202** stores authentication information (IDs) uniquely identifying the measurement devices **102**A, **102**B, and **102**C. The measurement values in the vital data are recorded in the measurement value space **203**. The authentication method space **213** of the personal authentication information space **204** records the authentication method used for personal authentication of the measurement device, in a case where the corresponding measurement device is configured to be capable of personal authentication. The personal ID space **214** of the personal authentication information space **204** records authentication information (IDs) uniquely identifying the users of the measurement devices. In a case where the corresponding device has functions of obtaining position information, such as having global positioning system (GPS) reception functions for example, the measurement location space **205** records the latitude and longitude indicating the position of the measurement device.

[0150] The determining unit **104** receives information necessary for personal authentication from the measurement devices **102**A, **102**B, and **102**C via the communication processing unit **103**. The determining unit **104** compares received information with information saved in the personal authentication database **112**, and determines whether or not the measurement devices **102**A, **102**B, and **102**C, which are the recipients of the information, have been personal-authenticated. The determining unit **104** notifies the device management unit **105** of the results of determination, and

transmits to the measurement devices **102**A, **102**B, and **102**C via the communication processing unit **103**.

[0151] The similarity verifying unit **106** (equivalent to an example of a calculating unit and determining unit) reads measurement data **200** stored in the measurement value database **111**, and extracts features from measurement values for each ID in the device ID space **212** over a predetermined period. The similarity verifying unit **106** calculates the similarity of features (equivalent to an example of a first value indicating degree of matching) for each extracted ID. When the similarity calculated between a personal-authenticated device ID and an unauthenticated device ID exceeds a predetermined first threshold value, the similarity verifying unit **106** determines the unauthenticated device ID to have been personal-authenticated, and notifies the device management unit **105** of the personal-authenticated device ID.

[0152] The device management unit **105** (equivalent to an example of a management unit) receives information regarding whether or not the measurement devices **102**A, **102**B, and **102**C are personal-authenticated, from the determining unit **104** and similarity verifying unit **106**. Based on the received information, the device management unit **105** updates the personal authentication information space **204** in the measurement value database **111**. Updating of personal authentication information in the measurement value database **111** by the device management unit **105** will be specifically exemplified by description in FIG. **8**.

[0153] The personal authentication database **112** stores data regarding which an individual can be identified, by the determining unit **104** comparing information necessary for personal authentication received from the measurement device **102**A via the communication processing unit **103**, and data stored in the personal authentication database **112**. Examples of personal authentication formats that the personal authentication database **112** can use include personal authentication identification information (ID) and password, biometric personal authentication by fingerprint information, biometric personal authentication by facial image, and so forth.

[0154] In the personal authentication by ID and password, the personal authentication database **112** stores information for matching IDs and passwords. In the biometric personal authentication by fingerprint information, the personal authentication database **112** stores features information by which individuals can be uniquely identified from fingerprint information. In the biometric personal authentication by facial image, the personal authentication database **112** stores features information by which individuals can be uniquely identified from facial images. The personal authentication database **112** may have one or multiple personal authentication formats as the personal authentication format. Note that the personal authentication formats that the personal authentication database **112** has is not restricted to the exemplified personal authentication formats.

[0155] FIG. **3** is a sequence diagram schematically illustrating an example of authentication procedures in the personal authentication by ID and password in the determining unit **104**. The measurement device **102**A is in a state where personal authentication has not been performed and the device is locked in step S**301**. In the locked state in step S**301**, the measurement device **102**A accepts an ID and password input by the user in step S**302**. In step S**303**, the ID and password are transmitted from the measurement device **102**A to the server **101**. The determining unit **104** of the server **101** compares the received ID and password with the personal authentication information registered in the personal authentication database **112** in step S**304**, and determines whether or not these match. The determining unit **104** notifies the results of determination to the device management unit **105**.

[0156] In a case where the received ID and password match the personal authentication information, step S**305** is executed, and the device management unit **105** of the server **101** registers the measurement device **102**A in the measurement value database **111** and authentication management database **113** as a personal-authenticated device. In a case where step S**305** is executed in step S**306**, the device management unit **105** of the server **101** transmits a signal representing completion of personal authentication to the measurement device **102**A via the communication processing unit **103**. In step S**307**, the locked state of the measurement device **102**A is disengaged.

[0157] On the other hand, in a case where the received ID and password do not match the personal authentication information in step S**304**, step S**305** is not executed, and the device management unit **105** of the server **101** transmits a signal indicating that the personal authentication information does not match, to the measurement device **102**A via the communication processing unit **103**. The measurement device **102**A transitions to the locked state of step S**301**, and goes to a state of prompting the user for input of ID and password again.

[0158] FIG. **4** is a diagram schematically illustrating an example of exchange of signals between the server **101** and measurement device **102**A when the processing illustrated in the sequence diagram in FIG. **3** is being executed, and a display example on the measurement device **102**A. In the unauthenticated locked state **311**, the user inputs a login ID to an ID input space **313** of a touch-panel display unit **102**Ad of the measurement device **102**A for example, inputs a password to a password input space **314**, and taps an authentication button **315**, whereby step S**303** is executed, and the ID and password are transmitted from the measurement device **102**A to the server **101**. In a case where steps S**304** and S**305** are executed at the server **101**, a signal indicating completion of personal authentication is transmitted from the server **101** to the measurement device **102**A in step S**306**. Upon the measurement device **102**A receiving the personal authentication completion, the measurement device **102**A transitions to a lock-disengaged state **312**, a list of personal-authenticated devices is displayed on the display unit **102**Ad of the measurement device **102**A, where the measurement device **102**A is displayed.

[0159] FIG. **5** is a sequence diagram schematically illustrating an example of authentication procedures in biometric personal authentication by fingerprint in the determining unit **104**. In a case of performing biometric personal authentication by fingerprint, the measurement device **102**A needs to be provided with fingerprint reading functions. In a case where the measurement device **102**A does not have fingerprint reading functions, the measurement device **102**A cannot perform biometric personal authentication by fingerprint, but having fingerprint reading functions is not an indispensable condition for the measurement device **102**A.

[0160] In step S**311**, the measurement device **102**A is in a state where personal authentication has not been performed and the device is locked. In the locked state in step S**311**, the

measurement device **102**A accepts a fingerprint input by the user in step S**312**. The fingerprint information input by the user is transmitted from the measurement device **102**A to the server **101** in step S**313**. In step S**314**, the determining unit **104** of the server **101** compares features of the received fingerprint information with personal authentication information registered in the personal authentication database **112**, and determines whether these match or not. The determining unit **104** notifies the device management unit **105** of the results of determination.

[0161] In a case where the features of the received fingerprint information match the personal authentication information, step S**315** is executed, and the device management unit **105** of the server **101** registers the measurement device **102**A in the measurement value database **111** and authentication management database **113** as a personal-authenticated device. In a case where step S**315** is executed, the device management unit **105** of the server **101** transmits a signal indicating completion of personal authentication to the measurement device **102**A via the communication processing unit **103** in step S**316**. In step S**317**, the locked state of the measurement device **102**A is disengaged.

[0162] On the other hand, in a case where the features of the received fingerprint information do not match the personal authentication information in step S**314**, step S**315** is not executed, and the device management unit **105** of the server **101** transmits a signal to the measurement device **102**A via the communication processing unit **103**, indicating that the personal authentication information does not match. The measurement device **102**A transitions to the locked state in step S**311**, and goes to a state of prompting the user for input of a fingerprint again.

[0163] FIG. **6** is a sequence diagram schematically illustrating an example of authentication procedures in biometric personal authentication by facial image in the determining unit **104**. In a case of performing biometric personal authentication by facial image, the measurement device **102**A needs to be provided with a camera. In a case where the measurement device **102**A does not have a camera, the measurement device **102**A cannot perform biometric personal authentication by facial image, but having a camera is not an indispensable condition for the measurement device **102**A.

[0164] In step S**321**, the measurement device **102**A is in a state where personal authentication has not been performed and the device is locked. In the locked state in step S**321**, the measurement device **102**A prompts the user to take a facial image of the user, using the camera that the measurement device **102**A has, in step S**322**. The measurement device **102**A obtains a facial image of the user that has been taken. The facial image of the user that has been taken is transmitted from the measurement device **102**A to the server **101** in step S**323**. In step S**324**, the determining unit **104** of the server **101** compares features of the received facial image with personal authentication information registered in the personal authentication database **112**, and determines whether these match or not. The determining unit **104** notifies the device management unit **105** of the results of determination.

[0165] In a case where the features of the received facial image match the personal authentication information, step S**325** is executed, and the device management unit **105** of the server **101** registers the measurement device **102**A in the measurement value database **111** and authentication management database **113** as a personal-authenticated device. In a case where step S**325** is executed, the device management unit **105** of the server **101** transmits a signal indicating completion of personal authentication to the measurement device **102**A via the communication processing unit **103** in step S**326**. In step S**327**, the locked state of the measurement device **102**A is disengaged.

[0166] On the other hand, in a case where the features of the received facial image do not match the personal authentication information in step S**324**, step S**325** is not executed, and the device management unit **105** of the server **101** transmits a signal to the measurement device **102**A via the communication processing unit **103**, indicating that the personal authentication information does not match. The measurement device **102**A transitions to the locked state in step S**321**, and goes to a state of prompting the user to take a facial image again.

[0167] The measurement device **102**A can transmit measurement data representing biometric information (vital data) to the server **101** as a personal-authenticated device, by the techniques exemplified in FIGS. **3**, **5**, and **6**. While the measurement device **102**A is being recognized by the server **101** as a personal-authenticated device, the data that the server **101** has received from the measurement device **102**A is stored in the server **101** with the personal authentication information space **204** filled in, following the format exemplified in FIG. **2**. That is to say, as illustrated in FIG. **2**, the authentication method, such as ID and password, fingerprint, or facial image is recorded in the authentication method space **213** of the personal authentication information space **204**, and the identification information (ID) uniquely identifying the user at the server **101** is recorded in the personal ID space **214** of the personal authentication information space **204**, in the measurement data **200** stored in the server **101**.

[0168] Next, a specific technique for succession of personal authentication information by comparing biometric information among multiple measurement devices will be described with reference to FIGS. **7** and **8**. FIG. **7** is a sequence diagram schematically illustrating an example of personal authentication information succession procedures. In this first embodiment, the measurement device **102**A (equivalent to an example of a first measurement device) has one or multiple types of personal authentication functions, out of functions of personal authentication by ID and password, functions of biometric personal authentication by fingerprint, and functions of biometric personal authentication by facial image. On the other hand, the measurement device **102**B (equivalent to an example of a second measurement device) has no personal authentication functions. FIG. **7** illustrates an example of a specific sequence for the measurement device **102**B to succeed personal authentication information of the measurement device **102**A when the measurement device **102**A and measurement device **102**B transmit biometric information measurement data to the server **101**. The measurement device **102**A that has personal authentication functions will be understood to be in an unlocked state in step S**400**.

[0169] In the unlocked state in step S**400**, the measurement device **102**A starts measurement of one or multiple types of biometric information of the user in step S**401**. Once measurement of biometric information is started in step S**401**, the measurement device **102**A transmits measurement data (equivalent to an example of first vital data)

of all biometric information measured at the measurement device **102**A to the server **101** in step S**402**. In step S**403**, the server **101** records the measurement data of the biometric information that has been received in the personal authentication information space **204**, which is saved in the measurement value database **111** within the server **101**.

[0170] On the other hand, in step S**404** the user starts measurement of one or multiple types of biometric information of the user using the measurement device **102**B. Conceivable actions necessary for the user to start measurement of biometric information using the measurement device **102**B include turning on the power of the measurement device **102**B, the user wearing the measurement device **102**B, the user entering a measurable range of the measurement device **102**B, and so forth. The type of action is irrelevant here in the present embodiment, as long as it is an action whereby measurement of biometric information of the user is started using the measurement device **102**B.

[0171] Upon measurement of biometric information of the user being started in step S**404** using the measurement device **102**B, biometric information measurement data (equivalent to an example of second vital data) that has been measured is transmitted from the measurement device **102**B to the server **101** in step S**405**. In step S**406**, the server **101** saves the received biometric information measurement data in the measurement value database **111** of the server **101**, in a state of not recording in the personal authentication information space **204**.

[0172] In step S**407**, the similarity verifying unit **106** of the server **101** calculates the similarity between the features of the measurement data of the measurement device **102**A and the features of the measurement data of the measurement device **102**B, stored in the measurement value database **111** of the server **101**.

[0173] The similarity verifying unit **106** uses measurement data of the same measurement type recorded in the type-of-measurement space **211** (FIG. **2**) of the measurement value database **111**. The similarity verifying unit **106** also uses measurement data taken in the same time slot. That is to say, the similarity verifying unit **106** uses measurement data of the measurement device **102**A taken during the one minute of 12:00 to 12:01 and measurement data of the measurement device **102**B taken during the one minute of 12:00 to 12:01, for example. Note that this is not restricted to one minute, and that the similarity verifying unit **106** may use, for example, measurement data taken during the five minutes of 12:00 to 12:05. This duration may be set beforehand for each measurement type, and the duration and measurement type may be stored in a correlated manner beforehand, in the ROM of the memory **108** for example.

[0174] In step S**408**, the similarity verifying unit **106** determines whether or not the similarity calculated in step S**407** is at a predetermined first threshold value or higher. In a case where determination is made that the similarity calculated in step S**407** is the predetermined first threshold value or higher in step S**408**, in step S**409** the similarity verifying unit **106** updates the measurement data **200** stored in the measurement value database **111** of the server **101** so that there is explicit indicating that the measurement device **102**B regarding which similarity has been calculated in step S**407** has succeeded the personal authentication information of the measurement device **102**A. The measurement data **200** after updating will be described later with reference to FIG. **11**.

[0175] FIG. **8** is a flowchart schematically illustrating an example of operation procedures of the similarity verifying unit **106** of the server **101**, in the operations in FIG. **7**. When the communication processing unit **103** starts to receive biometric information measurement data from the personal-authenticated measurement device **102**A in step S**411**, and starts to save the received biometric information measurement data in the measurement value database **111** (step S**403** in FIG. **7**), the processing in FIG. **8** is started.

[0176] In step S**412**, the similarity verifying unit **116** extracts, out of the measurement data **200** stored in the measurement value database **111** of the server **101**, data starting with the current point in time and going back a predetermined amount of time, based on the time-of-measurement space **201**. The similarity verifying unit **106** determines in step S**413** whether or not there is data of the measurement device **102**B existing in the data that has been extracted in step S**412**. In a case where no data of the measurement device **102**B exists in the extracted data (NO in step S**413**), the flow returns to step S**412**, and the similarity verifying unit **106** repeats extraction of data.

[0177] On the other hand, in a case where data of the measurement device **102**B exists in the extracted data (YES in step S**413**), in step S**414** the similarity verifying unit **106** separates the extracted data into data of the measurement device **102**A and data of the measurement device **102**B. The similarity verifying unit **106** extracts features of the measurement data from the measurement device **102**A in step S**415**, and extracts features of the measurement data from the measurement device **102**B in step S**416**.

[0178] Various techniques can be conceived for extracting features of the measurement data in steps S**415** and S**416**, such as

[0179] (A1) a technique where the values themselves of the measurement data are taken as features,

[0180] (A2) a technique where the measurement data is subjected to Fourier transform, and frequency components are taken as features,

[0181] (A3) a technique where the measurement data is subjected to application of filters, and the resultant data is taken as features,

[0182] (A4) a technique where the measurement data is subjected to principal component analysis, and the obtained principal component is taken as features, and

[0183] (A5) a technique where one or a combination of multiple types of the techniques exemplified above is taken as features, but techniques for extracting features are not restricted to the above examples.

[0184] In step S**417**, the similarity verifying unit **106** calculates the similarity between the features of measurement data from the measurement device **102**A and the features of measurement data from the measurement device **102**B. Examples of techniques for calculating similarity in step S**417** include

[0185] (B1) a technique where the proportion of the features of the measurement device **102**A as to the features of the measurement device **102**B is taken as the similarity,

[0186] (B2) a technique where the agreement rate of the features is taken as the similarity,

[0187] (B3) a technique where a correlation coefficient of the features is taken as the similarity,

[0188] (B4) a technique where a Pearson correlation of the features is taken as the similarity,

[0189] (B5) a technique where a proportion of error of the features is taken as the similarity, and

[0190] (B6) a technique where one or a combination of multiple types of the similarity calculation techniques exemplified above is taken as similarity, but techniques for calculating similarity are not restricted to the above examples.

[0191] Conceivable types of measurement data regarding which similarity can be calculated include blood pressure, number of steps walked, pulse, heart rate, electrocardiogram, weight, respiratory rate, depth of sleep, and so forth, and combinations thereof can be used as measurement data regarding which the similarity can be calculated, but the types of measurement data regarding which the similarity can be calculated are not restricted to the types exemplified here. The predetermined first threshold value can be decided beforehand in accordance with the type of similarity to be calculated, and saved in the memory **108**.

[0192] In step S**418**, the similarity verifying unit **106** determines whether the similarity calculated in step S**417** is at or above the predetermined first threshold value or not. In a case where the similarity is smaller than the predetermined first threshold value (NO in step S**418**), the flow returns to step S**412**, and the similarity verifying unit **106** resumes the flow from data extraction.

[0193] In a case where the set of measurement devices of which the similarity is at the predetermined first threshold value or higher has been uniquely identified (YES in step S**418**), the similarity verifying unit **106** updates the measurement value database **111** in step S**419**. An example of the updating will be described later with reference to FIG. **11**.

[0194] In step S**420**, the device management unit **105** registers the device ID of the measurement device **102**B, the time, and so forth, in the authentication management database **113** of the server **101**, to the effect that the measurement device **102**B is a personal-authenticated device at the current point in time of step S**412**. The content of registration in the authentication management database **113** will be described later with reference to FIG. **16**. After step S**420**, the flow returns to step S**412**, and the similarity verifying unit **106** resumes the flow of data extraction.

[0195] Now, a case where no measurement device where similarity is the threshold value or higher has been uniquely identified, but rather multiple are found in step S**418**, will be described. FIG. **9** is a diagram schematically illustrating an example of the measurement data **200** stored in the measurement value database **111** that is different from that in FIG. **2**. There may be cases where, as illustrated in FIG. **9**, the similarity between the features of "pulse" measured by "blood pressure meter 0002" and the features of "pulse" measured by "smartphone 0001" of "user A" is the threshold value or higher, and the similarity between the features of "pulse" measured by "blood pressure meter 0002" and the features of "pulse" measured by "smartphone 0002" of "user B" is the threshold value or higher.

[0196] In this case, the similarity verifying unit **106** compares the measurement location space **205** in the measurement value database **111**. In the example in FIG. **9**, the latitude and longitude recorded in the measurement location space **205** corresponding to the "blood pressure meter 0002" and the latitude and longitude recorded in the measurement location space **205** corresponding to the "smartphone 0001" agree. Thus, the similarity verifying unit **106** uniquely identifies the set of measurement devices of which the similarity is the threshold value or higher, by verifying that the measurement is being performed within a predetermined range.

[0197] Now, a method of obtaining the pulse count by analyzing coloration information of the body surface in time sequence from a moving image including the face, in a case where the measurement device **102**A has a camera, will be described. FIG. **10** is a flowchart schematically illustrating an example of procedures of the processing unit of the measurement device **102**A that has a camera detecting pulse from a moving image.

[0198] The processing unit of the measurement device **102**A starts accumulation of moving image data in step S**430**. In step S**431**, the processing unit determines whether or not a face is included in the moving image data. In step S**432**, the processing unit extracts coloration information of the facial portion of the moving image in time-sequence. In step S**433**, the processing unit calculates change in blood flow of the facial portion of the moving image, from coloration information in time sequence. In step S**434**, the processing unit calculates pulse in time sequence from the change in blood flow, and calculates the pulse count from the time intervals between pulses. In step S**435**, the processing unit determines whether or not accumulation of moving image data is continuing. If accumulation of moving image data is continuing (Yes in step S**435**), the flow returns to step S**431**, and the above-described steps are repeated. On the other hand, if accumulation of moving image data is not continuing (NO in step S**435**), the operations of FIG. **10** end.

[0199] FIG. **11** is a diagram illustrating a specific example of the update of the measurement value database **111** updated when there is succession of personal authentication information. Updating of the measurement value database **111** is performed in step S**409** in FIG. **7** and step S**419** in FIG. **8**.

[0200] There is no succession of personal authentication information performed in the measurement data **200** described in FIG. **2**. In comparison with this, the measurement data **200** illustrated in FIG. **11** has "succession (measurement device **102**A)" indicating that personal authentication information has been succeeded recorded in the authentication method space **213** of the personal authentication information space **204**. The measurement device **102**A in the example in FIG. **11** is "smartphone 0001". The ID recorded in the personal ID space **214** of the measurement device **102**A, which is the source of succession of personal authentication information, is also recorded in the personal ID space **214** of the personal authentication information space **204**.

[0201] FIG. **12** is a sequence diagram schematically illustrating procedures for notifying that the measurement device **102**B is to be handled as a personal-authenticated device. At the time of step S**420** being executed in FIG. **8**, the server **101** transmits the fact that the measurement device **102**B is being handled as a personal-authenticated device to the measurement device **102**A and the measurement device **102**B by the procedures illustrated in FIG. **12**.

[0202] In the state in step S**421** in FIG. **21**, personal authentication information is imparted to both the biometric information measurement data of the measurement device **102**A in the measurement value database **111** of the server **101**, and the biometric information measurement data of the measurement device **102**B, at the current point in time at the server **101**. When in the state in step S**421**, in step S**422** the

device management unit **105** of the server **101** transmits a signal to the measurement device **102**A via the communication processing unit **103**, representing that the measurement device **102**B is a personal-authenticated device. When in the state in step S**421**, the device management unit **105** transmits a signal to the measurement device **102**B via the communication processing unit **103** in step S**423**, representing that the measurement device **102**B is a personal-authenticated device.

[0203] In step S**424**, the measurement device **102**B is additionally displayed in the list of personal-authenticated devices displayed on the display unit of the measurement device **102**A. In step S**425**, the fact that the measurement device **102**B is a personal-authenticated device is displayed on the display unit of the measurement device **102**B.

[0204] Forms of displaying on the display unit of the measurement device **102**B that the measurement device **102**B is a personal-authenticated device may conceivably include displaying on the display in text characters, displaying a mark indicating that a personal-authenticated device, and so forth, in a case where the measurement device **102**B has a display. In a case where the measurement device **102**B has a light-emitting diode (LED), conceivable forms include lighting the LED using a specified color, causing the LED to blink at predetermined intervals, and so forth. Also, one or a combination of multiple types of the exemplified forms may be used to display that the measurement device **102**B is a personal-authenticated device at the display unit, display forms are not restricted as long as the user can confirm that the measurement device **102**B is a personal-authenticated device. In a case where the measurement device **102**B does not have a display unit for displaying that the measurement device **102**B is a personal-authenticated device, step S**425** is not executed.

[0205] FIG. **13** is a diagram schematically illustrating an example of exchange of signals between the server **101** and the devices **102**A and **102**B, and displays on the measurement devices **102**A and **102**B, when the processing described in FIGS. **7**, **8**, and **12** is executed.

[0206] In FIG. **13**, in state **411** the measurement device **102**A is authenticated and measuring, and transmitting biometric information to the server **101**. On the other hand, the measurement device **102**B is unauthenticated and not measuring. This state **411** transitions to a state **412** where the measurement device **102**B has started measurement. In state **412**, in addition to the state where the measurement device **102**A that had been measuring and continuing to transmit measurement data to the server **101** in step S**402** (FIG. **7**), the measurement device **102**B transmits measurement data to the server **101** in step S**405** (FIG. **7**).

[0207] Upon step S**405** being executed, the similarity between the measurement data of the measurement device **102**A and the measurement data of the measurement device **102**B is calculated at the server **101** (step S**407** in FIG. **7**), the similarity is compared with the threshold value (step S**408** in FIG. **7**), and determination is made regarding whether or not the measurement device **102**B should be taken as being a personal-authenticated device. If determination is made at the server **101** that it is acceptable for the measurement device **102**B to be taken as a personal-authenticated device, the fact that the measurement device **102**B is a personal-authenticated device is transmitted to the measurement device **102**A and the measurement device **102**B (steps S**422** and S**423** in FIG. **12**). Accordingly, the state transitions from state **412** to state **413**, the measurement device **102**B is added to the personal-authenticated device list on the display unit **102**Ad of the measurement device **102**A, and an LED **102**Bd of the measurement device **102**B is lit to indicate that it is a personal-authenticated device, and the measurement device **102**B is in an authenticated and measuring state.

[0208] Although an example of a smartphone is illustrated in FIG. **13** regarding the measurement device **102**A, the measurement device **102**A is not restricted to being a smartphone. It is sufficient for the measurement device **102**A to have personal authentication functions such as exemplified in FIGS. **3**, **5**, and **6**, to have a function of communication with the server **101**, and to have a display unit that can display information, and to have measurement functions for measuring one or more biometric information of blood pressure, number of steps walked, pulse count, heart rate, electrocardiogram, weight, respiratory rate, and depth of sleep. In the first embodiment, blood pressure, the number of steps walked, pulse count, heart rate, electrocardiogram, weight, respiratory rate, and depth of sleep, are equivalent to an example of measurement types.

[0209] Although an example of a wristwatch-type activity monitor is illustrated in FIG. **13** regarding the measurement device **102**B, the measurement device **102**B is not restricted to being a wristwatch-type activity monitor. It is sufficient for the measurement device **102**B to have functions of communicating with the server **101**, and to have measurement functions for measuring measurement items of blood pressure, number of steps walked, pulse count, heart rate, electrocardiogram, weight, respiratory rate, and depth of sleep, that the measurement device **102**A also is capable of measuring. Other conceivable specific examples of the measurement device **102**B include a blood pressure meter, body composition meter, bathroom scales, sleep monitor, activity monitor other than a wristwatch-type, and so forth. The measurement device **102**B may also analyze coloration information of the body surface from a moving image including the face to obtain the pulse count, as described with reference to FIG. **10**.

[0210] FIG. **14** is a flowchart schematically illustrating an example of other procedures for imparting personal authentication information to the measurement data of the measurement device **102**B. According to the procedures in FIG. **14**, in a case where succession of personal authentication information is performed by comparing the biometric information between the measurement device **102**A and measurement device **102**B, as described in FIGS. **7** and **8**, even if the similarity of measurement data between the measurement device **102**A and measurement device **102**B cannot be calculated, personal authentication information can be imparted to the measurement data of the measurement device **102**B using continuity of measurement data. The operations of FIG. **14** are executed while reception of measurement data from the measurement device **102**B is continuing, every predetermined amount of time for example.

[0211] In step S**601**, the determining unit **104** sets the start-point time to the current time at the server **101**. In step S**602**, the determining unit **104** extracts measurement data of the measurement device **102**B from the start-point time to a predetermined amount of time back, from the measurement value database **111**.

[0212] In step S**603**, the determining unit **104** determines whether or not data to which personal authentication information has been imparted exists in the data extracted in step S**602**. In a case where no data to which personal authentication information has been imparted exists in the data extracted in step S**602** (NO in step S**603**), the flow advances to step S**607**. On the other hand, in a case where data to which personal authentication information has been imparted exists in the data extracted in step S**602** (YES in step S**603**), the processing advances to step S**604**. In step S**607**, the determining unit **104** updates the start-point time to a point of time in the past that is half the predetermined time, and thereafter the flow returns to step S**602**.

[0213] In step S**604**, the determining unit **104** determines whether or not data to which personal authentication information has not been imparted exists in the data extracted in step S**602**. In a case where no data to which personal authentication information has not been imparted exists in the data extracted in step S**602** (NO in step S**604**), the flow advances to step S**607**. On the other hand, in a case where data to which personal authentication information has not been imparted exists in the data extracted in step S**602** (YES in step S**604**), the processing advances to step S**605**. In step S**605**, the determining unit **104** determines whether or not the data to which personal authentication information has been imparted and the data to which personal authentication information has not been imparted in the extracted measurement data of the measurement device **102**B are from consecutive measurement by the measurement device **102**B.

[0214] Conceivable determination techniques, for determining whether or not consecutive measurement, include determining not to be consecutive measurement in

[0215] (C1) a case where data explicitly indicating end of measurement is recorded between the data to which personal authentication information has been imparted and the data to which personal authentication information has not been imparted, and

[0216] (C2) a case where the greatest value of an interval between data to which personal authentication information has been imparted and the data to which personal authentication information has not been imparted exceeds a predetermined threshold value.

[0217] Techniques where the exemplified consecutive measurement determination techniques are combined are also conceivable. Note that it is sufficient to be able to determine whether or not consecutive measurement, and the determining techniques are not restricted.

[0218] In a case where it has been found in step S**605** that data to which personal authentication information has been imparted and the data to which personal authentication information has not been imparted of the measurement data of the measurement device **102**B was due to consecutive measurement by the measurement device **102**B (YES in step S**605**), the flow advances to step S**606**. On the other hand, in a case where it has been found that data to which personal authentication information has been imparted and the data to which personal authentication information has not been imparted of the measurement data of the measurement device **102**B was not due to consecutive measurement by the measurement device **102**B (NO in step S**605**), the flow advances to step S**607**.

[0219] In step S**606**, the determining unit **104** imparts personal authentication information to the measurement data not imparted with personal authentication information, and updates the measurement value database **111** of the server **101**. Thereafter, the flow advances to step S**607**.

[0220] Although the start-point time is extended back in time by half of the predetermined time, half of the predetermined time is not restrictive, and it is sufficient to have overlapping in the data being extracted. An arrangement may be made where, when the start-point time reaches the initial measurement time when start-point time is extended back, the operations of FIG. **14** end.

[0221] FIG. **15** is a sequence diagram schematically illustrating operations in a case of the measurement device **102**B that has succeeded personal authentication information from the measurement device **102**A having personal authentication functions ends measurement of biometric information. The operations in FIG. **15** are executed in a state where the measurement device **102**B is recognized as being a personal-authenticated device (step S**701**).

[0222] Upon the measurement device **102**B having ended measurement of biometric information in step S**702**, in step S**703** the measurement device **102**B transmits an end to measurement of biometric information to the server **101**. In step S**704**, the device management unit **105** of the server **101** registers in the authentication management database **113** (FIG. **16**) that handling the measurement device **102**B as a personal-authenticated device has been stopped. Accordingly, the measurement data of biometric information transmitted from the measurement device **102**B thereafter is saved in the measurement value database **111** without having personal authentication information imparted thereto.

[0223] In step S**705**, the device management unit **105** of the server **101** transmits to the measurement device **102**A that the measurement device **102**B is a personal-unauthenticated device. In step S**706**, the device management unit **105** transmits to the measurement device **102**B that the measurement device **102**B is a personal-unauthenticated device. In step S**707**, the measurement device **102**A deletes the measurement device **102**B from the personal-authenticated device list on the display unit **102**Ad (FIG. **13**) of the measurement device **102**A, and updates the personal-authenticated device list and displays. In step S**708**, the measurement device **102**B displays that the measurement device **102**B is a personal-unauthenticated device by turning off the LED **102**Bd (FIG. **13**). In a case where the measurement device **102**B does not have a display unit such as an LED or the like to display that it is a personal-unauthenticated device, step S**708** is not executed.

[0224] Regarding biometric information measurement data of the measurement device **102**B received from step S**704** and thereafter, in step S**709**, the server **101** saves the biometric information of the measurement device **102**B in the measurement value database **111** without authentication information, until biometric information measurement data is transmitted from the measurement device **102**A and comparison of similarity with the biometric information of the measurement device **102**B is performed, to deem to be personal-authenticated.

[0225] FIG. **16** is a diagram schematically illustrating an example of authentication management information **1600** stored in the authentication management database **113**. The authentication management information **1600** has a device ID space **1601**, time space **1602**, personal ID space **1603**, and authentication flag space **1604**, as illustrated in FIG. **16**. Information the same as that in the device ID space **212** and personal ID space **214** of the measurement data **200** (FIG. **2**)

is respectively stored in the device ID space **1601** and personal ID space **1603**. The time of the device management unit **105** starting or ending personal authentication is recorded in the time space **1602**. In a case of starting personal authentication, a flag indicating "authentication started" is recorded in the authentication flag space **1604**, and in a case of ending personal authentication, a flag indicating "authentication ended" is recorded. Reading out information recorded in the authentication management information **1600** enables the state of personal authentication measurement devices recorded in the device ID space **1601** to be comprehended.

Second Embodiment

[0226] An example of the measurement device **102**B not having personal authentication functions succeeding personal authentication information of the measurement device **102**A having personal authentication functions has been described in the first embodiment. In a second embodiment, an example will be described where the measurement device **102**C (equivalent to an example of a third measurement device) that does not have personal authentication functions further succeeds the personal authentication information that the measurement device **102**B (equivalent to an example of a second measurement device) that does not have personal authentication functions has succeeded.

[0227] FIG. **17** is a sequence diagram schematically illustrating an example of succession procedures of personal authentication information in the second embodiment. In step S**800**, the measurement device **102**B starts measurement of one or multiple types of biometric information of the user. Upon step S**800** being executed, the measurement device **102**B transmits measurement data (equivalent to an example of second vital data) of all biometric information measured at the measurement device **102**B to the server **101** in step S**801**. In step S**802**, the server **101** saves the measurement data of the biometric information that has been received from the measurement device **102**B in the measurement value database **111** within the server **101**. On the other hand, the measurement device **102**C starts measurement of one or multiple types of biometric information of the user in step S**803**.

[0228] Conceivable user actions necessary for the measurement device **102**B and measurement device **102**C to start measurement of biometric information in steps S**801** and S**803** include

[0229] (D1) turning on the power of the measurement device **102**B and measurement device **102**C,

[0230] (D2) the user wearing the measurement device **102**B and measurement device **102**C,

[0231] (D3) the user entering a measurable range of the measurement device **102**B and measurement device **102**C, and so forth. The type of action is irrelevant, as long as it is an action whereby measurement of biometric information of the user is started using the measurement device **102**B and measurement device **102**C. The measurement at the measurement device **102**B and measurement device **102**C does not have to be started by the same action.

[0232] Upon step S**803** having been executed, the measurement device **102**C transmits all biometric information measurement data (equivalent to an example of third vital data) that has been measured by the measurement device **102**C to the server **101** in step S**804**. In step S**805**, the server **101** saves the biometric information measurement data received from the measurement device **102**C in the measurement value database **111** in the server **101**.

[0233] In step S**806**, the device management unit **105** of the server **101** determines whether or not personal authentication information has been imparted to the measurement data from the measurement device **102**B that is stored in the measurement value database **111**. In the case in FIG. **2** for example, the personal authentication information space **204** corresponding to the "activity monitor 0001" in the device ID space **212** is blank, so the device management unit **105** determines that no personal authentication information is imparted to the measurement data from the activity monitor 0001 (example of measurement device **102**B). In the case in FIG. **11** for example, it is recorded in the personal authentication information space **204** corresponding to the "activity monitor 0001" in the device ID space **212** that personal authentication information has been succeeded, so the device management unit **105** determines that personal authentication information has been imparted to the measurement data from the activity monitor 0001 (example of measurement device **102**B).

[0234] In a case where no personal authentication information has been imparted to the measurement data from the measurement device **102**B that is stored in the measurement value database **111** of the server **101** in step S**806**, subsequent processing is not performed, and the flow returns to step S**805**. In a case where personal authentication information has been imparted to the measurement data from the measurement device **102**B that is stored in the measurement value database **111** of the server **101** in step S**806**, the flow advances to step S**807**. In step S**807**, the similarity verifying unit **106** of the server **101** calculates the similarity (equivalent to second value indicating degree of agreement) between features of the measurement data of the measurement device **102**B stored in the measurement value database **111** of the server **101** and features of the measurement data of the measurement device **102**C.

[0235] The similarity verifying unit **106** uses measurement data of the same measurement type recorded in the type-of-measurement space **211** (FIG. **2**) of the measurement value database **111** at this time. That is to say, the similarity verifying unit **106** uses measurement data taken in the same time slot. That is to say, the similarity verifying unit **106** uses measurement data of the measurement device **102**B taken during the one minute of 12:00 to 12:01 and measurement data of the measurement device **102**C taken during the one minute of 12:00 to 12:01. Note that this is not restricted to one minute, and that the similarity verifying unit **106** may use, for example, measurement data taken during the five minutes of 12:00 to 12:05. This duration may be set beforehand for each measurement type, and the duration and measurement type may be stored in a correlated manner beforehand, in the ROM of the memory **108** for example.

[0236] The techniques for similarity calculation performed in step S**807** may conceivably be the techniques (B1) through (B6) exemplified in the first embodiment but the techniques for calculating similarity are not restricted to the examples, as in the first embodiment. The predetermined second threshold value can be decided beforehand in accordance with the type of similarity to be calculated, and saved in the memory **108**.

[0237] In step S**808**, the similarity verifying unit **106** determines whether or not the similarity calculated in step S**807** is at a predetermined second threshold value or higher.

In a case where determination is made that the similarity calculated in step S807 is the predetermined second threshold value or higher in step S808, step S809 is executed. In step S809, the similarity verifying unit 106 updates the measurement data 200 that is stored in the measurement value data base 111 of the server 101, so that there is explicit indication that the measurement device 102C regarding which similarity has been calculated in step S807 has succeeded the personal authentication information of the measurement device 102B, as illustrated in FIG. 18. Specific processing performed in steps S807, S808, and S809 can be realized by techniques described with regard to FIG. 8.

[0238] FIG. 18 is a diagram illustrating a specific example of the measurement value database 111 updated in step S809 in FIG. 17. In the example in FIG. 18, out of the IDs recorded in the device ID space 212, the measurement device 102B is the "activity monitor 0001", and the measurement device 102C is the "blood pressure meter 0002".

[0239] There is no succession of personal authentication information performed regarding the "blood pressure meter 0002" in device ID space 212 in the updated measurement data 200 described in FIG. 11. In comparison with this, the measurement data 200 illustrated in FIG. 18 has "succession (activity monitor 0001)" indicating that personal authentication information has been succeeded from the measurement device 102B (i.e., the activity monitor 0001) recorded in the authentication method space 213 of the personal authentication information space 204 in the "blood pressure meter 0002" in the device ID space 212. The ID recorded in the personal ID space 214 of the measurement device 102B (i.e., the activity monitor 0001), which is the source of succession of personal authentication information, is also recorded in the personal ID space 214 of the personal authentication information space 204, i.e., "user A".

[0240] Note that pulse is measured by both the "activity meter 0001" that is an example of the measurement device 102B, and the "blood pressure meter 0002" that is an example of the measurement device 102C, as illustrated in the measurement data 200 in FIG. 18. Accordingly, the similarity can be calculated using the pulse measurement data in step S807 in FIG. 17.

Third Embodiment

[0241] FIG. 19 is a sequence diagram schematically illustrating an example of procedures for imparting personal authentication information to biometric information measurement data that has been measured in a third embodiment. In the third embodiment, a personal authentication mechanism having personal authentication functions in the measurement device 102A that measures biometric information has functions of measuring biometric information. The measurement device 102A has a camera in the example in FIG. 19.

[0242] In step S1001, the measurement device 102A is in a state where personal authentication has not been performed and the device is locked. From this locked state, the measurement device 102A prompts the user to use the camera to shoot a moving image including the face of the user in step S1002. The measurement device 102A obtains a moving image including the face of the user that has been shot.

[0243] In step S1003, the moving image including the face of the user that has been shot is transmitted from the measurement device 102A to the server 101. The determining unit 104 of the server 101 compares the features of the received moving image with the personal authentication information recorded in the personal authentication database 112 of the server 101 in step S1004, and determines whether or not the face in the moving image is the face of a registered user. In a case where determination is made that the face in the moving image is not the face of the registered user, the following processing is not executed.

[0244] In a case where determination is made that the face in the moving image is the face of the registered user, the determining unit 104 of the server 101 registers the measurement device 102A as being a personal-authenticated device of the registered user in step S1005. In step S1006, transmission is made to the effect that the measurement device 102A has been registered as a personal-authenticated device to the measurement device 102A from the server 101. The locked state of the measurement device 102A is disengaged in step S1007.

[0245] In step S1008, the server 101 extracts features corresponding to coloration information from the moving image including the face of the user that has been received, and detects biometric information of the user. Biometric information that can be detected include the pulse count, heart rate, state of stress, respiratory count, and so forth, of the user. For example, the pulse count can be detected using the procedures described with reference to FIG. 10. Although one or multiple types of the examples of biometric information can be detected, the types of detectable biometric information are not restricted. In step S1009, the server 101 imparts personal authentication information of the registered user to the detected biometric information, and saves in the measurement value database 111 of the server 101.

[0246] Although an example where the personal authentication mechanism is a camera has been exemplified in FIG. 19, the personal authentication mechanism is not restricted to being a camera. For example, in a case where biometric information such as pulse count can be measured or extracted from the finger of the user using a fingerprint authentication mechanism, the measurement device 102A may have a fingerprint authentication mechanism as the authentication mechanism thereof. Further, the type of authentication performed by the authentication mechanism of the measurement device 102A is not restricted.

Fourth Embodiment

[0247] A determining device that determines the state of measurement when measuring blood pressure using a blood pressure meter will be described in a fourth embodiment. A case where a wrist-worn blood pressure meter that is worn on the wrist to measure blood pressure will be described in the fourth embodiment.

[0248] FIG. 20 is a block diagram schematically illustrating an example of the configuration of the determining device according to the fourth embodiment. FIG. 21 is a block diagram schematically illustrating an example of the configuration of a blood pressure meter. FIG. 22 is a diagram schematically illustrating a measurement state when a user uses the blood pressure meter to measure blood pressure. FIG. 23 is a diagram schematically illustrating an example of a screen displayed on a display unit of the determining device before starting measurement of blood pressure.

[0249] As illustrated in FIG. 20, the determining device 2100 according to the fourth embodiment includes a camera

2120, an angle sensor 2140, a microphone 2130, a display unit 2150, a CPU 2110, a communication unit 2160, and a storage unit 2170.

[0250] The storage unit 2170 is made up of semiconductor memory or the like, for example. The storage unit 2170 includes, for example, ROM, RAM, EEPROM, and so forth. The ROM of the storage unit 2170 stores a control program according to the fourth embodiment to operate the CPU 2110. The storage unit 2170 records information such as audio data, image data, blood pressure measurement values, and so forth. Although the storage unit 2170 is built into the determining device 2100 in the fourth embodiment, this is not restrictive. The storage unit 2170 may be memory in a server connected to a network, for example.

[0251] The CPU 2110 operates in accordance with the control program according to the fourth embodiment stored in the storage unit 2170, to function as a facial position determining unit 2111, a posture determining unit 2112, an audio determining unit 2113, and a reliability determining unit 2114.

[0252] The determining device 2100 is held by one hand or both hands of a user 2000 who has the blood pressure meter 2200 worn on a wrist, such that the camera 2120 takes images of the face of the user 2000, as illustrated in FIG. 22. In the fourth embodiment, the determining device 2100 is held by the one hand of the user 2000 on which the blood pressure meter 2200 is worn. A smartphone is used as an example of the determining device 2100 in the fourth embodiment. A tablet computer may be used as the determining device 2100 as well.

[0253] A blood pressure meter 2200 that interoperates with the determining device 2100 includes a control unit 2210, a cuff 2220, a communication unit 2230, and a display unit 2240, as illustrated in FIG. 21. The control unit 2210 includes a CPU, memory, and so forth, and performs computation processing or the like. The cuff 2220 is a bag-like belt. The cuff 2220 is attached to the wrist of the user 2000 holding the determining device 2100, for example, in the fourth embodiment. The communication unit 2230 performs communication with the determining device 2100. The display unit 2240 displays measurement results.

[0254] Next, the configurations of the determining device 2100 will be described. The camera 2120 shoots still or moving images. The camera 2120 shoots the face of the user 2000 and inputs image data to the CPU 2110.

[0255] The angle sensor 2140 obtains first information indicating the angle of inclination of the normal to the surface of the display unit 2150 of the determining device 2100 as to the gravitational direction. The angle sensor 2140 is configured of a gyroscope or acceleration sensor, for example. The angle sensor 2140 is provided to the determining device 2100 in the fourth embodiment. An angle sensor provided to the blood pressure meter 2200 may be used instead of the angle sensor 2140. In this case, reference data representing the correlation between the angle of the wrist and the angle of the determining device 2100 may be used.

[0256] The microphone 2130 obtains audio around the determining device 2100. The microphone 2130 inputs the obtained audio to the CPU 2110. The display unit 2150 is controlled by the CPU 2110 and displays messages to prompt the user 2000 to assume an appropriate posture, blood pressure measurement values, reliability of measurement values, and so forth. Specific examples of screens displayed on the display unit 2150 will be described later. The communication unit 2160 is controlled by the CPU 2110 and performs wired or wireless communication with the blood pressure meter 2200. The communication unit 2160 transmits an instruction to the blood pressure meter 2200 to start measurement, receives measurement results from the blood pressure meter 2200, and exchanges data through communication with an external server and so forth.

[0257] The facial position determining unit 2111 obtains second information indicating the position and size of the face within the image data, from the image data of the camera 2120 of the determining device 2100. The second information is used by the posture determining unit 2112 to determine posture. The audio determining unit 2113 compares the audio data of the microphone 2130 of the determining device 2100 with exhaust sound data of the cuff 2220 stored in the storage unit 2170 beforehand, and determines whether or not the exhaust sound of the cuff 2220 is included in the audio obtained by the microphone 2130.

[0258] The posture determining unit 2112 determines the height at which the cuff 2220 is situated, from the second information obtained from the facial position determining unit 2111 and the first information obtained from the angle sensor 2140. Specifically, the posture determining unit 2112 determines that the cuff 2220 is situated at the same height as the heart of the user 2000 in a case where the angle indicated by the first information is within a predetermined first range, the position of the face of the user 2000 within the image data indicated in the second information is within a predetermined second range, and the proportion of the size of the face of the user 2000 in the image data indicated by the second information is in a predetermined third range. The posture determining unit 2112 outputs to the display unit 2150, for example, that determination has been made that the cuff 2220 is situated at the same height as the heart of the user 2000.

[0259] The posture determining unit 2112 may determine that the angle indicated in the first information is within the predetermined first range if the difference between the angle of inclination of the normal to the surface of the display unit 2150 of the determining device 2100 as to the gravitational direction, decided beforehand so that the position of the cuff 2220 of the blood pressure meter 2200 will be at the same height as the heart of the user 2000, and the first information obtained by the angle sensor 2140 is at or below a threshold value decided beforehand. The storage unit 2170 may store beforehand the above-described angle of inclination of the normal to the surface of the display unit 2150 of the determining device 2100 as to the gravitational direction, decided beforehand so that the position of the cuff 2220 of the blood pressure meter 2200 will be at the same height as the heart of the user 2000.

[0260] When starting measurement of blood pressure, the posture determining unit 2112 displays a frame 2151 of a size decided beforehand at a position on the display unit 2150 decided beforehand, and displays an instruction to the user 2000, such as "please match face to frame", below the frame 2151. The posture determining unit 2112 may determine that when a facial image 2152 of the user 2000 taken by the camera 2120 is situated within the frame 2151, the position of the face of the user 2000 within the image data indicated in the second information is within the predetermined second range, and the proportion of the size of the

face of the user **2000** in the image data indicated by the second information is in the predetermined third range.

[0261] The size of the facial image **2152** (FIG. **23**) of the user **2000** taken by the camera **2120** displayed on the display unit **2150** is dependent on the distance between the camera **2120** (i.e., the determining device **2100**), and the face of the user **2000**. Accordingly, the sideways length of the frame **2151** can be decided beforehand taking into consideration a general length of the arm and size of the face of the user **2000**.

[0262] The height position of the facial image **2152** of the user **2000** displayed on the display unit **2150** is dependent on the angle of the user **2000** holding the determining device **2100**, and the height of the determining device **2100**. Accordingly, the length and position of the frame **2151** in the vertical direction, and the angle of the normal to the surface of the display unit **2150** of the determining device **2100** as to the gravitational direction described above, can be decided beforehand so that the height of the wrist of the user **2000** holding the determining device **2100** matches the height of the heart of the user **2000**.

[0263] FIG. **24** is a flowchart schematically illustrating operations of the determining device **2100** when measuring blood pressure according to the fourth embodiment. FIGS. **25** through **28** are diagrams schematically illustrating examples of displays made at the determining device when measuring blood pressure. The operations of the determining device **2100** will be described with reference to FIGS. **23** through **28**.

[0264] First, the user **2000** wears the cuff **2220** of the blood pressure meter **2200** on the arm. The blood pressure meter that is used may be of a type worn on the wrist or a type worn on the upper arm, but an example of a wrist-worn blood pressure meter will be described in the fourth embodiment. The user **2000** holds the determining device **2100** in one hand or both hands (in the fourth embodiment, the one hand at the side to which the blood pressure meter **2200** is worn, as described above), and directs the camera **2120** toward the face of the user **2000**.

[0265] In step S**2100**, the posture determining unit **2112** prompts the user **2000** to assume a correct posture through the display unit **2150**. In the fourth embodiment, the posture determining unit **2112** displays the frame **2151** and the facial image **2152** taken by the camera **2120** on the display unit **2150**, as illustrated in FIG. **23**, and instructs the user **2000** to move the hand holding the determining device **2100** so that the facial image **2152** is within the frame **2151**. The method for presenting a correct posture is not restricted to this, and for example, the posture determining unit **2112** may simply display the direction in which the user **2000** should move the hand holding the determining device **2100** on the display unit **2150**.

[0266] In step S**2101**, the facial position determining unit **2111** obtains an image including the face of the user **2000**, taken by the camera **2120**. In step S**2102**, the facial posture determining unit **2111** obtains the second information indicating the position and size of the face within the image from the obtained image, and hands the second information to the posture determining unit **2112**. This position of the face is the center position of the region of the face of the user **2000** in the image data taken by the camera **2120**, for example. The size of the face is, for example, information indicating the proportion of the area of the face of the user **2000** in the image data taken by the camera **2120**.

[0267] In step S**2103**, the posture determining unit **2112** obtains first information indicating the angle of the normal to the surface of the display unit **2150** of the determining device **2100** as to the gravitational direction, from the angle sensor **2140**. Thereafter, in step S**2104**, the posture determining unit **2112** determines whether the angle indicated by the first information, the position of the face of the user **2000** within the image data, and the proportion of the size of the face of the user **2000** in the image data, indicated by the second information, are each within the predetermined ranges. In a case where the angle indicated by the first information is within the first range, the position of the face of the user **2000** in the image data indicated by the second information is within the second range, and the proportion of the size of the face of the user **2000** in the image data indicated by the second information is within the third range (YES in step S**2104**), the posture determining unit **2112** determines that the height of the cuff **2220** and the height of the heart of the user **2000** agree, and notifies the reliability determining unit **2114** to the effect that the user **2000** is using the blood pressure meter **2200** in a correct posture.

[0268] In a case of shooting the face of the user **2000** by the camera **2120** of the determining device **2100** held in the hand at the same side as the arm where the cuff **2220** is worn, the positional relations between the camera **2120**, cuff **2220**, face of user **2000**, and heart are restricted. Accordingly, the relative position between the cuff **2220** and the heart of the user **2000** can be calculated from the position of face and proportion of size of face of the user **2000** in the image data taken by the camera **2120**, indicated by the second information.

[0269] Further, the vertical relationship between the cuff **2220** and the heart can be determined by using the angle of the normal to the surface of the display unit **2150** of the determining device **2100** as to the gravitational direction, indicated by the first information obtained from the angle sensor **2140**. The cuff **2220** and the heart are preferably at the same height, for correct blood pressure measurement. Accordingly, the posture can be determined by storing the angle detected by the angle sensor **2140** in a case where the cuff **2220** and the heart are at the same height, and the position of the face in the image and the proportion of the size of the face in the image, in the storage unit **2170**, and performing determination that each are at predetermined values.

[0270] In a case where the position of the face, proportion of the size of the face, or the angle are not in the predetermined ranges, the determination results by the facial position determining unit **2111** and posture determining unit **2112** are preferably fed back to the **2000** user by the display unit **2150** as illustrated in FIG. **23**, thereby prompting the user **2000** to assume a correct posture.

[0271] In step S**2105**, the facial position determining unit **2111** uses the image obtained in step S**2101** to authenticate the face of the user **2000**. The storage unit **2170** stores features of the facial image of the user **2000** beforehand. The facial position determining unit **2111** extracts features of the facial image of the user **2000** from the image obtained in step S**2101**. The facial position determining unit **2111** compares the extracted features and the features of the facial image of the user **2000** stored in the storage unit **2170** beforehand, and determines whether matching or not. By performing this personal authentication in step S**2105**, the

person currently using the blood pressure meter **2200** can be identified, thereby preventing blood pressure measurement by another person.

[0272] In a case where personal authentication cannot be performed in step S**2105**, the blood pressure measurement may be terminated. Also, in a case where determination is made by the posture determining unit **2112** that the cuff **2220** is at a predetermined height (YES in step S**2104**), step S**2105** may be skipped and the flow directly advance to step S**2106**.

[0273] In step S**2106**, the posture determining unit **2112** instructs starting of blood pressure measurement by the blood pressure meter **2200** via the communication unit **2160**. The method of instructing starting of blood pressure measurement at this time may be to connect the communication unit **2160** and the blood pressure meter **2200** by cable or wirelessly, and instruct starting of blood pressure measurement via the communication unit **2160**. Alternatively, the user **2000** may be instructed to start blood pressure measurement via the display unit **2150**, as illustrated in FIG. **25**, so that the user **2000** operates the blood pressure meter **2200**.

[0274] After starting blood pressure measurement, in step S**2107** the audio determining unit **2113** detects the exhaust sound of the cuff **2220** from the audio obtained by the microphone **2130**. The cuff **2220** of the blood pressure meter **2200** expands and contracts by internal pressure being controlled, and emits exhaust sound when depressurizing. The exhaust sound of the cuff **2220** is stored in the storage unit **2170** beforehand. The audio determining unit **2113** compares the audio obtained by the microphone **2130** and the exhaust sound stored in the storage unit **2170** beforehand. The audio determining unit **2113** determines whether or not the exhaust sound emitted by the cuff **2220** is included in the audio that has been obtained by the microphone **2130**, based on the comparison results, and outputs the determination results to the reliability determining unit **2114**.

[0275] Note that an arrangement may be made where data where the blood pressure meter **2200** is placed at different distances and the exhaust sound of the cuff **2220** is recorded may be saved in the storage unit **2170** or an external server, and the audio determining unit **2113** compares the audio obtained by the microphone **2130** with the multiple types of exhaust sounds. This enables confirmation of the cuff **2220** being situated nearby the determining device **2100**. As a result, fraudulence such as measurement by a different person, measurement with the cuff **2220** worn on the arm opposite to the side where the determining device **2100** is held, and so forth, can be eliminated.

[0276] In step S**2108**, the facial position determining unit **2111** obtains an image including the face of the user **2000** taken by the camera **2120**, obtains the second information, and notifies the obtained second information to the reliability determining unit **2114**. In step S**2109**, the posture determining unit **2112** obtains the first information from the angle sensor **2140**, and notifies the obtained first information to the reliability determining unit **2114**. Thus, in the fourth embodiment, the first information and second information are obtained by the angle sensor **2140** and camera **2120** even while measuring blood pressure, and the reliability determining unit **2114** is notified. During measurement of blood pressure, the posture determining unit **2112** preferably displays a message such as "currently measuring, please do not move" on the display unit **2150** as illustrated in FIG. **26**, thereby instructing the user **2000** to maintain the correct posture and not move.

[0277] When a predetermined amount of time has elapsed after starting of blood pressure measurement (step S**2106**), the determining device **2100** judges that blood pressure measurement has ended. Alternatively, the determining device **2100** may judge that blood pressure measurement has ended when receiving notification from the blood pressure meter **2200** via the communication unit **2160** to the effect that blood pressure measurement has ended. Thereafter, the determining device **2100** obtains the measured blood pressure measurement values from the blood pressure meter **2200** via the communication unit **2160** in step S**2110**.

[0278] Note that the blood pressure meter **2200** may have a speaker that emits a particular sound indicating end of measurement, for example. The audio determining unit **2113** may judge that blood pressure measurement has ended when determining that the particular sound has been emitted. The blood pressure meter **2200** may, after having emitted the particular sound from the speaker, transmit information to the determining device **2100** such as blood pressure values, time of end of measurement, and so forth.

[0279] After end of the blood pressure measurement, in steps S**2111** and S**2112** the reliability determining unit **2114** determines the reliability of the measurement results, using the audio data, second information, and first information, obtained respectively in steps S**2107**, S**2108**, and S**2109**.

[0280] Specifically, in step S**2111**, the reliability determining unit **2114** performs determination the same as in step S**2104** regarding the first information and the second information. For example, in a case where the angle indicated by the first information is not within the predetermined first range, or in a case where the position of the face of the user **2000** indicated by the second information is not within the predetermined second range, or in a case where the proportion of size of the face of the user **2000** indicated by the second information is not within the predetermined third range (NO in step S**2111**), the posture has conceivably changed after starting measurement. Accordingly, the reliability determining unit **2114** determines that the reliability of measurement results is low, and returns the processing to step S**2106**.

[0281] Also, the reliability determining unit **2114** may continue to obtain images and angles after starting blood pressure measurement in step S**2106**. The reliability determining unit **2114** may measure the amount of time that the position and proportion of size of the face in the image, and the angle, were outside the predetermined ranges. In a case where this is longer than a predetermined amount of time, the reliability determining unit **2114** may determine the reliability of the measurement results to be low.

[0282] In step S**2112**, the reliability determining unit **2114** determines whether or not the exhaust sound of the cuff **2220** has been detected by the audio determining unit **2113** from the audio obtained in step S**2107**. In a case where no exhaust sound of the cuff **2220** is detected, or in a case where the detection level of the exhaust sound is at or below a predetermined threshold value (NO in step S**2112**), the reliability determining unit **2114** determines that the reliability of the measurement results is low, and returns the flow to step S**2106**.

[0283] In a case where determination is made at the reliability determining unit **2114** that the reliability of the

measurement results is low (NO in step **S2111** or No in step **S2112**), measurement is performed again by the communication unit **2160** communicating with the blood pressure meter **2200** in the example illustrated in FIG. **24**, but this is not restrictive. For example, one of

[0284] (E1) discarding the measurement results as being invalid,

[0285] (E2) lowering the weighting of the measurement results when being used in analyzing, such as evaluation of health or the like, and

[0286] (E3) displaying a screen such as illustrated in FIG. **27** on the display unit **2150** and notifying the user **2000** that measurement has failed and prompting measurement again, may be carried out. The measurement results of the reliability determining unit **2114** may be quantified, and the measurement results be handled differently depending on numerical values of reliability.

[0287] In a case where judgment is not made that reliability is low (YES in step **S2111** and YES in step **S2112**), in step **S2113** the reliability determining unit **2114** displays a screen such as illustrated in FIG. **28** on the display unit **2150**, to the effect that measurement has been successful. The reliability determining unit **2114** also displays the measurement values received from the blood pressure meter **2200**.

[0288] In a case where the blood pressure meter **2200** according to the fourth embodiment is not used in conjunction with the determining device **2100**, the blood pressure meter **2200** may operate as a normal blood pressure meter, and may operate in cooperation with the determining device **2100** by the operation mode of the blood pressure meter **2200** having been switched.

[0289] Note that the determining device **2100** according to the fourth embodiment is for determining the posture of the user **2000**, and the measurement device used is not restricted to the blood pressure meter **2200**. The determining device **2100** may be used with a measurement device regarding which the posture of the user **2000** affects measurement results, such as with bathroom scales or the like. Accordingly, the reliability of measurement values can be improved.

[0290] The following advantages can be obtained by the fourth embodiment.

[0291] (1) The determining device **2100** has the camera **2120** and CPU **2110** in addition to the angle sensor **2140**. Accordingly, the posture of the user **2000** can be estimated more accurately by using images of the camera **2120** in which the positional relation of the user **2000** and cuff **2220** is known, as compared to the conventional posture estimation of the user **2000** using the angle sensor alone, thereby improving accuracy of measurement results.

[0292] (2) The determining device **2100** has the camera **2120** and display unit **2150**. The frame **2151** indicating the appropriate facial position is displayed as illustrated in FIG. **23**, in addition to the image data taken by the camera **2120**, at the display unit **2150**. Accordingly, the user **2000** can easily and intuitively assume a correct posture, by feedback to the user via the display unit **2150**.

[0293] (3) The determining device **2100** uses the facial image of the user **2000** taken by the camera **2120**, and accordingly can detect difference in posture that the angle sensor **2140** alone cannot estimate. This also makes it more difficult for the user **2000** to perform intentionally fraudulent measurement. By eliminating readily-conceivable fraudulence, such as measuring while lying down for example, fraudulent measurement can be suppressed.

[0294] (4) The determining device **2100** has the camera **2120** and shoots the face of the user **2000** at a predetermined position, so facial recognition from the image can be easily performed. This yields advantages of easily organizing and analyzing measurement results in association with individuals regarding the measurement results, and preventing fraudulence where one person performs measurements in place of another.

Fifth Embodiment

[0295] An example of using a wrist-worn blood pressure meter that is worn on the wrist and blood pressure is measured has been described in the fourth embodiment. An example of an upper-arm-worn blood pressure meter that is worn on the upper arm and blood pressure is measured will be described in the fifth embodiment.

[0296] FIG. **29** is a block diagram schematically illustrating an example of the configuration of a determining device according to the fifth embodiment. FIG. **30** is a diagram schematically illustrating a measurement state when a user uses the blood pressure meter to measure blood pressure. FIG. **31** is a diagram schematically illustrating an example of a screen displayed on a display unit of the determining device before starting measurement of blood pressure. Note that the blood pressure meter used in the fifth embodiment has the same configuration as the blood pressure meter **2200** in the fourth embodiment illustrated in FIG. **21**.

[0297] A determining device **2300** according to the fifth embodiment includes a camera **2320**, an angle sensor **2340**, a display unit **2350**, a CPU **2310**, a communication unit **2360**, and a storage unit **2370**, as illustrated in FIG. **29**.

[0298] The storage unit **2370** is made up of semiconductor memory or the like, for example. The storage unit **2370** includes, for example, ROM, RAM, EEPROM, and so forth. The ROM of the storage unit **2370** stores a control program according to the fifth embodiment to operate the CPU **2310**. The storage unit **2370** records information such as audio data, image data, blood pressure measurement values, and so forth. Although the storage unit **2370** is built into the determining device **2300** in the fifth embodiment, this is not restrictive. The storage unit **2370** may be memory in a server connected to a network, for example.

[0299] The CPU **2310** operates in accordance with the control program according to the fifth embodiment stored in the storage unit **2370**, to function as a facial position determining unit **2311**, a posture determining unit **2312**, and a reliability determining unit **2314**.

[0300] The determining device **2300** is held by both hands of the user **2000** who has the blood pressure meter **2200** worn on the upper arm, such that the camera **2320** takes images of the face of the user **2000**, as illustrated in FIG. **30**. A smartphone is used as an example of the determining device **2300** in the fifth embodiment. A tablet computer may be used as the determining device **2300** as well.

[0301] Next, the configurations of the determining device **2300** will be described. The camera **2320**, angle sensor **2340**, and communication unit **2360** respectively have the same functions as the camera **2120**, angle sensor **2140**, and communication unit **2160** in the fourth embodiment illustrated in FIG. **20**.

[0302] The display unit **2350** is controlled by the CPU **2310** to display a message instructing the user **2000** to

assume an appropriate posture, reliability of measurement values, and so forth. Specific examples of screens displayed on the display unit **2350** will be described later. The display unit **2350** according to the fifth embodiment is a touchscreen display, where, when the user **2000** touches the display unit **2350**, the touched position is detected and notified to the CPU **2310**.

[0303] The facial position determining unit **2311** has the same functions as the facial position determining unit **2111** according to the fourth embodiment illustrated in FIG. **20**. The posture determining unit **2312** determines the height where the cuff **2220** is situated from the second information obtained from the facial position determining unit **2311** and the first information obtained from the angle sensor **2340**. Specifically, in a case where the angle indicated by the first information is within the first range, the position of the face of the user **2000** in the image data indicated by the second information is within the second range, and the proportion of the size of the face of the user **2000** in the image data indicated by the second information is within the third range, the posture determining unit **2312** determines that the cuff **2220** and the heart of the user **2000** are at the same height. The posture determining unit **2312** outputs information to the effect that determination has been made that the cuff **2220** and the heart of the user **2000** are at the same height, to the display unit **2350** for example.

[0304] The posture determining unit **2312** may determine that the angle indicated in the first information is within the predetermined first range if the difference between the angle of inclination of the normal to the surface of the display unit **2350** of the determining device **2300** as to the gravitational direction, decided beforehand so that the position of the cuff **2220** of the blood pressure meter **2200** will be at the same height as the heart of the user **2000**, and the first information obtained by the angle sensor **2340** is at or below a threshold value decided beforehand. The storage unit **2370** may store beforehand the above-described angle of inclination of the normal to the surface of the display unit **2350** of the determining device **2300** as to the gravitational direction, decided beforehand so that the position of the cuff **2220** of the blood pressure meter **2200** will be at the same height as the heart of the user **2000**.

[0305] When starting measurement of blood pressure, the posture determining unit **2312** displays a frame **2351** of a size decided beforehand at a position on the display unit **2350** decided beforehand, displays icons **2353**A and **2353**B at positions decided beforehand at the left edge and right edge of the display unit **2350**, and also displays a message to the user **2000** below the frame **2351**, such as "please match face to frame, and touch both sides to start measurement", as illustrated in FIG. **31**.

[0306] The posture determining unit **2312** may determine that when a facial image **2352** of the user **2000** taken by the camera **2320** is situated within the frame **2351**, and the icons **2353**A and **2353**B are each touched, the position of the face of the user **2000** within the image data indicated in the second information is within the predetermined second range, and the proportion of the size of the face of the user **2000** in the image data indicated by the second information is in the predetermined third range.

[0307] The size of the facial image **2352** (FIG. **31**) of the user **2000** taken by the camera **2320** and displayed on the display unit **2350** is dependent on the distance between the camera **2320** (i.e., the determining device **2300**), and the face of the user **2000**. Accordingly, the sideways length of the frame **2351** can be decided beforehand taking into consideration a general length of the arms and size of the face of the user **2000**.

[0308] The height position of the facial image **2352** of the user **2000** displayed on the display unit **2350** is dependent on the angle of the user **2000** holding the determining device **2300**, and the height of the determining device **2300**. Accordingly, the length and position of the frame **2351** in the vertical direction, and the angle of the normal to the surface of the display unit **2350** of the determining device **2300** as to the gravitational direction described above, can be decided beforehand so that the height of the upper arm of the user **2000** holding the determining device **2300** matches the height of the heart of the user **2000**.

[0309] FIG. **32** is a flowchart schematically illustrating operations of the determining device **2300** when measuring blood pressure according to the fifth embodiment. FIGS. **33** through **35** are diagrams schematically illustrating examples of screens displayed on the determining device **2300** when measuring blood pressure. The operations of the determining device **2300** will be described with reference to FIGS. **31** through **35**.

[0310] First, the user **2000** wears the cuff **2220** of the blood pressure meter **2200** on the upper arm. The user **2000** holds the determining device **2300** in both hands, and directs the camera **2320** toward the face of the user **2000**.

[0311] In step S**2200**, the posture determining unit **2312** prompts the user **2000** to assume a correct posture through the display unit **2350**. In this fifth embodiment, the posture determining unit **2312** displays the frame **2351** and the facial image **2352** taken by the camera **2320** on the display unit **2350**, as illustrated in FIG. **31**. The posture determining unit **2312** also displays the first icon **2353**A near the left edge of the display unit **2350**, displays the second icon **2353**B near the right edge of the display unit **2350**, and further displays a message "please match face to frame, and touch both sides to start measurement" below the frame **2351**, thereby instructing the user **2000** to touch both the first icon **2353**A and second icon **2353**B.

[0312] In step S**2201**, the facial position determining unit **2311** obtains an image including the face of the user **2000**, taken by the camera **2320**. In step S**2202**, the facial position determining unit **2311** obtains the second information indicating the position of the face within the image and the proportion of the size of the face within the image from the obtained image, and hands the second information to the posture determining unit **2312**. This position of the face is the center position of the region of the face of the user **2000** in the image data taken by the camera **2320**, for example. The proportion of the size of the face is, for example, information indicating the proportion of the area of the face of the user **2000** in the image data taken by the camera **2320**.

[0313] In step S**2203**, the posture determining unit **2312** obtains first information indicating the angle of the normal to the surface of the display unit **2350** of the determining device **2300** as to the gravitational direction, from the angle sensor **2340**. In step S**2204**, the posture determining unit **2312** obtains contact information regarding contact to the first icon **2353**A and second icon **2353**B displayed on the display unit **2350**, from the display unit **2350**.

[0314] Based on the contact information that has been obtained, in step S**2205** the posture determining unit **2312** determines whether or not the user **2000** is in contact with

both of the first icon **2353**A and second icon **2353**B. In a case where the user **2000** is in contact with both icons (YES in step S**2205**), the posture determining unit **2312** judges that the positions of the hands of the user **2000** are fixed, and the flow advances to step S**2206**. On the other hand, in a case where the user **2000** is not in contact with both icons (NO in step S**2205**), the flow returns to step S**2200**, and the posture determining unit **2312** instructs the user **2000** to touch both of the first icon **2353**A and second icon **2353**B, as illustrated in FIG. **31**, for example.

[0315] In step S**2206**, the posture determining unit **2312** determines whether the angle indicated by the first information, the position of the face of the user **2000** within the image data, and the proportion of the size of the face of the user **2000** in the image data, indicated by the second information, are each within the predetermined ranges. In a case where the angle indicated by the first information is within the first range, the position of the face of the user **2000** in the image data indicated by the second information is within the second range, and the proportion of the size of the face of the user **2000** in the image data indicated by the second information is within the third range (YES in step S**2206**), the posture determining unit **2312** determines that the height of the cuff **2220** and the height of the heart of the user **2000** agree, and notifies the reliability determining unit **2314** to the effect that the user **2000** is using the blood pressure meter **2200** in a correct posture.

[0316] In step S**2207**, the facial position determining unit **2311** uses the image obtained in step S**2201** to authenticate the face of the user **2000**. The storage unit **2370** stores features of the facial image of the user **2000** beforehand. The facial position determining unit **2311** extracts features of the facial image of the user **2000** from the image obtained in step S**2201**. The facial position determining unit **2311** compares the extracted features and the features of the facial image of the user **2000** saved in the storage unit **2370** beforehand, and determines whether matching or not. By performing this personal authentication in step S**2207**, the person currently using the blood pressure meter **2200** can be identified, thereby preventing blood pressure measurement by another person.

[0317] In a case where personal authentication cannot be performed in step S**2207**, the blood pressure measurement may be terminated. Also, in a case where determination is made by the posture determining unit **2312** that the user **2000** is at the correct posture (YES in step S**2206**), the flow may directly advance to step S**2208**.

[0318] In step S**2208**, the posture determining unit **2312** transmits a command to the blood pressure meter **2200** to start measurement, via the communication unit **2360**.

[0319] In step S**2209**, the facial position determining unit **2311** obtains an image including the face of the user **2000** taken by the camera **2320**, obtains the second information, and notifies the obtained second information to the reliability determining unit **2314**. In step S**2210**, the posture determining unit **2312** obtains the first information from the angle sensor **2340**, and notifies the obtained first information to the reliability determining unit **2314**. In step S**2211**, the posture determining unit **2312** obtains contact information regarding the first icon **2353**A and second icon **2353**B displayed on the display unit **2350**, from the display unit **2350**.

[0320] Thus, in the fifth embodiment, the first information and second information are obtained by the angle sensor **2340** and camera **2320** even while measuring blood pressure, contact information regarding the first icon **2353**A and second icon **2353**B is obtained from the display unit **2350**, and the reliability determining unit **2314** is notified of the obtained information. During measurement of blood pressure, the posture determining unit **2312** may display a message such as "currently measuring, please do not move" on the display unit **2350** as illustrated in FIG. **33**, thereby instructing the user **2000** to maintain the correct posture and not move.

[0321] When a predetermined amount of time has elapsed after starting of blood pressure measurement (step S**2208**), the determining device **2300** judges that blood pressure measurement has ended. Alternatively, the determining device **2300** may judge that blood pressure measurement has ended when receiving notification from the blood pressure meter **2200** via the communication unit **2360** to the effect that the blood pressure measurement has ended. Thereafter, the determining device **2300** obtains the measured blood pressure measurement values from the blood pressure meter **2200** via the communication unit **2360** in step S**2212**.

[0322] After end of the blood pressure measurement, in steps S**2213** and S**2214** the reliability determining unit **2314** determines the reliability of the measurement results, using the image data, angle data, and contact information, obtained respectively in steps S**2209**, S**2210**, and S**2211**, using the same procedures as in step S**2205** and S**2206**.

[0323] Note that a microphone and an audio determining unit may be provided in the same way as in the fourth embodiment, to perform determination by audio. This can further improve reliability.

[0324] In a case where determination is made at the reliability determining unit **2314** that the reliability of the measurement results is low (NO in step S**2213** or NO in step S**2214**), measurement is performed again by the communication unit **2360** communicating with the blood pressure meter **2200** in the example illustrated in FIG. **32**, but this is not restrictive. For example, one of

[0325] (F1) discarding the measurement results as being invalid,

[0326] (F2) lowering the weighting of the measurement results when being used in analyzing, such as evaluation of health or the like, and

[0327] (F3) displaying a screen such as illustrated in FIG. **34** on the display unit **2350** and notifying the user **2000** that measurement has failed and prompting measurement again,

may be carried out. The measurement results of the reliability determining unit **2314** may be quantified, and the measurement results may be handled differently depending on numerical values of reliability.

[0328] In a case where judgment is not made that reliability is low (YES in step S**2213** and YES in step S**2214**), in step S**2215** the reliability determining unit **2314** displays a screen such as illustrated in FIG. **35** on the display unit **2350**, to the effect that measurement has been successful. The reliability determining unit **2314** also displays the measurement values received from the blood pressure meter **2200**.

[0329] According to the fifth embodiment, in addition to the advantages of the fourth embodiment described above, the positions of both hands of the user **2000** are fixed by using contact information of contact with the first icon **2353**A and second icon **2353**B displayed on the display unit **2350**, thereby enabling accurate posture determination.

Sixth Embodiment

[0330] A technique for identifying a measurement subject with a determining device that determines a measurement state when measuring blood pressure using a blood pressure meter, will be described in a sixth embodiment. The technique for identifying a measurement subject according to the sixth embodiment is different from step **S2105** in FIG. **24** and step **S2207** in FIG. **32**.

[0331] FIG. **36** is a block diagram schematically illustrating a configuration example of a determining device according to the sixth embodiment. The measurement state at the time of the user measuring blood pressure using the blood pressure meter in the sixth embodiment is the same as in the fourth embodiment illustrated in FIG. **22**. The screen displayed on the display unit of the determining device before start measuring blood pressure in the sixth embodiment is the same as with the fourth embodiment illustrated in FIG. **23**.

[0332] The blood pressure meter used in the sixth embodiment has the same configuration as with the fourth embodiment illustrated in FIG. **21**. Note however, the blood pressure meter **2200** used in the sixth embodiment (FIG. **21**) measures pulse, in addition to blood pressure as with a normal blood pressure meter. The control unit **2210** of the blood pressure meter **2200** transmits the results of measuring pulse to a determining device **2500** via the communication unit **2230**, in addition to the measurement results of blood pressure.

[0333] The determining device **2500** according to the sixth embodiment has a CPU **2510**, a camera **2520**, a microphone **2530**, an angle sensor **2540**, a display unit **2550**, a communication unit **2560**, and a storage unit **2570**, as illustrated in FIG. **36**.

[0334] The storage unit **2570** is made up of semiconductor memory or the like, for example. The storage unit **2570** includes, for example, ROM, RAM, EEPROM, and so forth. The ROM of the storage unit **2570** stores a control program according to the sixth embodiment to operate the CPU **2510**. The storage unit **2570** records information such as audio data, image data, blood pressure measurement values, and so forth. Although the storage unit **2570** is built into the determining device **2500** in the sixth embodiment, this is not restrictive. The storage unit **2570** may be memory in a server connected to a network, for example.

[0335] The CPU **2510** operates in accordance with the control program according to the sixth embodiment stored in the storage unit **2570**, to function as a facial position determining unit **2511**, a posture determining unit **2512**, an audio determining unit **2513**, a reliability determining unit **2514**, and a pulse measurement unit **2515**.

[0336] In FIG. **36**, the camera **2520**, microphone **2530**, angle sensor **2540**, display unit **2550**, and communication unit **2560** respectively function the same as the camera **2120**, microphone **2130**, angle sensor **2140**, display unit **2150**, and communication unit **2160** of the fourth embodiment illustrated in FIG. **20**. The facial position determining unit **2511**, posture determining unit **2512**, and audio determining unit **2513** respectively function the same as the facial position determining unit **2111**, posture determining unit **2112**, and audio determining unit **2113** of the fourth embodiment illustrated in FIG. **20**.

[0337] The pulse measurement unit **2515** measures the pulse of the user **2000** by analyzing the coloration information of the body surface from the moving image including the face of the user **2000**, that has been taken by the camera **2520**. The pulse measurement unit **2515** measures the pulse of the user **2000** by the procedures illustrated in FIG. **10**, for example.

[0338] The reliability determining unit **2514** functions the same as the reliability determining unit **2114** according to the fourth embodiment (FIG. **20**). The reliability determining unit **2514** further receives the measurement results of pulse transmitted from the blood pressure meter **2200** (FIG. **3**) via the communication unit **2560**. The reliability determining unit **2514** compares the pulse of the user **2000** measured by the pulse measurement unit **2515** with the pulse transmitted from the blood pressure meter **2200**, and determines whether the intervals of pulse waves between the two match. Upon determining that these match, the reliability determining unit **2514** continues the blood pressure measurement operations described in the fourth embodiment, for example, as normal processing. If determining that these do not match, the reliability determining unit **2514** terminates the blood pressure measurement operations described in the fourth embodiment, for example, as abnormality processing.

[0339] FIG. **37** is a flowchart schematically illustrating the operations of the determining device **2500** identifying the measurement subject, in the sixth embodiment. In step **S2500**, the camera **2520** shoots the user **2000**. The facial position determining unit **2511** obtains the image of the user **2000** shot by the camera **2520**. In step **S2505**, the facial position determining unit **2511** extracts a facial image of the user **2000** from the obtained image. The facial position determining unit **2511** notifies the position of the extracted facial image to the posture determining unit **2512**.

[0340] The posture determining unit **2512** determines whether or not the facial image at the position that has been notified (e.g., facial image **2152** in FIG. **23**) has been detected within a frame (e.g., frame **2151** in FIG. **23**) displayed on the display unit **2550**. If the position of the facial image is within the frame (YES in step **S2505**), the processing advances to step **S2510**. On the other hand, if the position of the facial image is not within the frame (NO in step **S2505**), the processing returns to step **S2500**, and the above-described processing is repeated.

[0341] In step **S2510**, the posture determining unit **2512** instructs the blood pressure meter **2200** to start blood pressure measurement. In step **S2515**, the audio determining unit **2513** determines whether or not the exhaust sound of the cuff **2220** of the blood pressure meter **2200** has been detected from the audio obtained by the microphone **2530**. In a case where the exhaust sound of the cuff **2220** is detected (YES in step **S2515**), the flow advances to step **S2520**. On the other hand, in a case where no exhaust sound of the cuff **2220** is detected (NO in step **S2515**), the flow advances to step **S2535**.

[0342] In step **S2520**, the pulse measurement unit **2515** measures the pulse of the user **2000** by analyzing in time sequence the coloration information of the body surface from the moving image including the face of the user **2000**, taken by the camera **2520** and extracted by the facial position determining unit **2511**. In step **S2520**, the procedures illustrated in FIG. **10**, for example, are executed, and the pulse of the user **2000** is measured. The pulse measurement unit **2515** notifies the measured pulse to the reliability determining unit **2514**.

[0343] In step **S2525**, the reliability determining unit **2514** receives the pulse from the blood pressure meter **2200** via

the communication unit **2560**. In step S**2530**, the reliability determining unit **2514** compares the pulse waves notified from the pulse measurement unit **2515** with the pulse waves of the pulse received from the blood pressure meter **2200**, and determines whether the intervals of the two match. If the intervals between pulse waves of the pulse notified from the pulse measurement unit **2515** and intervals between pulse waves of the pulse received from the blood pressure meter **2200** match (YES in step S**2530**), the flow advances to step S**2540**. If the intervals between pulse waves of the pulse notified from the pulse measurement unit **2515** and intervals between pulse waves of the pulse received from the blood pressure meter **2200** do not match (NO in step S**2530**), the flow advances to step S**2535**.

[0344] In step S**2535**, the reliability determining unit **2514** terminates blood pressure measurement, as abnormality processing. In step S**2540**, the reliability determining unit **2514** continues blood pressure measurement as normal processing. Processing of step S**2106** and thereafter in FIG. **24**, for example, may be performed in step S**2540**.

[0345] As described above, in the sixth embodiment, the pulse measurement unit **2515** measures the pulse of the user **2000** by analyzing, in time sequence, the coloration information of the body surface from the moving image including the face of the user **2000** taken by the camera **2520**, and notifies the measurement results to the reliability determining unit **2514**. The reliability determining unit **2514** also receives pulse measured by the blood pressure meter **2200** via the communication unit **2560**. The reliability determining unit **2514** determines whether or not the intervals of pulse waves of the pulse of the user **2000** and the pulse measured by the blood pressure meter **2200** match. Thus, according to the sixth embodiment, the user **2000** being taken by the camera **2520** and the measurement subject of whose blood pressure is being measured by the blood pressure meter **2200** can be determined to be the same, in a sure manner. Although the determining device **2500** (FIG. **36**) is described as being used in the sixth embodiment, the determining device **2100** (FIG. **20**) according to the fourth embodiment or the determining device **2300** (FIG. **29**) according to the fifth embodiment may be used instead.

Modifications

[0346] FIG. **38** is a block diagram schematically illustrating an example of the configuration of a system having the determining device and a server. The determining device **2100** and a server **2600** are connected to a network **2700**, and are configured to be capable of communication with each other, as illustrated in FIG. **38**. The server **2600** is installed externally, such as at a medical institution, an insurance provider, or the like. Although the determining device **2100** (FIG. **20**) according to the fourth embodiment is illustrated as being connected to the server **2600** in the example in FIG. **38**, the determining device **2300** (FIG. **29**) according to the fifth embodiment or the determining device **2500** (FIG. **36**) according to the sixth embodiment may be connected to the server **2600**.

[0347] In step S**2113** in FIG. **24**, the reliability determining unit **2114** may further notify the blood pressure measurement results and the determination results of the reliability determining unit **2114** to an external device such as the server **2600** or the like, a medical institution, or an insurance provider, via the communication unit **2160**. At this time, whether or not to transmit, and information to be transmitted, may be changed in accordance with the determination results by the reliability determining unit **2114**. In a case where personal authentication has been performed, the reliability determining unit **2114** preferably transmits with personal identification information and measurement results associated.

[0348] Also, in step S**2215** in FIG. **32**, the reliability determining unit **2314** may further transmit the blood pressure measurement results and determination results of the reliability determining unit **2314** to an external device such as the server **2600** or the like, a medical institution, or an insurance provider, via the communication unit **2360**. At this time, whether or not to transmit, and information to be transmitted, may be changed in accordance with the determination results by the reliability determining unit **2314**. In a case where personal authentication has been performed, the reliability determining unit **2314** preferably transmits with personal identification information and measurement results associated.

[0349] The technology realized by the present disclosure, whereby personal authentication information is succeeded among multiple measurement devices by comparing biometric information enables measurement data of measurement devices that do not have personal authentication functions to be collected at a server and saved in a format associated with an individual, which is advantageous in accurately comprehending and estimating the health state of the user. The determining device according to the present disclosure is also advantageous in improvement of reliability of household use blood pressure meters, for example.

What is claimed is:

1. A blood pressure measurement state determination method for determining a blood pressure measurement state, using a determining device that is held in a hand of a user to whom a blood pressure meter is mounted, the method comprising:

obtaining image data including a face of the user by a camera that the determining device has;

obtaining first information indicating an inclination angle of the determining device as to the gravitational direction, by an angle sensor that the determining device has;

obtaining second information indicating a position of the face of the user in the image data, and the proportion of the size of the face of the user in the image data;

determining whether or not the angle indicated in the first information is within a first range;

determining whether or not the position of the face of the user indicated in the second information is within a second range;

determining whether or not the proportion of the size of the face of the user indicated in the second information is within a third range;

determining whether or not the user is correctly using the blood pressure meter;

providing a first notification indicating that the blood pressure meter is being correctly used when it is determined that the user is correctly using the blood pressure meter;

providing a second notification indicating the blood pressure meter is not correctly using when it is determined that the user is not correctly using the blood pressure meter,

wherein in the determination regarding whether or not the user is correctly using the blood pressure meter, determination is made that the user is correctly using the blood pressure meter when the angle indicated in the first information is determined to be within the first range, the position of the face of the user indicated in the second information is determined to be within the second range, and the proportion of the size of the face of the user indicated in the second information is determined to be within the third range.

2. The blood pressure measurement state determination method according to claim **1**, further comprising:

obtaining audio around the determining device; and

determining whether or not the obtained audio and audio emitted by the blood pressure meter, stored in a storage unit beforehand, agree,

wherein, the determining of whether or not the user is correctly using the blood pressure meter further includes determining that the user is using the blood pressure meter correctly if determination is made that the obtained audio and audio emitted by the blood pressure meter stored in the storage unit agree.

3. The blood pressure measurement state determination method according to claim **1**, further comprising:

transmitting a command instructing to start measurement of blood pressure of the user to the blood pressure meter upon determination being made that the user is using the blood pressure meter correctly.

4. The blood pressure measurement state determination method according to claim **3**, further comprising:

determining again whether or not the user is using the blood pressure meter correctly, after a predetermined amount of time has elapsed after transmitting the command.

5. The blood pressure measurement state determination method according to claim **3**, further comprising:

determining again whether or not the user is using the blood pressure meter correctly, upon receiving a notification is received from the blood pressure meter indicating that blood pressure measurement of the user has ended.

6. The blood pressure measurement state determination method according to claim **1**, further comprising:

displaying a first icon indicating the position to hold the determining device with one hand out of the left hand and right hand of the user, and a second icon indicating the position to hold the determining device with other hand out of the left hand and right hand of the user, on a touch panel display unit provided to the determining device,

wherein the determining of whether or not the user is correctly using the blood pressure meter further includes determining that the user is using the blood pressure meter correctly if detecting that the one hand of the user is in contact with the first icon and that the other hand of the user is in contact with the second icon.

7. The blood pressure measurement state determination method according to claim **1**, further comprising:

determining whether or not the image data matches image data of the user of the determining device stored in the storage unit beforehand,

wherein the determining of whether or not the user is correctly using the blood pressure meter further includes determining that the user is using the blood pressure meter correctly if detecting that the image data matches image data of the user of the determining device stored in the storage unit.

8. The blood pressure measurement state determination method according to claim **1**, wherein the first notification and the second notification are provided to a server connected to the determining device.

9. The blood pressure measurement state determination method according to claim **1**, wherein the first notification and the second notification are provided to the user.

10. The blood pressure measurement state determination method according to claim **9**, further comprising:

prompting the user to use the blood pressure meter correctly when it is determined that the user is not correctly using the blood pressure meter.

11. A blood pressure measurement state determining device for determining a blood pressure measurement state device that is held in a hand of a user to whom a blood pressure meter is mounted, the determining device comprising:

a camera that obtains image data including a face of the user;

an angle sensor that obtains first information indicating an inclination angle of the determining device as to the gravitational direction;

a processor; and

and a display,

wherein the processor

obtains second information indicating a position of the face of the user in the image data, and the proportion of the size of the face of the user in the image data,

determines whether or not the angle indicated in the first information is within a first range, determines whether or not the position of the face of the user indicated in the second information is within a second range, and determines whether or not the proportion of the size of the face of the user indicated in the second information is within a third range, and

determines that the user is correctly using the blood pressure meter if determination is made that the angle indicated in the first information is within a first range, determination is made that the position of the face of the user indicated in the second information is within a second range, and determination is made that the proportion of the size of the face of the user indicated in the second information is within a third range,

and wherein the display

displays a notification indicating to the user that the blood pressure meter is being correctly used upon determination being made that the user is correctly using the blood pressure meter, and

displays a notification prompting the user to use the blood pressure meter correctly upon determination being made that the user is not correctly using the blood pressure meter.

12. A non-transitory computer-readable recording medium storing a program for determining a blood pressure measurement state, using a determining device that determines a blood pressure measurement state and is held in a hand of a user to whom a blood pressure meter is mounted,

the program causing a computer of the determining device to execute

obtaining image data including a face of the user by a camera that the determining device has,

obtaining first information indicating an inclination angle of the determining device as to the gravitational direction, by an angle sensor that the determining device has,

obtaining second information indicating a position of the face of the user in the image data, and the proportion of the size of the face of the user in the image data,

determining whether or not the angle indicated in the first information is within a first range,

determining whether or not the position of the face of the user indicated in the second information is within a second range,

determining whether or not the proportion of the size of the face of the user indicated in the second information is within a third range, determining whether or not the user is correctly using the blood pressure meter,

providing a first notification indicating that the blood pressure meter is being correctly used when it is determined that the user is correctly using the blood pressure meter, and

providing a second notification indicating that the blood pressure meter is not correctly used when it is determined that the user is not correctly using the blood pressure meter,

wherein in the determination regarding whether or not the user is correctly using the blood pressure meter, determination is made that the user is correctly using the blood pressure meter when the angle indicated in the first information is determined to be within the first range, the position of the face of the user indicated in the second information is determined to be within the second range, and the proportion of the size of the face of the user indicated in the second information is determined to be within the third range.

* * * * *

专利名称(译)	血压测量状态确定方法，血压测量状态确定装置和记录介质		
公开(公告)号	US20190076064A1	公开(公告)日	2019-03-14
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申请(专利权)人(译)	PANASONIC知识产权CORPORATION OF AMERICA		
当前申请(专利权)人(译)	PANASONIC知识产权CORPORATION OF AMERICA		
[标]发明人	TAHARA KOHEI IIZUKA SHOICHI MORIMOTO TAKASHI OGAWA TOMOKI MAEDA SHIGENORI AKIMOTO NOBUHIRO		
发明人	TAHARA, KOHEI IIZUKA, SHOICHI MORIMOTO, TAKASHI OGAWA, TOMOKI MAEDA, SHIGENORI AKIMOTO, NOBUHIRO		
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CPC分类号	A61B5/1176 A61B5/7475 A61B5/7435 G06K9/00288 A61B5/022 G10L25/51 G06Q40/08 G06K2009/00328 A61B5/024 A61B5/0402 A61B5/0816 A61B5/1118 A61B2505/07 G06K9/00255 G06K9/00281 G06K9/3208		
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外部链接	Espacenet USPTO		

摘要(译)

一种用于使用安装有血压计的用户的手中握持的装置来确定血压测量状态的方法。该方法包括：通过设备具有的相机获得（i）包括用户的面部的图像数据，（ii）通过设备的角度传感器获得指示确定设备关于重力方向的倾斜角度的第一信息（iii）指示用户在图像数据中的面部位置的第二信息，以及用户在图像数据中的面部大小的比例;基于图像数据，第一信息和第二信息确定用户是否正确使用血压计;并提供指示确定结果的通知。