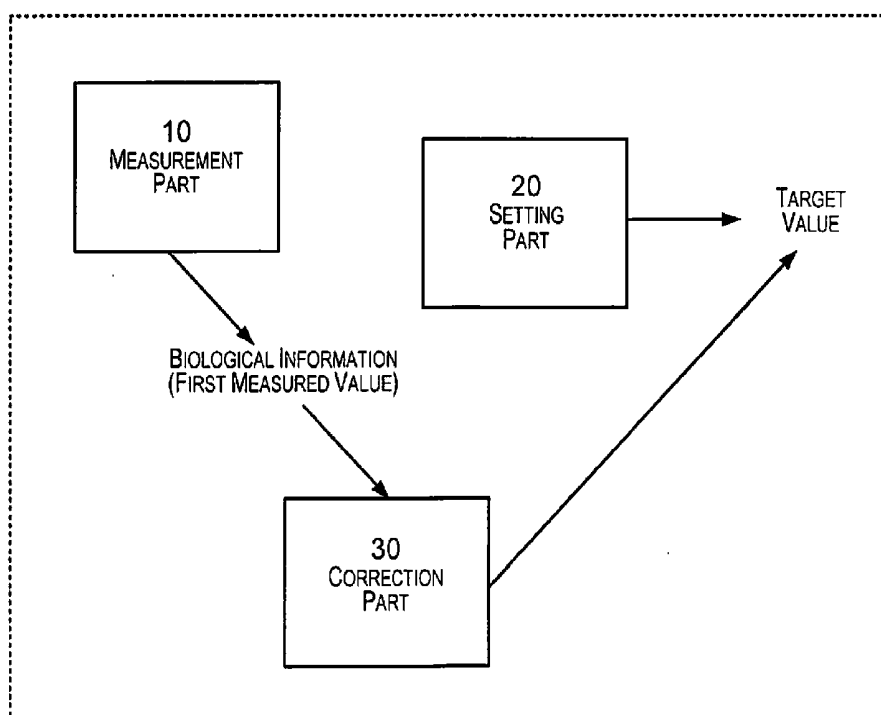


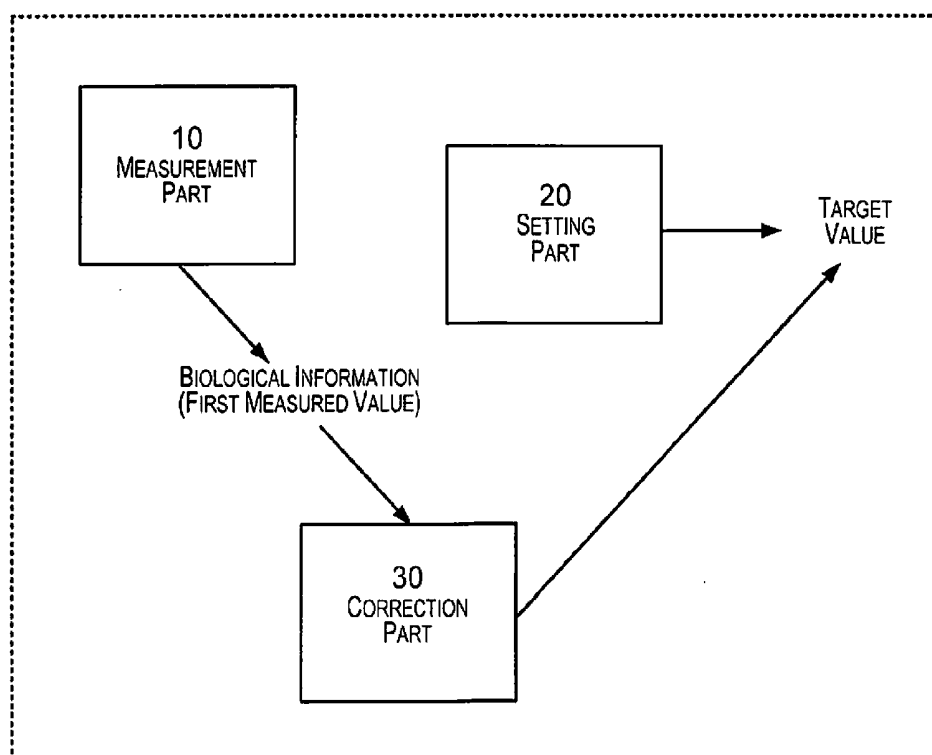


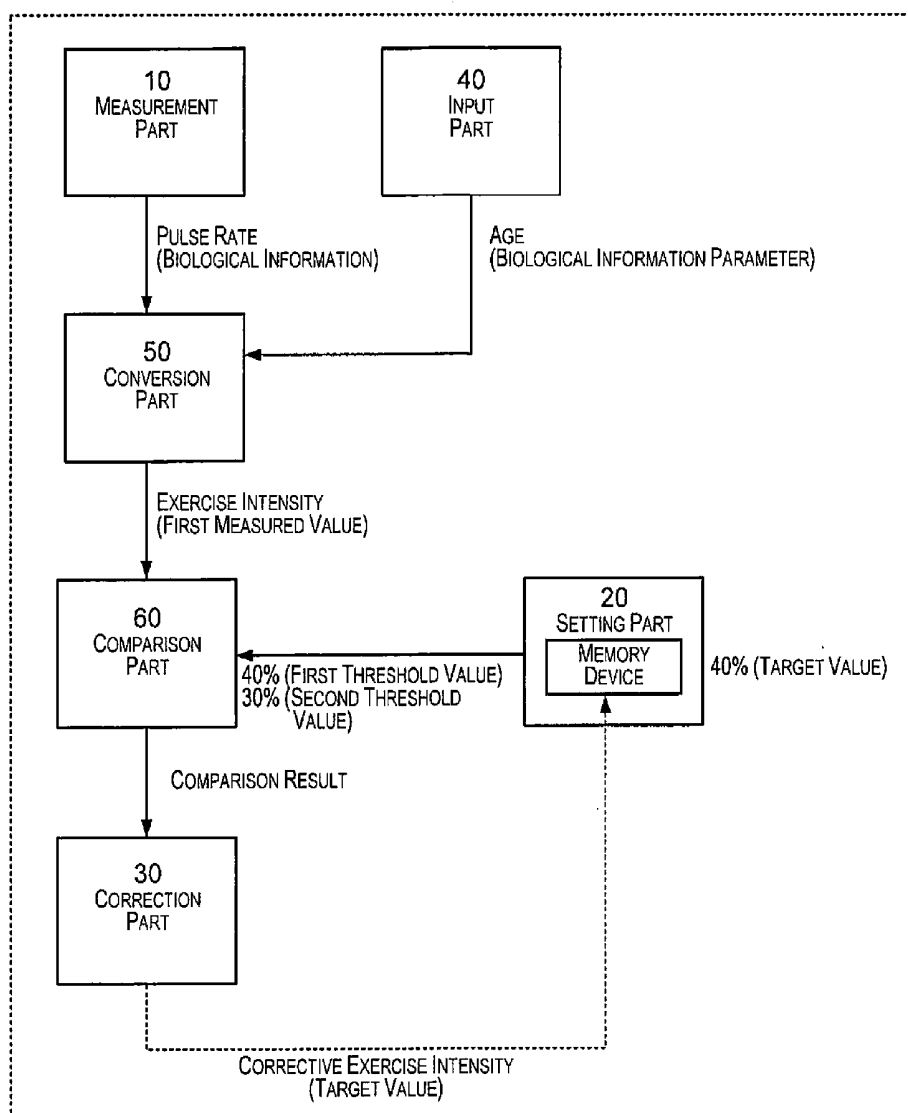
US 20150265160A1

(19) **United States**(12) **Patent Application Publication**
KATO et al.(10) **Pub. No.: US 2015/0265160 A1**(43) **Pub. Date: Sep. 24, 2015**(54) **BIOLOGICAL INFORMATION MEASURING
DEVICE**(52) **U.S. CL.**CPC *A61B 5/024* (2013.01); *A61B 5/1118*
(2013.01); *A61B 5/7405* (2013.01); *A61B*
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Hironori NAKAZAWA, Shiojiri (JP)(57) **ABSTRACT**(21) Appl. No.: **14/729,336**(22) Filed: **Jun. 3, 2015****Related U.S. Application Data**(63) Continuation of application No. 13/013,248, filed on
Jan. 25, 2011.(30) **Foreign Application Priority Data**Feb. 1, 2010 (JP) 2010-020015
Sep. 29, 2010 (JP) 2010-218337**Publication Classification**(51) **Int. Cl.***A61B 5/024* (2006.01)
A61B 5/00 (2006.01)
A61B 5/11 (2006.01)

A biological information measuring device worn by a subject's body including a setting part, a measurement part, a correction part, and a notification part. The setting part stores a preset target range information representing a suitable range for an exercise intensity, the preset target range information being generated based on an age of the subject. The measurement part measures a biological information relating to the exercise intensity. The correction part corrects the preset target range information stored in the setting part based on the biological information measured by the measurement part during a first exercise period to generate a corrected range information. The notification part notifies an information indicative of the exercise intensity with respect to the corrected range information during a second exercise period, which is after the first exercise period, based on the biological information measured by the measurement part during the second exercise period.



**Fig. 1**

**Fig. 2**

AGE (YEARS)	RESTING PULSE (bpm)
0	70
5	70
10	70
15	70
20	70
25	69
30	68
35	67
40	66
45	65
50	64
55	63
60	62
65	61
70	60
75	60
80	60
85	60
90	60
95	60

Fig. 3

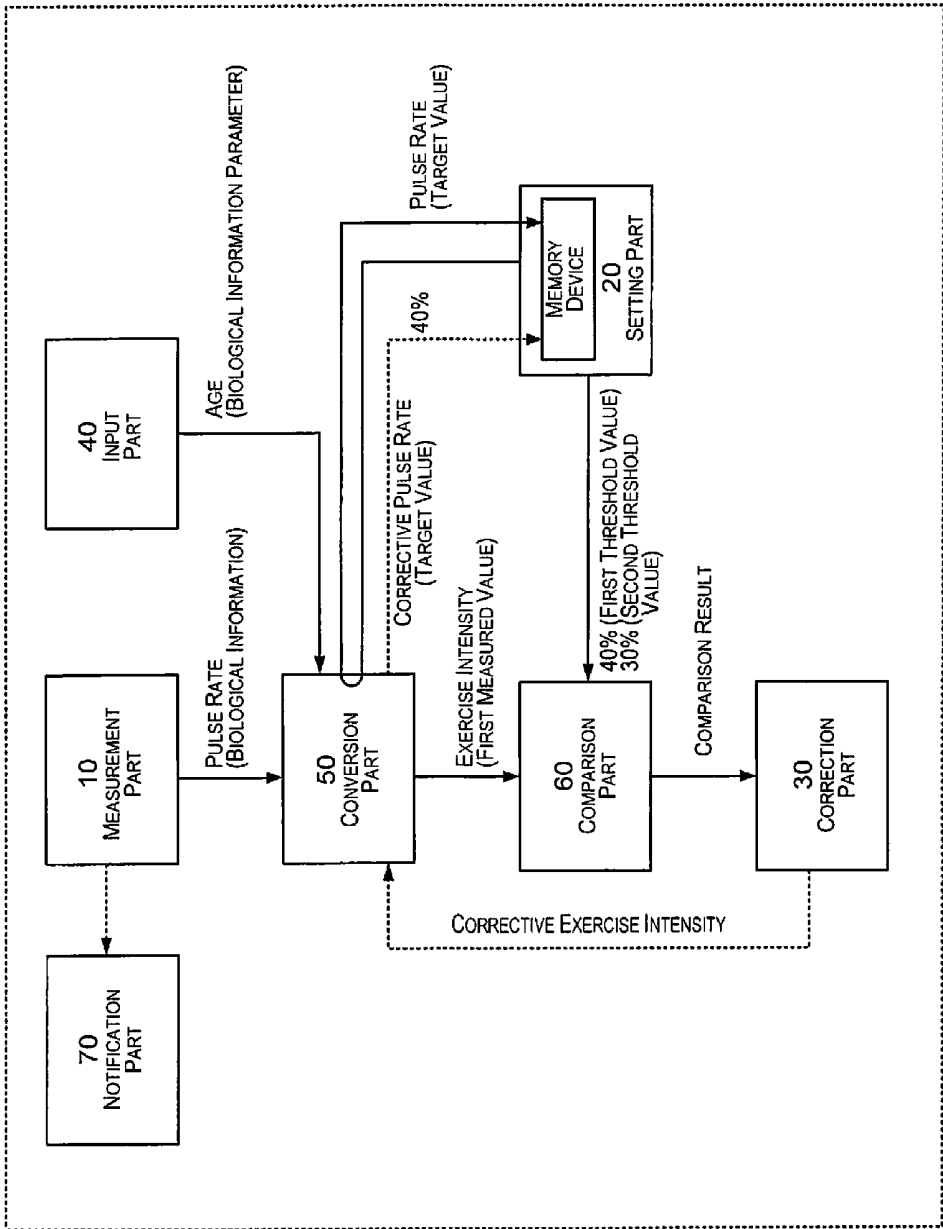


Fig. 4

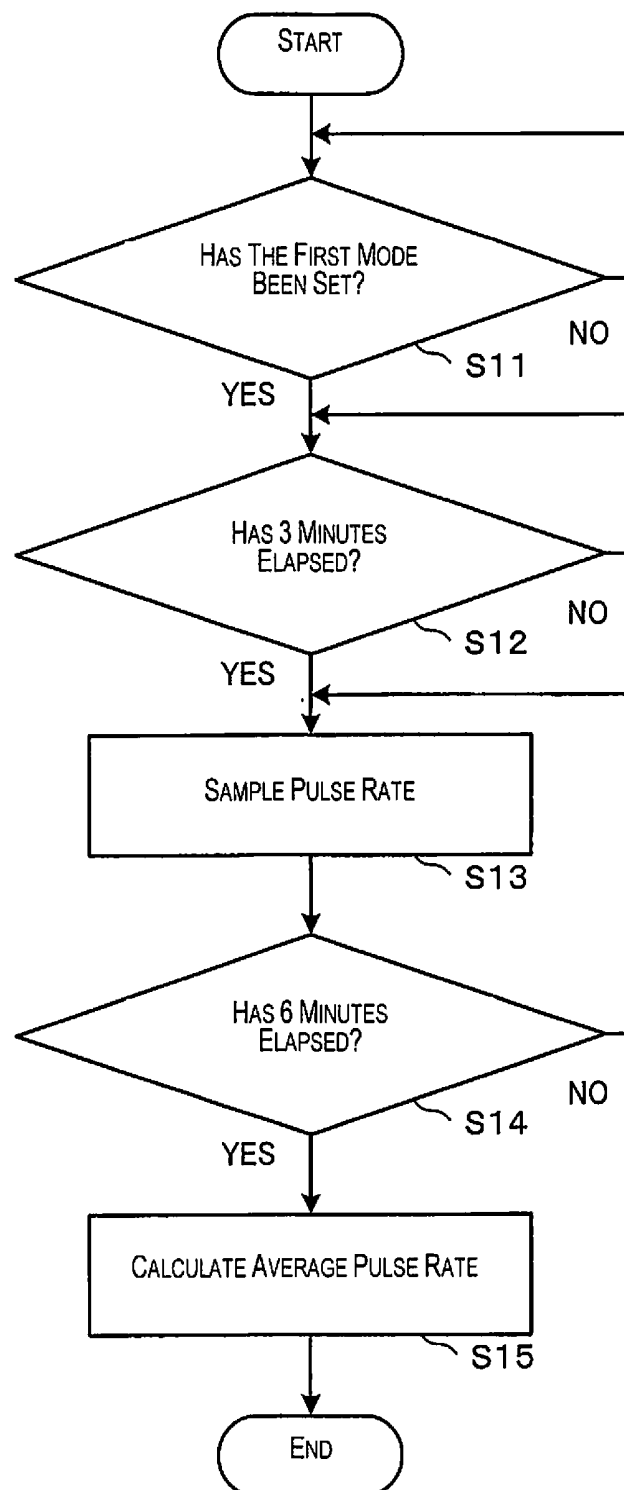
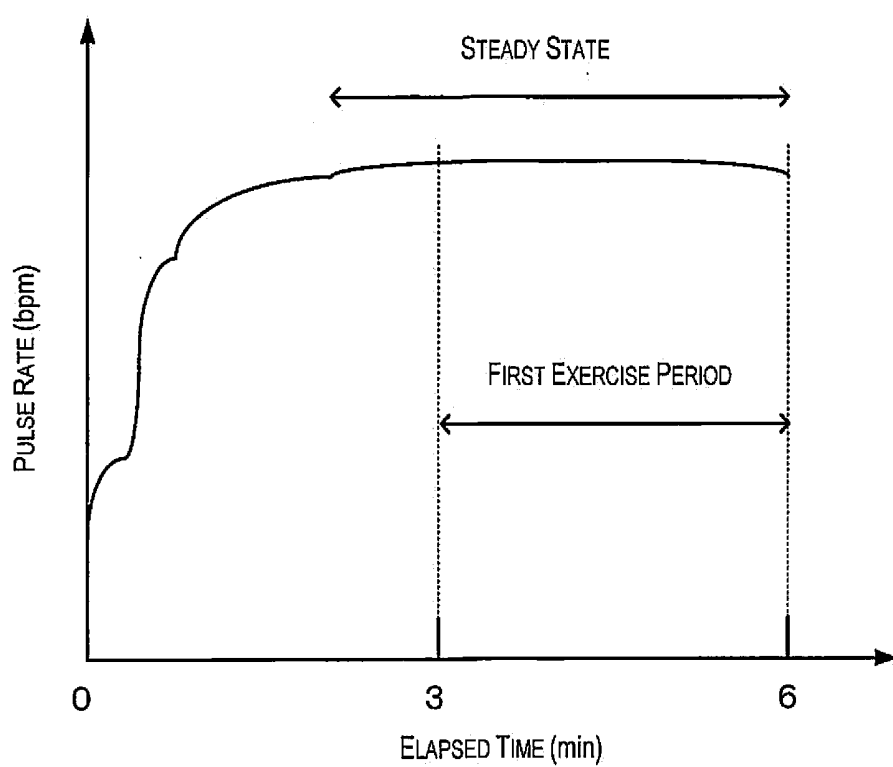
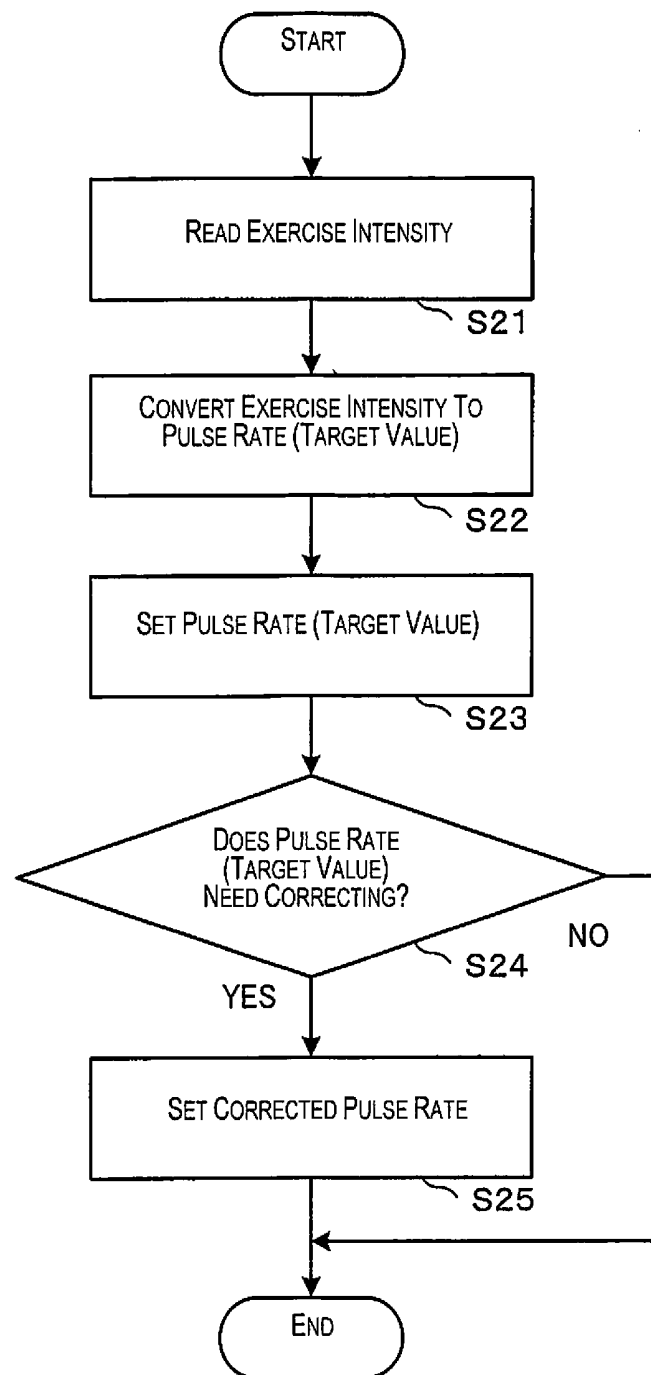


Fig. 5

**Fig. 6**

**Fig. 7**

AGE (YEARS)	PULSE RATE TARGET VALUE (bpm) (EXERCISE INTENSITY = 40%)
25	119
26	119
27	119
28	118
29	118
30	117
31	116
32	116
33	116
34	115
35	114
36	114
37	113
38	113
39	113
40	112
41	111
42	111
43	110
44	110
45	109
46	109
47	108
48	108
49	107
50	106
51	106
52	106
53	105
54	105
55	104
56	103
57	103
58	103
59	102
60	101

Fig. 8

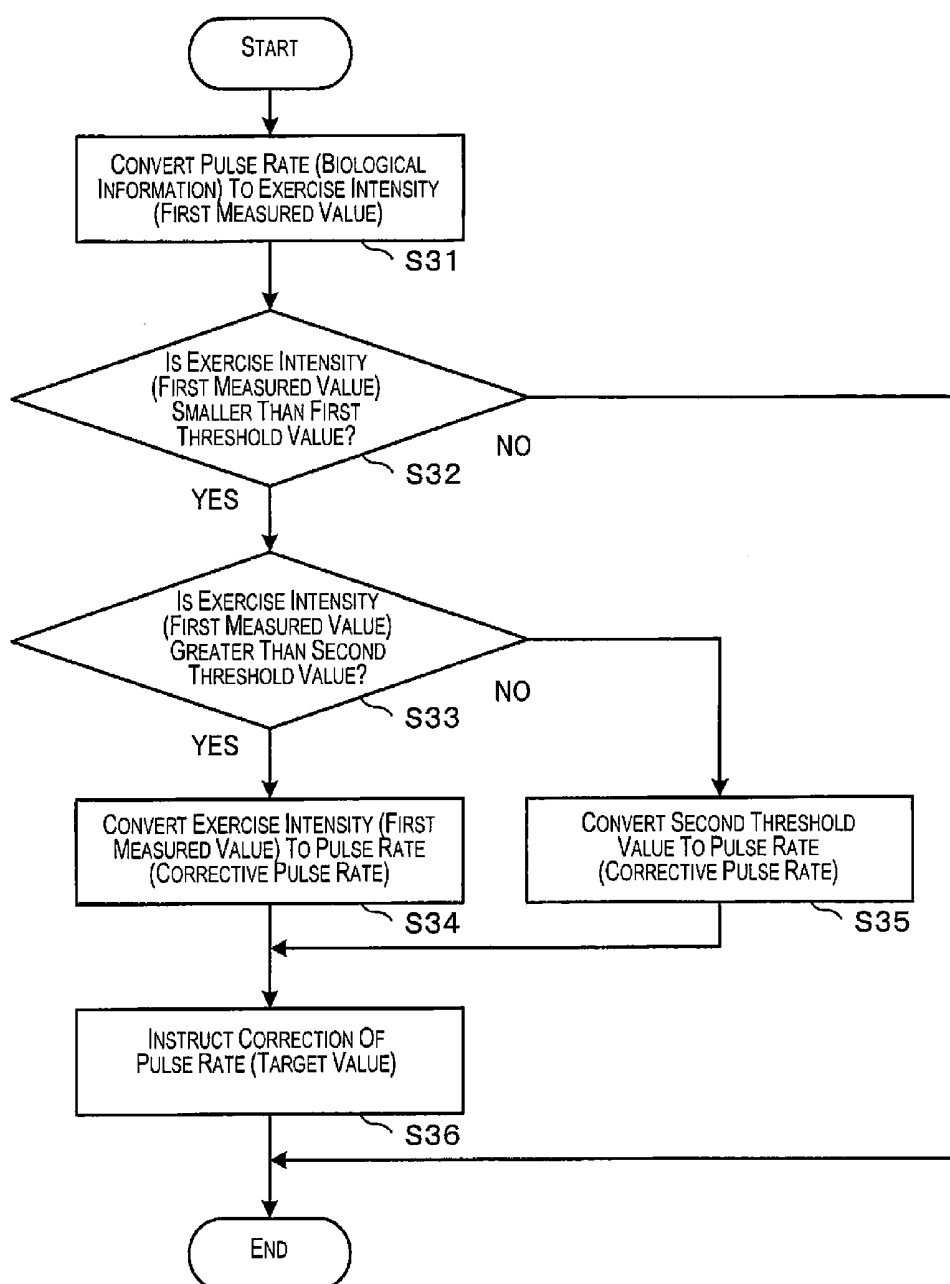


Fig. 9

TEST SUBJECT	FIRST MEASURED VALUE (%)	FIRST THRESHOLD VALUE (%)	SECOND THRESHOLD VALUE (%)	PULSE RATE TARGET VALUE (bpm) (EXERCISE INTENSITY = 40%)	CORRECTIVE PULSE RATE (bpm)
USER A	37	40	30	111	109
USER B	20	40	30	111	100
USER C	21	40	30	114	102
USER D	45	40	30	114	—

Fig. 10

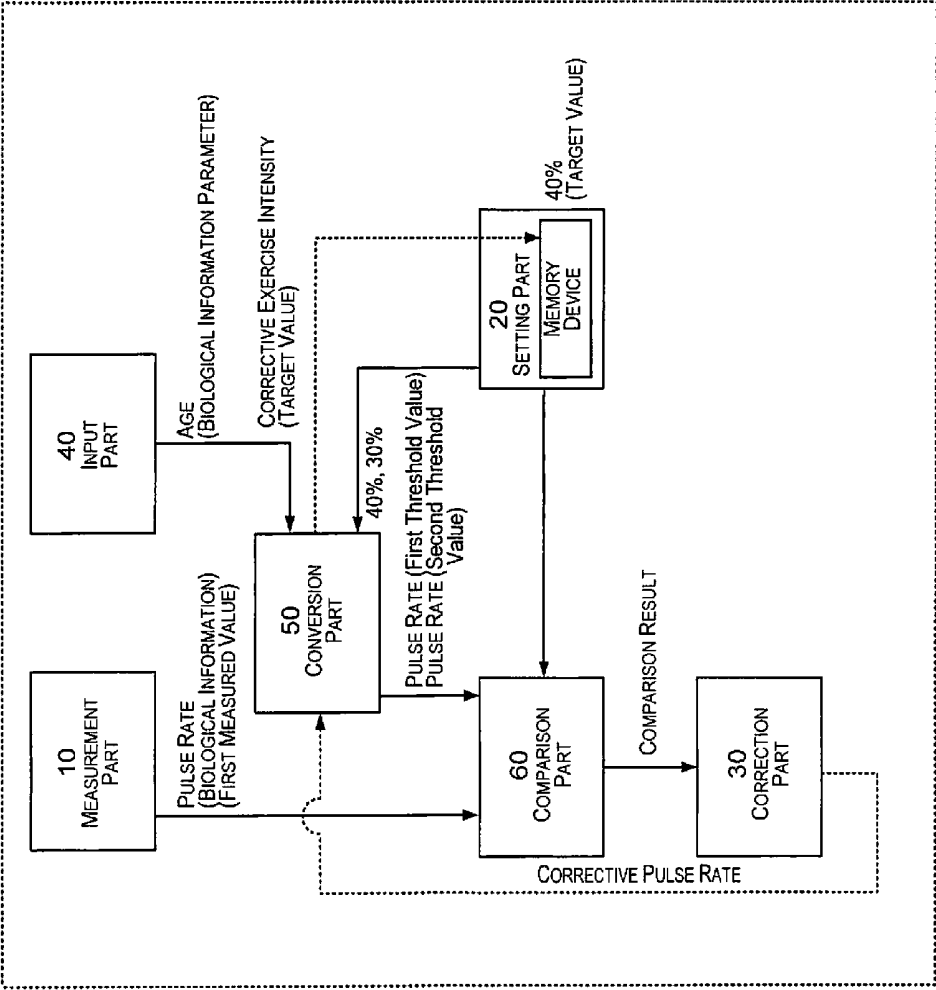


Fig. 11

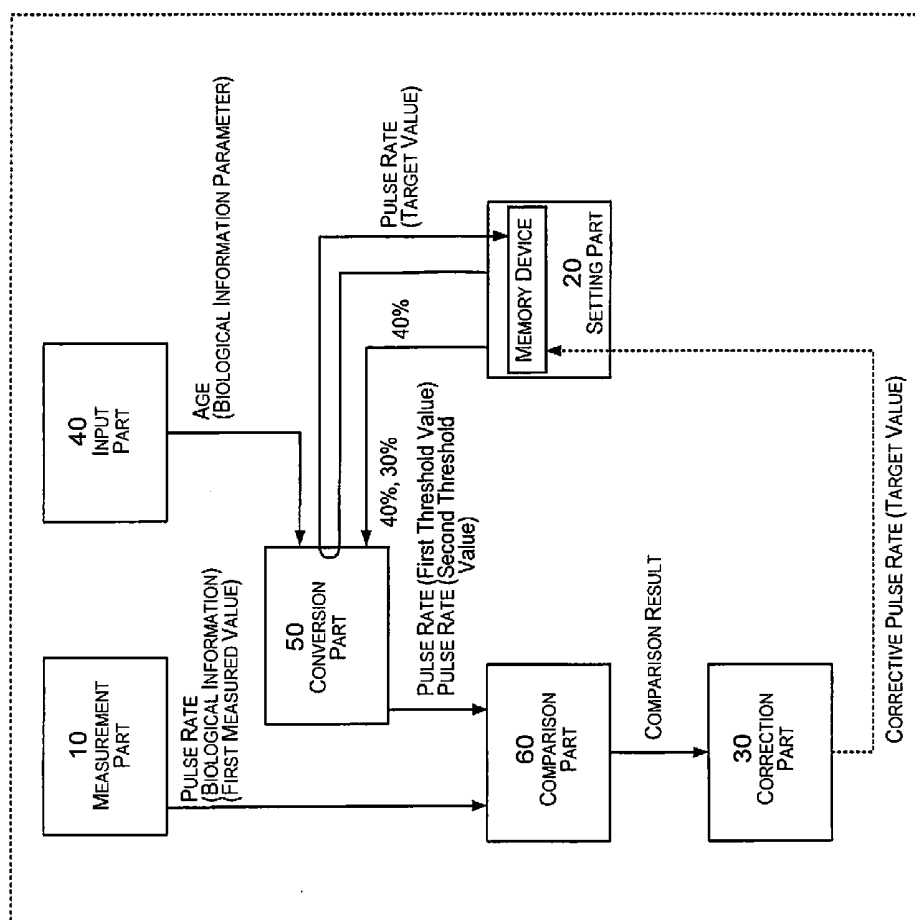


Fig. 12

TEST SUBJECT	FIRST MEASURED VALUE (%)	FIRST THRESHOLD VALUE (%)	SECOND THRESHOLD VALUE (%)	EXERCISES INTENSITY TARGET VALUE (%)	CORRECTIVE EXERCISE INTENSITY (%)
USER A	37	40	30	40	37
USER B	20	40	30	40	30
USER C	21	40	30	40	30
USER D	45	40	30	40	—

Fig. 13A

TEST SUBJECT	FIRST MEASURED VALUE (bmp)	FIRST THRESHOLD VALUE (bmp)	SECOND THRESHOLD VALUE (bmp)	EXERCISES INTENSITY TARGET VALUE (%)	CORRECTIVE EXERCISE INTENSITY (%)
USER A	108	111	100	40	37
USER B	89	111	100	40	30
USER C	92	114	102	40	30
USER D	120	114	102	40	—

Fig. 13B

TEST SUBJECT	FIRST MEASURED VALUE (bmp)	FIRST THRESHOLD VALUE (bmp)	SECOND THRESHOLD VALUE (bmp)	PULSE RATE TARGET VALUE (bmp) (EXERCISE INTENSITY = 40%)	CORRECTIVE PULSE RATE (bmp)
USER A	108	111	100	111	108
USER B	89	111	100	111	100
USER C	92	114	102	114	102
USER D	120	114	102	114	—

Fig. 13C

TEST SUBJECT	FIRST MEASURED VALUE (%)	PULSE RATE TARGET VALUE (bpm) (EXERCISE INTENSITY = 40%)	CORRECTIVE PULSE RATE (bpm) (CORRECTIVE LOWER LIMIT)	PULSE RATE TARGET VALUE (bpm) (EXERCISE INTENSITY = 70%)	PULSE RATE ZONE (bpm)
USER A	37	111	109	145	109~145
USER B	20	111	100	145	100~145
USER C	21	114	102	150	102~150
USER D	45	114	—	150	114~150

Fig. 14

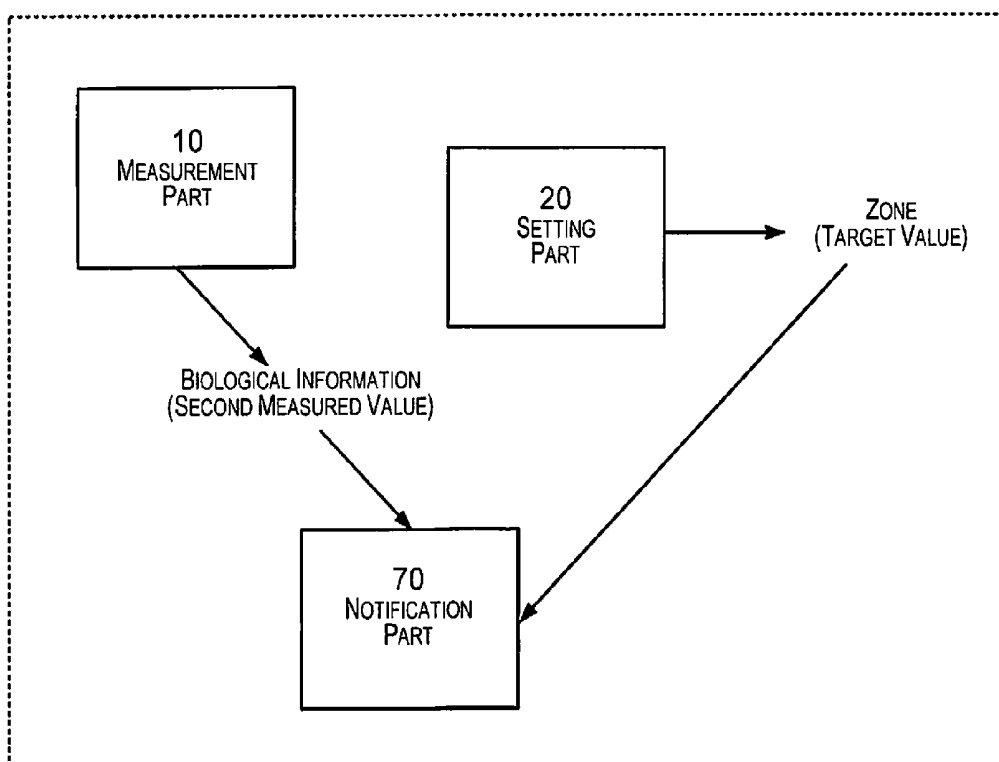
**Fig. 15**

Fig. 16A

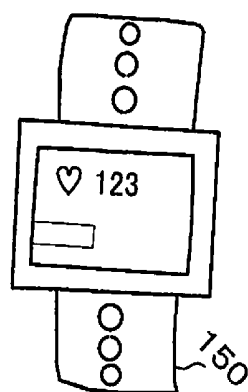


Fig. 16B

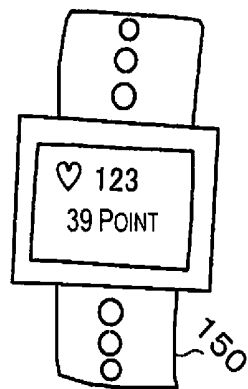


Fig. 17A

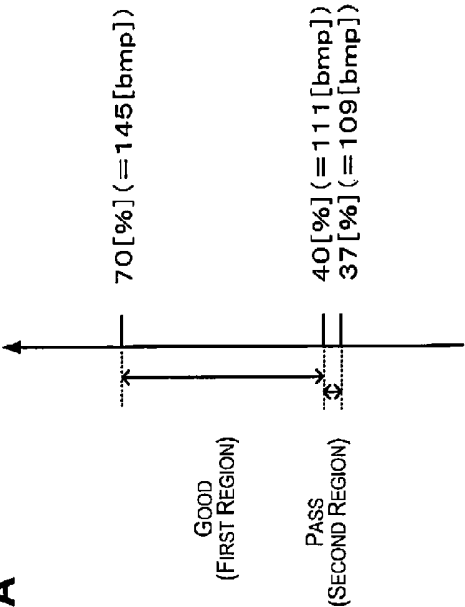


Fig. 17C

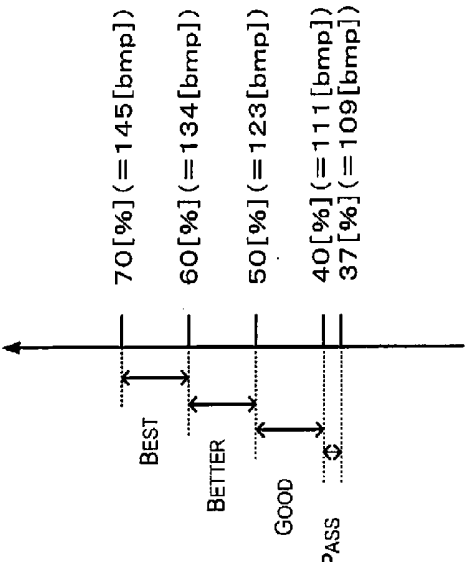


Fig. 17B

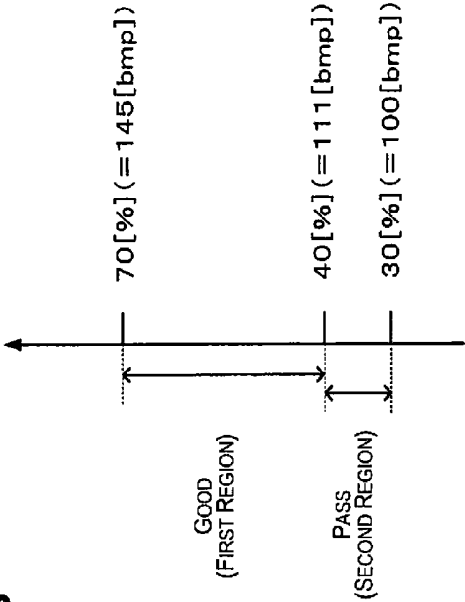


Fig. 17D

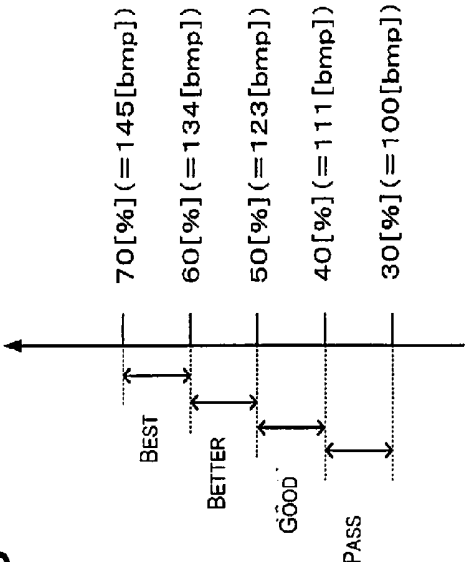


Fig. 18A

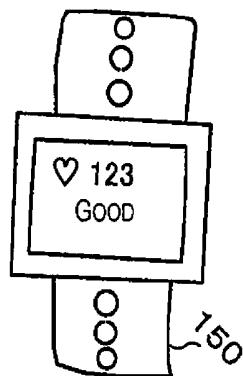


Fig. 18D

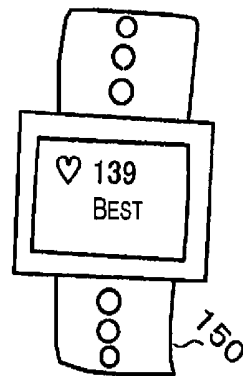


Fig. 18B

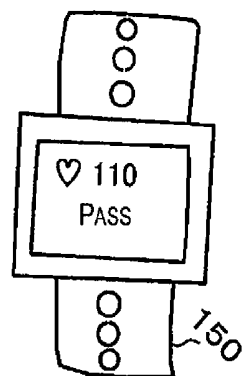


Fig. 18E

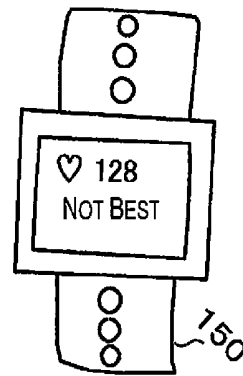


Fig. 18C

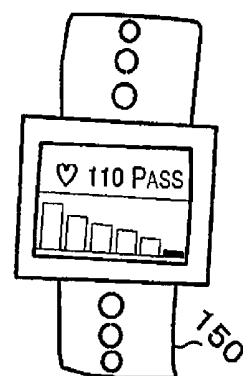


Fig. 18

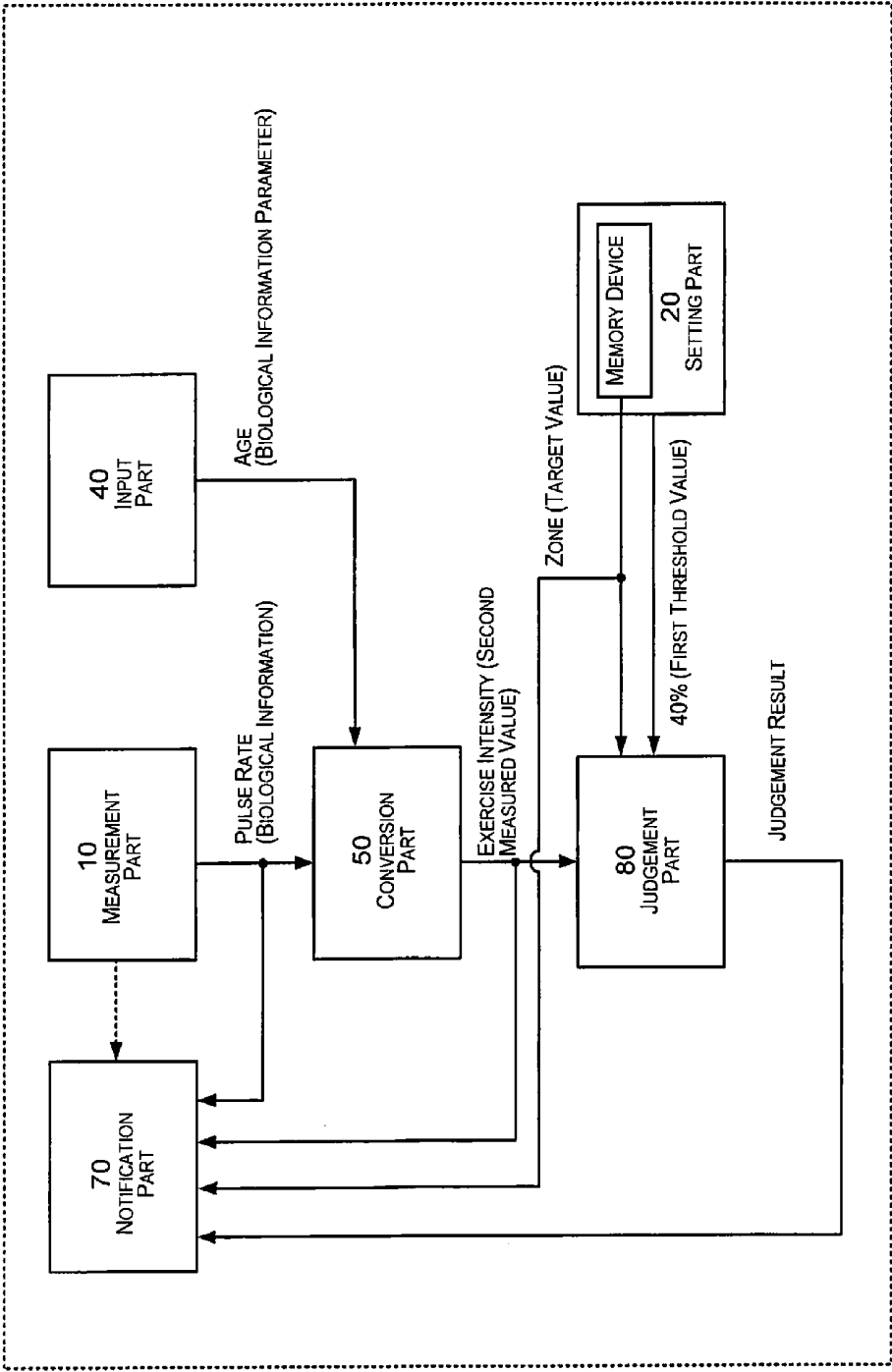


Fig. 19

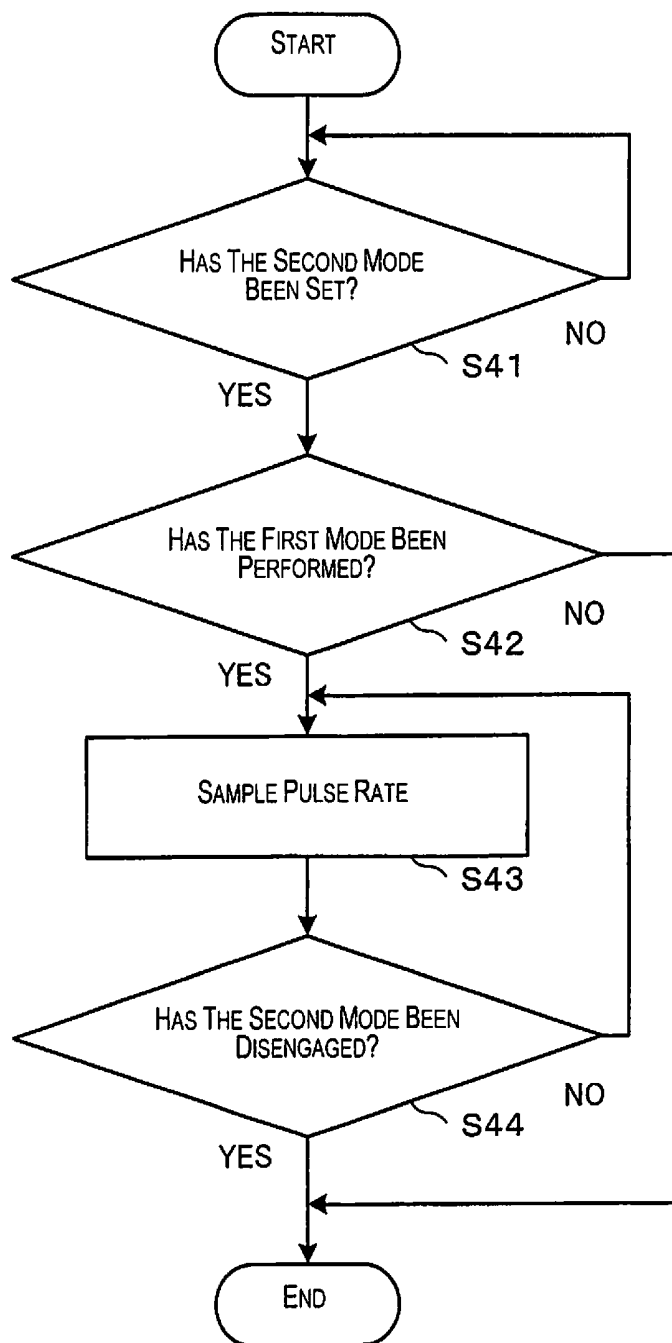


Fig. 20

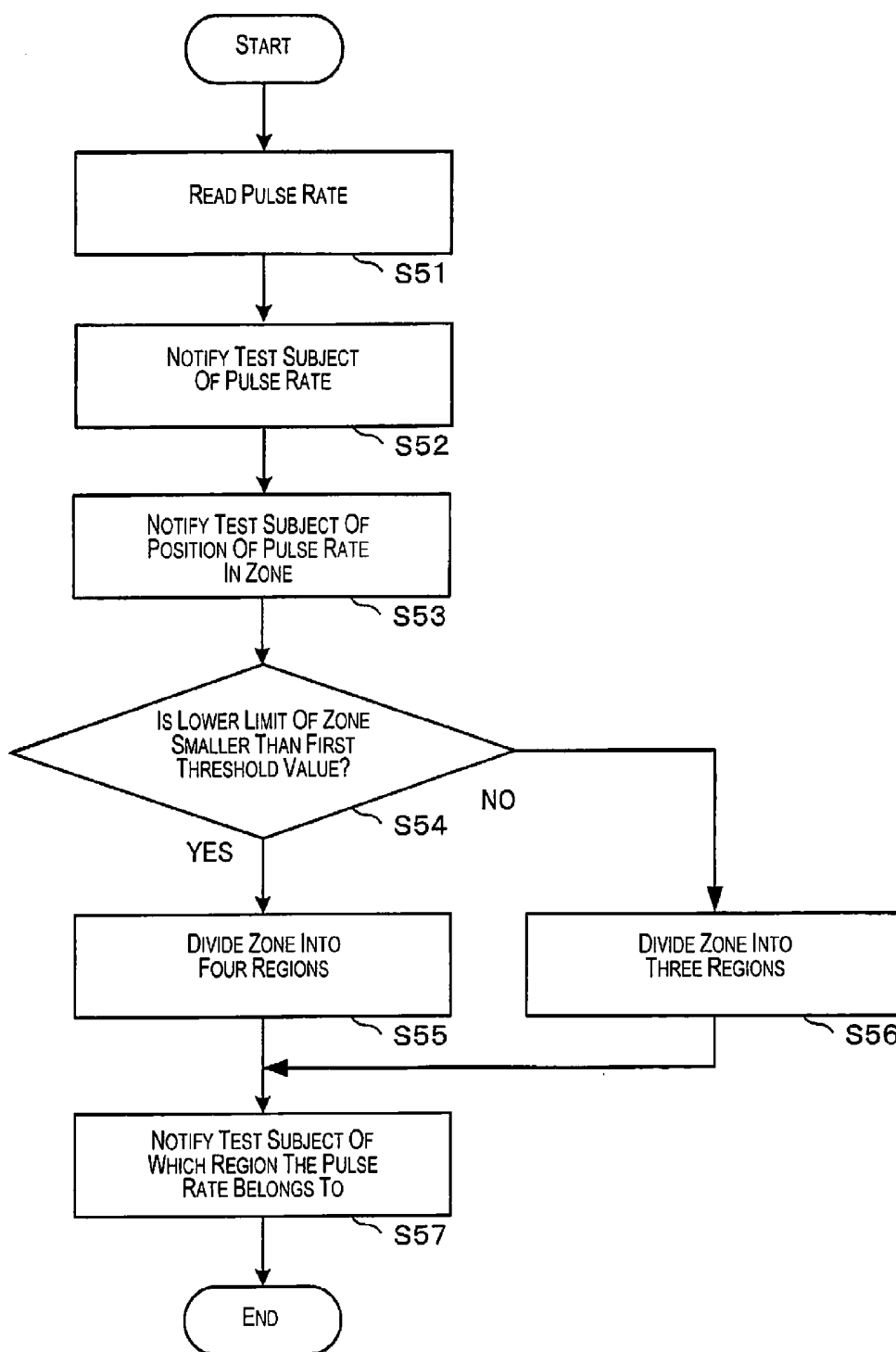


Fig. 21

BIOLOGICAL INFORMATION MEASURING DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation application of U.S. patent application Ser. No. 13/013,248, filed on Jan. 25, 2011. This application claims priority to Japanese Patent Application Nos. 2010-020015, filed on Feb. 1, 2010 and 2010-218337, filed on Sep. 29, 2010. The entire disclosures of U.S. patent application Ser. No. 13/013,248 and Japanese Patent Application Nos. 2010-020015 and 2010-218337 are expressly incorporated by reference herein.

BACKGROUND

[0002] 1. Technological Field

[0003] The present invention relates to a biological information measuring device and similar devices.

[0004] 2. Background Technology

[0005] The intensity of an exercise when, e.g., a person goes for a walk, can be represented by a heart rate (or in a broader sense, biological information). The exercise intensity of such description can be evaluated using an evaluation formula such as the Karvonen method. Since the heart rate normally matches the pulse rate (or in a broader sense, biological information), the pulse rate can be used instead of the heart rate. Specifically, a pulse rate monitor, which is an example of a biological information measuring device that measures the pulse rate, is sometimes called a heart rate monitor. The exercise intensity may also be evaluated according to, e.g., oxygen intake, blood lactate concentration, and other biological information instead of the pulse rate or the heart rate. Specifically, oxygen intake, blood lactate concentration, and other biological information can be used as biological information that can be converted to exercise intensity.

[0006] Japanese Patent No. 3421738 (Patent Citation 1) is an example of the related art.

SUMMARY

Problems to be Solved by the Invention

[0007] In Patent Citation 1, there is disclosed a device that notifies a user (or in a broader sense, a test subject) whether the heart rate (or in a broader sense, the exercise intensity) during exercise is within a suitable range (or in a broader sense, a zone) for the heart rate. Although the heart rate is used in Patent Citation 1, a problem is presented in that there are significant individual differences in the rate of increase in heart rate, the rate of decrease in heart rate, and other actual physical performance. Therefore, even on an assumption of the age (or in a broader sense, a biological information parameter) being identical, it is difficult to set a suitable range for the heart rate using a fixed evaluation formula such as that shown in the Mathematical Formula 1 in Claim 1 of Patent Citation 1. For example, in an instance in which a lower threshold (or in a broader sense, a target value) of the suitable range for the heart rate is set high, it is difficult for the heart rate during exercise to reach the suitable range for the heart rate. A situation of such description hinders motivation for exercise.

[0008] According to several aspects of the invention, it is possible to provide a biological information measuring device capable of providing motivation for exercise.

[0009] A biological information measuring device according to one aspect is worn by a subject's body and includes a setting part, a measurement part, a correction part, and a notification part. The setting part stores a preset target range information representing a suitable range for an exercise intensity, the preset target range information being generated based on an age of the subject. The measurement part measures a biological information relating to the exercise intensity performed by the subject. The correction part corrects the preset target range information stored in the setting part based on the biological information measured by the measurement part during a first exercise period to generate a corrected range information. The notification part notifies an information indicative of the exercise intensity with respect to the corrected range information during a second exercise period, which is after the first exercise period, based on the biological information measured by the measurement part during the second exercise period.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 is an example of a configuration of a biological information measuring device according to a present embodiment;

[0011] FIG. 2 is an example of a specific configuration of the biological information measuring device according to FIG. 1;

[0012] FIG. 3 is an example of a relationship between age and the resting pulse rate;

[0013] FIG. 4 is an example of another specific configuration of the biological information measuring device according to FIG. 1;

[0014] FIG. 5 is a flow chart showing an example of operation of the measurement part in FIG. 2 or 4;

[0015] FIG. 6 is an example of a change in pulse rate during a six-minute walk;

[0016] FIG. 7 is a flow chart showing an example of operation of the setting part in FIG. 4;

[0017] FIG. 8 is an example of pulse rate target value settings according to age;

[0018] FIG. 9 is a flow chart showing an example of operation of the correction part in FIG. 4;

[0019] FIG. 10 is an example of pulse rate target value settings according to the first measured value;

[0020] FIG. 11 is an example of a modification of the specific configuration in FIG. 2;

[0021] FIG. 12 is an example of a modification of the specific configuration in FIG. 4;

[0022] FIGS. 13A, 13B, and 13C are other examples of pulse rate target value settings according to the first measured value;

[0023] FIG. 14 is an example of zone settings according to the first measured value;

[0024] FIG. 15 is another example of the biological information measuring device according to the present embodiment;

[0025] FIGS. 16A and 16B are examples of a notification of a current position within a zone relating to exercise intensity;

[0026] FIGS. 17A, 17B, 17C, and 17D are examples of a division of zones relating to exercise intensity;

[0027] FIGS. 18A, 18B, 18C, 18D, and 18E are examples of a notification of the second measured value;

[0028] FIG. 19 is an example of a specific configuration of the biological information measuring device in FIG. 15;

[0029] FIG. 20 is a flow chart showing an example of operation of the measurement part in FIG. 19; and

[0030] FIG. 21 is a flow chart showing an example of operation of the notification part in FIG. 19.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0031] A description shall now be given for the present embodiment. The present embodiment described below is not intended to unduly limit the scope of the Claims of the present embodiment. Not every configuration described in the present embodiment is necessarily an indispensable constituent feature of the invention.

1. First Mode (First Exercise Period)

1.1 Basic Configuration

[0032] FIG. 1 shows an example of a configuration of the biological information measuring device according to a present embodiment. The example shown in FIG. 1 is an example of configuration corresponding to a first exercise period (or in a broader sense, a first mode), and an example of configurations corresponding to a second exercise period (or in a broader sense, a second mode) that follows the first exercise period will be described further below. As shown in FIG. 1, the biological information measuring device includes a measurement part 10, a setting part 20, and a correction part 30. The measurement part 10 measures biological information. The biological information is, e.g., a pulse rate, and a biological information measuring device including a measurement part 10 for measuring the pulse rate may be called a pulse rate monitor. The measurement part 10 may also measure the heart rate as with e.g., Patent Citation 1, or may measure oxygen intake, blood lactate concentration, or other biological information that can be converted to exercise intensity.

[0033] The setting part 20 sets a target value relating to exercise intensity. A unit for the target value may be the exercise intensity itself, or may be the biological information measured by the measurement part 10 (e.g., the pulse rate). In relation to walking or performing another exercise for lifestyle improvement towards maintaining or improving health, exercise intensity within a range of, e.g., 40% to 70% is known to correspond to aerobic exercise. Therefore, the setting part 20 may set, e.g., 40%, which is a lower limit of a zone in which the exercise intensity ranges from 40% to 70%, as a target value.

[0034] Since the exercise intensity may also be represented by biological information that can be converted to exercise intensity using the Karvonen method or another evaluation formula, the setting part 20 may set a pulse rate (e.g., 111 bpm) corresponding to the lower limit of the zone (e.g., 40%) as the target value. The target value relating to exercise intensity may also apply to exercise other than aerobic exercise, and the target value relating to exercise intensity may be an upper limit of the zone, or may be the zone itself.

[0035] The correction part 30 corrects the target value (e.g., 111 bpm=40%) according to a first measured value relating to exercise intensity determined from biological information during the first exercise period. A unit for the first measured value may be the exercise intensity itself, or may be the biological information measured by the measurement part 10 (e.g., the pulse rate). For example, the pulse rate of a test

subject (e.g., user A), during an exercise period of, e.g., a six-minute walk, is measured. In an instance in which the biological information during the first exercise period is, e.g., 108 bpm, the first measured value is, e.g., 108 bpm. Also, in an instance in which the exercise intensity corresponding to 108 bpm is, e.g., 37%, the first measured value may be, e.g., 37% (=108 bpm). The correction part 30 is capable of taking the actual physical performance of the test subject during the first exercise period (e.g., 108 bpm=37%) into account and correcting the target value (e.g., 111 bpm=40%).

[0036] The user A may, e.g., find it easier to reach a pulse rate of 108 bpm while finding it more difficult to reach an initial target value of 111 bpm. In other words, even in an instance in which the exercise performed by the test subject does not strictly reach the initial target value of 111 bpm, exercise corresponding to a pulse rate of, e.g., 108 bpm can be judged as a “pass” as long as an aim of improving lifestyle towards maintaining or improving health is being met. In such an instance, it is possible to provide the user A with a biological information measuring device (or in a narrower sense, a pulse rate monitor) capable of providing motivation for exercise.

[0037] Specifically, in an instance in which the first measured value (e.g., 108 bpm=37%) is smaller than a first threshold value (e.g., 111 bpm=40%), the correction part 30 may correct the target value (e.g., 111 bpm=40%) to the first measured value (e.g., 108 bpm=37%). The first threshold value is, e.g., the target value; and the unit for the first threshold value may be the exercise intensity itself, or may be the biological information measured by the measurement part 10 (e.g., the pulse rate). For example, the target value may be 111 bpm with the first threshold value being 40%. Using the first threshold value as the target value makes it possible for the biological information for exercise during a second exercise period that follows the first exercise period to readily reach the target value. Therefore, it is possible to provide motivation for exercise.

[0038] Also, in an instance in which the biological information during the first exercise period of a user B is, e.g., 89 bpm, the first measured value is, e.g., 89 bpm. In an instance in which the first measured value (e.g., 89 bpm=20%) is equal to or less than a second threshold value (e.g., 100 bpm=30%), the correction part 30 may correct the target value (e.g., 111 bpm=40%) to the second threshold value (e.g., 100 bpm=30%). The second threshold value may be set so as to be smaller than, e.g., the first threshold value. The unit for the second threshold value may be the exercise intensity itself, or may be the biological information measured by the measurement part 10 (e.g., the pulse rate). Using the second threshold value as the target value makes it possible to prevent a low target value from being set. In other words, even in an instance in which the user B is readily capable of reaching a pulse rate of, e.g., 89 bpm, it can be judged as a “fail” if the aim of improving lifestyle towards maintaining or improving health is not being met. However, judging that reaches the second threshold value (e.g., 100 bpm=30%) to be a “pass” makes it possible to make the user B motivated for exercise compared to an instance in which it is judged to be a “pass” upon reaching the original 111 bpm (=40%).

[0039] While in the example shown in FIG. 1, the biological information measuring device includes the measurement part 10, the setting part 20, and the correction part 30; each of the measurement part 10, the setting part 20, and the correction part 30 may include, e.g., a gate array or another ASIC.

All or a part of the measurement part 10, the setting part 20, and the correction part 30 may include a computer (or in a broader sense, a device including a processing part and a memory part). The processing part is, e.g., an MPU (i.e., microprocessing unit). The memory part functions as a work region of the processing part (or in a narrower sense, all or some of the measurement part 10, the setting part 20, and the correction part 30), and the memory part is, e.g., a memory device or a HDD (hard disk drive). The biological information measuring device may have an information storage medium (i.e., a medium that can be read by a computer) for storing, e.g., a program, data, or other information. The information storage medium is, e.g., a memory card or an optical disk. The processing part is capable of performing a variety of processes according to a program stored in the information storage medium or the memory part. Specifically, a program for causing the computer to function as all or some of the measurement part 10, the setting part 20, or the correction part 30 may be stored in the information storage medium or the memory part.

1.2 First Example of Configuration

[0040] FIG. 2 shows an example of a specific configuration of the biological information measuring device in FIG. 1. In the example shown in FIG. 2, the biological information measuring device is a pulse rate monitor; however, an example of a specific configuration of the biological information measuring device is not limited to that shown in FIG. 2. Structures that are identical to those in the example described above are affixed with the same numerals, and a description of the structures is not provided.

[0041] As shown in FIG. 2, the biological information measuring device may further include an input part 40, a conversion part 50, and a comparison part 60. The input part 40 is, e.g., an operation button or a touch panel. The conversion part 50 and the comparison part 60 may include, e.g., a gate array or another ASIC, as with the measurement part 10, the setting part 20, and the correction part 30. All or some of the functions of conversion part 50 and the comparison part 60 may also be performed by at least one of the measurement part 10, the setting part 20, and the correction part 30.

[0042] In the example shown in FIG. 2, e.g., age is entered into the input part 40 as a previously known biological information parameter. The conversion part 50 converts the pulse rate from the measurement part 10 into exercise intensity. The conversion part 50 may have a formula for conversion between the pulse rate and exercise intensity, or may have a LUT (i.e., a look-up table) for storing results of conversions between the pulse rate and exercise intensity. The Karvonen method or another evaluation formula may be used as the conversion formula. The Karvonen method can be represented using a following Equation (1).

[Mathematical Formula 1]

$$S = \frac{HR_{AVE} - HR_{REST}}{HR_{MAX} - HR_{REST}} \times 100 \quad (1)$$

[0043] In Equation 1, S represents exercise intensity (%), HR_{AVE} represents the pulse rate during exercise (bpm), HR_{REST} represents the resting pulse rate (bpm), and HR_{MAX} represents the maximum pulse rate (bpm).

[0044] FIG. 3 shows an example of a relationship between age and resting pulse rate. As shown in FIG. 3, the resting pulse rate HR_{REST} can be determined from, e.g., age. For example, in an instance in which the age is 20 years, the resting pulse rate HR_{REST} can be set to 70 bpm. In an instance in which the age is 60 years, the resting pulse rate HR_{REST} can be set to 62 bpm. The resting pulse rate HR_{REST} may be measured using the measurement part 10, or a constant value may be used irrespective of age.

[0045] The maximum pulse rate HR_{MAX} is also determined from, e.g., age. However, a constant value may also be used irrespective of age. Since it is difficult to use the measurement part 10 to measure the maximum pulse rate HR_{MAX} , the maximum pulse rate HR_{MAX} can be represented using the following Equation 2.

[Mathematical Formula 2]

$$HR_{MAX} = 220 - AGE \quad (2)$$

[0046] In Equation 2, "AGE" represents the age in years. In an instance in which, e.g., the age is 20 years, the maximum pulse rate HR_{MAX} can be set to 200 bpm. In an instance in which the age is 60 years, the maximum pulse rate HR_{MAX} can be set to 160 bpm.

[0047] In the example shown in FIG. 2, the conversion part 50 is capable of obtaining the exercise intensity according to the pulse rate from the measurement part 10 and the age from the input part 40, using a correspondence relationship such as that shown, e.g., in Equations 1 and 2 and FIG. 3. The exercise intensity obtained in the conversion part 50 is the first measured value (i.e., the actual physical performance of the test subject during the first exercise period). Taking the age from input part 40 into account makes it possible for the biological information measuring device (or in a narrower sense, the conversion part 50) to obtain the first measured value in a more accurate manner.

[0048] In the example shown in FIG. 2, an exercise intensity of, e.g., 40% is preset in the setting part 20 as the exercise intensity target value. The target value (e.g., an exercise intensity of 40%) can be stored, e.g., in a memory device, and the memory device or another memory part for storing the target value can also be called the setting part 20. In an instance in which the target value (e.g., an exercise intensity of 40%) is the lower limit of the zone, an upper limit of the zone (e.g., an exercise intensity of 70%) may also be preset, as another target value, in the setting part 20.

[0049] In the example shown in FIG. 2, a first exercise intensity threshold value of, e.g., 40% is preset in the setting part 20, and a second exercise intensity threshold value of, e.g., 30% is preset in the setting part 20. The comparison part 60 is capable of comparing the first measured value (i.e., the actual physical performance of the test subject during the first exercise period) with at least one of the first threshold value (e.g., an exercise intensity of 40%) and the second threshold value (e.g., an exercise intensity of 30%).

[0050] The correction part 30 corrects the target value (e.g., an exercise intensity of 40%) according to a result of the comparison performed by the comparison part 60. In an instance in which the first measured value is smaller than the first threshold value, the correction part 30 corrects the target value to the first measured value (i.e., corrective exercise intensity). In an instance in which the first measured value is equal to or less than the second threshold value, the correction part 30 corrects the target value to the second threshold value

(i.e., corrective exercise intensity). In an instance in which the first measured value is equal to or greater than the first threshold value, the correction part 30 may maintain the target value.

1.3 Second Configuration Example

[0051] FIG. 4 shows another example of a specific configuration of the biological information measuring device in FIG. 1. Structures that are identical to those in the example described above are affixed with the same numerals, and a description of the structures is not provided. In the example shown in FIG. 2, the exercise intensity target value is preset in the setting part 20, and the exercise intensity target value itself is stored in the memory device. However, in the example shown in FIG. 4, a pulse rate target value is stored in the memory device.

[0052] In the example shown in FIG. 4, the conversion part 50 converts the exercise intensity target value (e.g., 40%) from the setting part 20 into a pulse rate target value. Equation 1 described above can be modified into the following Equation 3.

[Mathematical Formula 3]

$$HR_S = \frac{S}{100} \times (HR_{MAX} - HR_{REST}) + HR_{REST} \quad (3)$$

[0053] In Equation 3, HR_S represents the pulse rate target value (bpm), and corresponds to HR_{AVE} in Equation 1. When $S=40\%$ is used as the exercise intensity target value in Equation 3, the pulse rate target value HR_S corresponding to the exercise intensity of 40% can be obtained. For example, in an instance in which the age is 41 years, the pulse rate target value HR_S is 111 bpm. Taking the age from the input part 40 into account makes it possible for the biological information measuring device (or in a narrower sense, the setting part 20, or in an even narrower sense, the conversion part 50) to obtain the pulse rate target value (e.g., 111 bpm) in a more accurate manner. In the example shown in FIG. 4, the target value (e.g., a pulse rate of 111 bpm) can be stored in, e.g., the memory device.

[0054] In the example shown in FIG. 2, the correction part 30 directly corrects the target value (e.g., an exercise intensity of 40%). However, in the example shown in FIG. 4, the unit for the target value is the pulse rate; therefore, the correction part 30 corrects the target value (e.g., a pulse rate of 111 bpm) via the conversion part 50. In the example shown in FIG. 4, in an instance in which the first measured value (i.e., the exercise intensity during the first exercise period) is smaller than the first threshold value (e.g., an exercise intensity of 40%), the conversion part 50 converts the first measured value to a pulse rate. The correction part 30 corrects the pulse rate target value stored in the memory device into a pulse rate corresponding to the first measured value (i.e., a corrective pulse rate obtained in the conversion part 50). In an instance in which the first measured value is equal to or less than the second threshold value (e.g., an exercise intensity of 30%), the conversion part 50 converts the second threshold value into a pulse rate. The correction part 30 corrects the pulse rate target value stored in the memory device into a pulse rate corresponding to the second threshold value (i.e., a corrective pulse rate obtained in the conversion part 50).

[0055] As shown in FIG. 4, the biological information measuring device may include a notification part 70. The first configuration example shown in FIG. 2 may also include the notification part 70. The notification part 70 (corresponding to a first notification part) is capable of notifying the test subject of an ideal exercise pace for the first exercise period. In order to more accurately obtain the actual physical performance of the test subject during the first exercise period, the biological information measuring device requires the test subject to walk for, e.g., 6 minutes at an exercise pace of, e.g., 2 Hz. For example, the notification part 70 may emit a pacing signal, in the form of a high-pitched alert sound, twice per second. The test subject can form an ideal exercise state by walking forward at a rate of two paces per second in time with the pacing signal. The notification part 70 is, e.g., a speaker, but may also be an LED, a vibrator, or another device. The notification part 70 may emit light twice per second, or may vibrate twice per second.

[0056] The notification part 70 may also notify the test subject of a current exercise pace during the first exercise period. In such an instance, the notification part 70 may output a sound, a light, or a similar signal in time with, e.g., the actual walking pace. Obtaining the actual exercise pace makes it possible for the test subject to voluntarily match the actual exercise pace with the ideal exercise pace (e.g., 2 Hz). The walking pace may be measured, e.g., using an acceleration sensor and the walking pace may be measured by, e.g., the measurement part 10. The biological information measuring device is thus capable of notifying the test subject of at least one of the ideal exercise pace during the first exercise period and the current pace.

1.4 Example of Operation

[0057] FIG. 5 is a flow chart showing an example of operation of the measurement part 10 shown in FIG. 2 or 4. First, before the measurement part 10 performs the first mode, the test subject prepares for, e.g., a six-minute walk. Specifically, the test subject maintains a state of rest before the six-minute walk, and prepares to set the first mode. Before the first mode is set, the test subject operates the input part 40 and enters an age into the biological information measuring device. The first mode may be set at the same time as the age being entered into the input part 40, or the first mode may be set when a dedicated operation button or a similar input device for setting the first mode is pressed or otherwise operated. For example, the input part 40 may have the dedicated operation button or a similar input device.

[0058] In the example shown in FIG. 5, the measurement part 10 (or in a broader sense, the biological information measuring device) judges whether the first mode has been set (step S11). In an instance in which the first mode has not been set, the measurement part 10 performs step S11 again. In an instance in which the first mode has been set, the measurement part 10 performs the first mode. As the first mode, the measurement part 10 measures the time that has elapsed since the first mode has been set.

[0059] The test subject sets the biological information measuring device to the first mode, then walks for six minutes. In an instance in which the ideal exercise state is an exercise pace of 2 Hz, the test subject maintains a forward walking rate of two steps a second for six minutes. In an instance in which the biological information measuring device includes the notification part 70, the notification part 70 can continue issuing a pacing signal in the form of a high-pitched alert

sound, emitted twice a second for six minutes, starting at the same time as when the first mode is set. The notification part 70 is also capable of notifying the test subject of the current exercise pace (including the current exercise pace in comparison with the ideal exercise pace) for six minutes according to the actual walking pace, using a message such as “The current exercise pace is 2 Hz,” “Please maintain the current pace,” “The current exercise pace is 1.9 Hz,” “Please walk faster,” “The current exercise pace is 2.5 Hz,” or “Please walk slower.”

[0060] FIG. 6 is an example of a change in pulse rate during a six-minute walk. In the example shown in FIG. 6, when the first mode is set, or specifically, when the elapsed time is 0 minutes, the pulse rate indicates the resting pulse rate. The resting pulse rate when the elapsed time is 0 minutes (i.e., the measured value) may be different from the resting pulse rate determined from age as shown in FIG. 3 (i.e., the estimated value). When the test subject starts walking, the pulse rate rises; subsequently, the pulse rate during exercise indicates a steady state (see FIG. 6). The pulse rate in a steady state can be made to correspond with the actual physical performance of the test subject. Since there are individual differences in a rate of increase in the pulse rate, a range of elapsed time between, e.g., 3 minutes to 6 minutes can be designated as the first exercise period. The measurement part 10 measuring the pulse rate during the first exercise period makes it possible to evaluate the actual physical performance of the test subject. A range of elapsed time between, e.g., 0 minutes to 6 minutes may instead be designated as the first exercise period, and, e.g., the measurement part 10 may determine the presence of a steady state and measure the pulse rate in a steady state during the first exercise period.

[0061] In the example shown in FIG. 5, the measurement part 10 (or in a broader sense, the biological information measuring device) judges whether three minutes have elapsed since the first mode has been set (step S12). In an instance in which the elapsed time is less than 3 minutes, the measurement part 10 performs step S12 again. In an instance in which the elapsed time is 3 minutes or above, the measurement part 10 samples the pulse rate at predetermined intervals (step S13). For example, the measurement part 10 measures the pulse rate in real time, and stores the pulse rate, e.g., every 10 seconds.

[0062] In the example shown in FIG. 5, the measurement part 10 (or in a broader sense, the biological information measuring device) judges whether six minutes have elapsed since the first mode has been set (step S14). In an instance in which the elapsed time is less than 6 minutes, the measurement part 10 performs step S13 again. In an instance in which the elapsed time is 6 minutes or above, the measurement part 10 discontinues sampling. The measurement part 10 is capable of storing, e.g., 18 (=3×6) pulse rate values in the range of elapsed time between 3 minutes and 6 minutes.

[0063] In the example shown in FIG. 5, the measurement part 10 (or in a broader sense, the biological information measuring device) calculates an average pulse rate (step S15). The measurement part 10 can obtain an average value between, e.g., 18 pulse rate values, and can use the average value as the pulse rate during the first exercise period (or in a broader sense, the biological information). The measurement part 10 may use, instead of the average pulse rate, one of the pulse rates during the steady state.

[0064] FIG. 7 is a flow chart showing an example of operation of the setting part in FIG. 4. In the example shown in FIG.

7, the setting part 20 (or in a broader sense, the biological information measuring device) reads the preset exercise intensity of, e.g., 40% (step S21). Then the setting part 20 (or in a broader sense, the biological information measuring device) converts the preset exercise intensity (e.g., 40%) to a pulse rate (i.e., target value relating to exercise intensity) according to, e.g., age, e.g., via the conversion part 50 and the input part 40 (step S22). The setting part 20 (or in a broader sense, the biological information measuring device) sets the pulse rate (i.e., target value relating to exercise intensity) to, e.g., the memory device (step S23).

[0065] FIG. 8 shows an example of pulse rate target value settings according to age. As shown in FIG. 8, the pulse rate (i.e., target value relating to exercise intensity) can be determined from, e.g., age. A setting relationship such as that shown in FIG. 8 can be determined using a correspondence relationship such as that shown in Equation 1, Equation 2, and FIG. 3. For example, in an instance in which the age of the user A is 41 years, 111 bpm, which corresponds to the preset exercise intensity (e.g., 40%), is set as the pulse rate (i.e., target value relating to exercise intensity) in the memory device (step S23). Also, in an instance in which the age of the user B is also 41 years, 111 bpm is set as the pulse rate (i.e., target value relating to exercise intensity) in the memory device (step S23). In an instance, e.g., where the age of users C and D is 35 years, 114 bpm, which corresponds to the preset exercise intensity (e.g., 40%), is set as the pulse rate (i.e., target value relating to exercise intensity) in the memory device (step S23).

[0066] In the example shown in FIG. 7, the setting part 20 (or in a broader sense, the biological information measuring device) judges whether there is a need to correct the pulse rate set in the memory device (i.e., target value relating to exercise intensity), e.g., via the comparison part 60, the correction part 30, and the conversion part 50 (step S24). In an instance in which there is no need to correct the pulse rate (i.e., target value relating to exercise intensity), the setting part 20 maintains the pulse rate (i.e., target value relating to exercise intensity). In an instance in which there is a need to correct the pulse rate (i.e., target value relating to exercise intensity), the setting part 20 overwrites the pulse rate set in the memory device (i.e., target value relating to exercise intensity) with a corrective pulse rate (step S25).

[0067] FIG. 9 is a flow chart showing an example of operation of the correction part in FIG. 4. In the example shown in FIG. 9, the correction part 30 (or in a broader sense, the biological information measuring device) converts the pulse rate (or in a broader sense, biological information) during the first exercise period to exercise intensity (i.e., the first measured value) according to, e.g., age, via, e.g., the conversion part 50 and the input part 40 (step S31). The correction part 30 (or in a broader sense, the biological information measuring device) judges, e.g., via the comparison part 60, whether the exercise intensity (i.e., the first measured value) is smaller than the first threshold value (step S32). In an instance in which the exercise intensity (i.e., the first measured value) is smaller than the first threshold value, the correction part 30 (or in a broader sense, the biological information measuring device) further judges whether the exercise intensity (i.e., the first measured value) is greater than the second threshold value (step S33). The first threshold value and the second threshold value are set, e.g., in the setting part 20, and the

comparison part 60 (or in a broader sense, the correction part 30) is capable of reading the first threshold value and the second threshold value.

[0068] In an instance in which the exercise intensity (i.e., the first measured value) is smaller than the first threshold value and the exercise intensity (i.e., the first measured value) is greater than the second threshold value, the correction part 30 (or in a broader sense, the biological information measuring device) converts the exercise intensity (i.e., the first measured value) to a pulse rate (i.e., corrective pulse rate) according to, e.g., age, e.g., via the conversion part 50 and the input part 40 (step S34). In an instance in which the exercise intensity (i.e., the first measured value) is equal to or less than the second threshold value, the correction part 30 (or in a broader sense, the biological information measuring device) converts the second threshold value to a pulse rate (i.e., corrective pulse rate) according to, e.g., age, e.g., via the conversion part 50 and the input part 40 (step S35).

[0069] In the example shown in FIG. 9, the correction part 30 (or in a broader sense, the biological information measuring device) instructs, e.g., the setting part 20 to correct the pulse rate (i.e., the target value), e.g., via the conversion part 50 (step S36). The setting part 20 overwrites the pulse rate set in the memory device (i.e., the target value) using the corrective pulse rate obtained in steps S34 and S35 (step S25 in FIG. 7).

[0070] FIG. 10 is an example of pulse rate target value settings according to the first measured value. In the example shown in FIG. 10, in an instance, e.g., where the first measured value for the user A aged 41 years (i.e., an exercise intensity of 37% determined from a pulse rate of 108 bpm during the first exercise period) is smaller than the first threshold value and greater than the second threshold value, 109 bpm, which corresponds to the first measured value, is set as a pulse rate (i.e., target value relating to exercise intensity) in the memory device (steps S34 and S36 in FIG. 9). In an instance, e.g., where the first measured value of the user B aged 41 years (i.e., an exercise intensity of 20% determined from a pulse rate of 89 bpm obtained during the first exercise period) is equal to or smaller than the second threshold value, 100 bpm, which corresponds to the second threshold value, is set as a pulse rate (i.e., target value relating to exercise intensity) in the memory device (steps S35, S36).

[0071] In the example shown in FIG. 10, in an instance, e.g., where the first measured value of the user C aged 35 years (i.e., an exercise intensity of 21% determined from a pulse rate of 92 bpm obtained during the first exercise period) is equal to or smaller than the second threshold value, 102 bpm, which corresponds to the second threshold value, is set as a pulse rate (i.e., target value relating to exercise intensity) in the memory device (steps S35, S36 in FIG. 9). In an instance, e.g., where the first measured value of the user D aged 35 years (i.e., an exercise intensity of 45% determined from a pulse rate of 120 bpm obtained during the first exercise period) is equal to or greater than the first threshold value, 114 bpm, which corresponds to the preset exercise intensity (e.g., 40%), is used without correction.

1.5 Example of Modification

[0072] FIG. 11 is an example of a modification of the specific configuration in FIG. 2. Structures that are identical to those in the example described above are affixed with the same numerals, and a description of the structures is not provided. In the example shown in FIG. 2, the exercise inten-

sity and at least one of the first threshold value and the second threshold value are compared by the comparison part 60. In the example shown in FIG. 11, the comparison part 60 uses the pulse rate during the first exercise period itself, instead of the exercise intensity.

[0073] FIG. 12 is an example of a modification of the specific configuration in FIG. 4. Structures that are identical to those in the example described above are affixed with the same numerals, and a description of the structures is not provided. In the example shown in FIG. 4, the exercise intensity and at least one of the first threshold value and the second threshold value are compared by the comparison part 60. In the example shown in FIG. 12, the comparison part 60 uses the pulse rate during the first exercise period itself, instead of the exercise intensity.

[0074] In the examples shown in FIGS. 11 and 12, a standard value of the first threshold value of, e.g., 40% is preset in the setting part 20, and a standard value of the second threshold value of, e.g., 30% is preset in the setting part 20. The conversion part 50 (or in a broader sense, the biological information measuring device) converts the preset standard value (e.g., 40%) to a pulse rate (i.e., a first pulse rate threshold value) according to, e.g., age, e.g., via the setting part 20 and the input part 40. The conversion part 50 also converts the preset reference value (e.g., 30%) to a pulse rate (i.e., a second pulse rate threshold value) according to, e.g., age.

[0075] In the examples shown in FIGS. 11 and 12, the comparison part 60 is capable of comparing the first measured value (i.e., the pulse rate during the first exercise period itself, relating to exercise intensity) and at least one of the first threshold value (i.e., the pulse rate corresponding to an exercise intensity of, e.g., 40%) and the second threshold value (i.e., the pulse rate corresponding to an exercise intensity of, e.g., 30%).

[0076] In the example shown in FIG. 11, the correction part 30 corrects the target value (e.g., exercise intensity=40%) via the conversion part 50. In the example shown in FIG. 11, in an instance in which the first measured value is smaller than the first threshold value (e.g., a pulse rate corresponding to an exercise intensity of 40%), the conversion part 50 converts the first measured value to exercise intensity. The correction part 30 corrects the exercise intensity target value stored in the memory device into the first measured value (i.e., the corrective exercise intensity obtained in the conversion part 50). In an instance in which the first measured value is equal to or less than the second threshold value (e.g., a pulse rate corresponding to an exercise intensity of 30%), the conversion part 50 converts the second threshold value to exercise intensity. The correction part 30 corrects the pulse rate target value stored in the memory device into the second threshold value (i.e., the corrective exercise intensity obtained in the conversion part 50).

[0077] In the example shown in FIG. 12, the correction part 30 corrects the target value (e.g., a pulse rate corresponding to an exercise intensity of 40%) according to a result of the comparison performed by the comparison part 60. In an instance in which the first measured value is less than the first threshold value, the correction part 30 corrects the target value to the first measured value (i.e., corrective pulse rate). In an instance in which the first measured value is equal to or less than the second threshold value, the correction part 30 corrects the target value to the second threshold value (i.e., corrective pulse rate).

[0078] FIGS. 13A, 13B, and 13C are other examples of pulse rate target value settings according to the first measured value. FIG. 13A corresponds to FIG. 2, FIG. 13B corresponds to FIG. 11, and FIG. 13C corresponds to FIG. 12.

[0079] In the example shown in FIG. 13A, in an instance in which, e.g., the first measured value for the user A aged 41 years (i.e., an exercise intensity of 37% determined from a pulse rate of 108 bpm during the first exercise period) is less than the first threshold value and greater than the second threshold value, the first measured value of 37% is set as the exercise intensity (i.e., target value relating to exercise intensity) in the memory device. In an instance in which, e.g., the first measured value for the user B aged 41 years (i.e., an exercise intensity of 20% determined from a pulse rate of 89 bpm during the first exercise period) is equal to or less than the second threshold value, the second threshold value of 30% is set as the exercise intensity (i.e., target value relating to exercise intensity) in the memory device.

[0080] In the example shown in FIG. 13A, in an instance in which, e.g., the first measured value for the user C aged 35 years (i.e., an exercise intensity of 21% determined from a pulse rate of 92 bpm during the first exercise period) is equal to or less than the second threshold value, the second threshold value of 30% is set as the exercise intensity (i.e., target value relating to exercise intensity) in the memory device. In an instance in which, e.g., the first measured value for the user D aged 35 years (i.e., an exercise intensity of 45% determined from a pulse rate of 120 bpm during the first exercise period) is equal to or greater than the first threshold value, the preset exercise intensity (e.g., 40%) is used without correction.

[0081] In the example shown in FIG. 13B, in an instance in which, e.g., the first measured value for the user A aged 41 years (i.e., a pulse rate of 108 bpm during the first exercise period, relating to exercise intensity) is less than the first threshold value and greater than the second threshold value, 37%, which corresponds to the first measured value, is set as the exercise intensity (i.e., target value relating to exercise intensity) in the memory device. In an instance in which, e.g., the first measured value for user B aged 41 years (i.e., a pulse rate of 89 bpm during the first exercise period, relating to exercise intensity) is equal to or less than the second threshold value, 30%, which corresponds to the second threshold value, is set as the exercise intensity (i.e., target value relating to exercise intensity) in the memory device.

[0082] In the example shown in FIG. 13B, in an instance in which, e.g., the first measured value for the user C aged 35 years (i.e., a pulse rate of 92 bpm during the first exercise period, relating to exercise intensity) is equal to or less than the second threshold value, 30%, which corresponds to the second threshold value, is set as the exercise intensity (i.e., target value relating to exercise intensity) in the memory device. In an instance in which, e.g., the first measured value for the user D aged 35 years (i.e., a pulse rate of 120 bpm during the first exercise period, relating to exercise intensity) is equal to or greater than the first threshold value, the preset exercise intensity (e.g., 40%) is used without correction.

[0083] In the example shown in FIG. 13C, in an instance in which, e.g., the first measured value for the user A aged 41 years (i.e., a pulse rate of 108 bpm during the first exercise period, relating to exercise intensity) is less than the first threshold value and greater than the second threshold value, the first measured value of 108 bpm is set as the pulse rate (i.e., target value relating to exercise intensity) in the memory device. In an instance in which, e.g., the first measured value

for the user B aged 41 years (i.e., a pulse rate of 89 bpm during the first exercise period, relating to exercise intensity) is equal to or less than the second threshold value, the second threshold value of 100 bpm is set as the pulse rate (i.e., target value relating to exercise intensity) in the memory device.

[0084] In the example shown in FIG. 13C, in an instance in which, e.g., the first measured value for the user C aged 35 years (i.e., a pulse rate of 92 bpm during the first exercise period, relating to exercise intensity) is equal to or less than the second threshold value, 102 bpm, which corresponds to the second threshold value, is set as the pulse rate (i.e., target value relating to exercise intensity) in the memory device. In an instance in which, e.g., the first measured value for the user D aged 35 years (i.e., a pulse rate of 120 bpm during the first exercise period, relating to exercise intensity) is equal to or greater than the first threshold value, the preset exercise intensity (e.g., 114 bpm, which corresponds to 40%) is used without correction.

1.6 Setting of Zones

[0085] As shown in FIGS. 10, 13A, 13B, and 13C, the unit for the target value relating to exercise intensity set in the setting part 20 may be the exercise intensity itself, or may be a pulse rate corresponding to the exercise intensity (or in a broader sense, biological information measured by the measurement part 10). In FIGS. 2, 4, 11, and 12, an exercise intensity of 40% as an exercise intensity target value, or a pulse rate corresponding to 40% as a pulse rate target value, is preset in the setting part 20.

[0086] However, as described above, with regards to the exercise intensity target value, the setting part 20 may be preset not only with a lower limit (i.e., 40%) of a zone within which the exercise intensity ranges, e.g., from 40% to 70%, but also with an upper limit of the zone (i.e., 70%). Similarly, with regards to the heart rate target value, the setting part 20 may be preset not only with a lower limit of the zone (i.e., a pulse rate corresponding to 40%), but also with an upper limit of the zone (i.e., a pulse rate corresponding to 70%).

[0087] FIG. 14 shows an example of zone settings according to the first measured value. FIG. 14 corresponds to FIG. 10, to which upper limits of zones have been added. In the example shown in FIG. 14, even in an instance in which the lower limit of the zone is corrected according to the first measured value (i.e., the actual physical performance of the test subject during the first exercise period), the upper limit of the zone can be used without correction. Specifically, the zone for the user A aged 41 years is corrected from a range of 111 bpm to 145 bpm to a range of 109 bpm to 145 bpm. The zone for the user B aged 41 years is corrected from a range of 111 bpm to 145 bpm to a range of 100 bpm to 145 bpm. The zone for the user C aged 35 years is corrected from a range of 114 bpm to 150 bpm to a range of 102 bpm to 150 bpm. The zone for the user D aged 35 years has a range of 114 bpm to 150 bpm and remains uncorrected.

2. Second Mode (Second Exercise Period that Follows the First Exercise Period).

2.1 Basic Configuration

[0088] FIG. 15 is another example of the biological information measuring device according to the present embodiment. The example shown in FIG. 15 is an example of a configuration corresponding to a second exercise period (or in a broader sense, a second mode) that follows the first exercise

period. The target value relating to exercise intensity that is set in the setting part 20 is corrected as required by the correction part 30 as shown in FIG. 1. Structures that are identical to those in the example described above are affixed with the same numerals, and a description of the structures is not provided.

[0089] In the first mode, the target value relating to exercise intensity is set so as to take the first measured value relating to exercise intensity, determined from biological information during the first exercise period, into account. Therefore, after the first exercise period, i.e., after the target value relating to exercise intensity has been appropriately set, the notification part 70 (or in a broader sense, the biological information measuring device) is capable of appropriately evaluating, in the second mode, the exercise state of the test subject performing a walk or another exercise in relation to the zone (i.e., a target value).

[0090] In the example shown in FIG. 15, the notification part 70 (corresponding to a second notification part) notifies the test subject of a current position within the zone relating to exercise intensity, according to a second measured value relating to exercise intensity determined from biological information during a second exercise period that follows the first exercise period. The unit for the second measured value may be the exercise intensity itself, or may be the biological information measured by the measurement part 10 (e.g., pulse rate). For example, the pulse rate of a test subject (e.g., user A), during an exercise period of, e.g., a 30 minute walk, is measured. In an instance in which the biological information during the second exercise period (e.g., the pulse rate 10 minutes after the start of a walk) that follows the first exercise period is, e.g., 123 bpm, the first measured value is, e.g., 123 bpm. In an instance in which the exercise intensity corresponding to 123 bpm is, e.g., 50%, the second measured value may be, e.g., 50% (=123 bpm). The notification part 70 can notify the test subject of an actual physical performance of the test subject during the second exercise period that follows the first exercise period (e.g., a pulse rate of 123 bpm=exercise intensity of 50%).

2.2 Example of Notification

[0091] FIGS. 16A and 16B are examples of a notification of a current position within the zone relating to exercise intensity. FIGS. 16A and 16B show, e.g., a liquid crystal display or a similar display part as an example of the notification part 70. FIGS. 16A and 16B also show examples of an outer appearance of the biological information measuring device. The biological information measuring device may further have a wristband 150 capable of attaching the biological information measuring device to an arm (or specifically, a wrist) of the test subject (i.e., the user).

[0092] In an instance in which the zone relating to exercise intensity is, e.g., the pulse rate zone of user A in FIG. 14 (i.e., 109 bpm to 145 bpm=37% to 70%), the notification part 70 can notify the user A of a position of the second measured value (e.g., 123 bpm) within the zone relating to exercise intensity. In the example shown in FIG. 16A, a current position in the zone relating to exercise intensity is represented using, e.g., a following Equation 4.

[Mathematical Formula 4]

$$X = \frac{Y - Z_{MIN}}{Z_{MAX} - Z_{MIN}} \quad (4)$$

[0093] In Equation 4, Y represents the second measured value, Z_{MIN} represents the lower limit of the zone, and Z_{MAX} represents the upper limit of the zone. X represents a position in the zone. X in Equation 4 is normalized so that X is equal to 1 when Y is equal to Z_{MAX} .

[0094] In the example shown in FIG. 16A, the current position X is displayed as a bar level. In the example shown in FIG. 16A, the length of a lateral bar shown on the notification part 70 (i.e., the display part) corresponds to the current position X within the zone relating to exercise intensity (= (123 bpm - 109 bpm) / (145 bpm - 109 bpm) = 0.39). The test subject can perceive the length of the bar and thereby obtain the actual physical performance of the test subject during the second exercise period that follows the first exercise period.

[0095] In the example shown in FIG. 16B, the current position within the zone relating to exercise intensity is represented by a score. For example, in an instance in which the second measured value is equal to the lower limit of the zone, a score of zero can be displayed. Also, e.g., in an instance in which the second measured value is equal to the upper limit of the zone, a score of 100 can be displayed. In the example shown in FIG. 16B, the second measured value (e.g., 123 bpm) is displayed as a score of 39 points. In the example shown in FIG. 16B, the value of the score corresponds to the current position X in the zone relating to exercise intensity represented by Equation 4 (i.e., 0.39), for example. The test subject can perceive the value of the score and thereby obtain the actual physical performance of the test subject during the second exercise period that follows the first exercise period.

[0096] The configuration of the notification part 70 is not limited to that shown in FIGS. 16A and 16B, and the current position in the zone relating to exercise intensity may be outputted, e.g., as an audible message. As shown in FIGS. 16A and 16B, the notification part 70 can display the second measured value (e.g., the current pulse rate of 123 bpm).

[0097] FIGS. 17A, 17B, 17C, and 17D show examples of a division of zones relating to exercise intensity. FIGS. 17A and 17C correspond to, e.g., a zone for the user A in FIG. 14, and FIGS. 17B and 17D correspond to, e.g., a zone for the user B in FIG. 14. In the example shown in FIG. 17A, the biological information measuring device divides the zone relating to exercise intensity (i.e., exercise intensity of 37% to 70%) into two regions (i.e., “pass” region and “good” region) according to the first measured value (i.e., a pulse rate of 109 bpm=exercise intensity of 37%). In other words, in addition to an initial first region relating to exercise intensity (i.e., exercise intensity of 40% to 70%: from the first threshold value to the upper limit of the zone), a second region (i.e., exercise intensity of 37% to 40%: from the first measured value to the first threshold value) is added according to the first threshold value (i.e., exercise intensity of 40%). In the example shown in FIG. 17B, the biological information measuring device divides the zone relating to exercise intensity (i.e., exercise intensity of 30% to 70%) into two regions (“pass” region (i.e., a second region: from the second threshold value to the first threshold value) and “good” region (i.e., a first region: from the first threshold value to the upper limit of the zone)) according to the first threshold value (i.e., exer-

cise intensity of 40%). The initial first region corresponding to the “good” region in FIGS. 17A and 17B (i.e., exercise intensity of 40% to 70%) can be divided into three regions (i.e., “good” region, “better” region, and “best” region) as shown in FIGS. 17C and 17D. The three regions can respectively be called a first subregion, a second subregion, and a third subregion of the initial first region. Preferably, the first region is divided into two or three subregions, because in an instance in which the first region is too finely divided, it becomes difficult, during exercise, to allocate, e.g., a pulse rate (i.e., the second measured value) into a divided subregion.

[0098] The biological information measuring device is thus capable of dividing the zone relating to exercise intensity into a plurality of regions according to the first threshold value. In an instance in which the lower limit of the zone is not corrected according to the first measured value, such as in the example of the zone for user D in FIG. 14, it is possible for the biological information measuring device to only use the zone relating to exercise intensity (i.e., exercise intensity of 40% to 70%) itself. However, the zone for user D may be divided into a plurality of subregions, i.e., three regions (“good” region, “better” region, “best” region), as shown in FIGS. 17C and 17D.

[0099] FIGS. 18A, 18B, 18C, 18D, and 18E show examples of a notification of the second measured value. The notification part 70 (or in a broader sense, the biological information measuring device) is capable of notifying the test subject whether the second measured value relating to exercise intensity determined from biological information during the second exercise period that follows the first exercise period belongs to either one of the first region or the second region. In an instance in which the second region does not exist, the notification part 70 notifies the test subject whether the second measured value belongs to the first region. In an instance in which the first region includes a plurality of subregions, the notification part 70 may notify the test subject of which subregion the second measured value belongs to. Alternatively, the notification part 70 may notify the test subject whether the second measured value belongs to any one of the subregions (e.g., a subregion in which the exercise intensity is the highest among the subregions).

[0100] The example shown in FIG. 18A shows that the second measured value (e.g., a pulse rate of 123 bpm=exercise intensity of 50%) is equal to or greater than the first threshold value and equal to or less than the upper limit of the zone, and is therefore within, e.g., the “good” region (exercise intensity of 40% to 70%) in FIG. 17A. The example shown in FIG. 18B shows that the second measured value (e.g., a pulse rate of 100 bpm=exercise intensity of 39%) is equal to or greater than the second threshold value or the first measured value and less than the first threshold value, and is therefore within, e.g., the “pass” region (exercise intensity of 37% to 40%) in FIG. 17A. The “pass” region is a region that has been added to the initial zone; therefore, the test subject is able to increase the pace of walking or another exercise so as to reach a higher region.

[0101] The notification part 70 can notify the test subject of which of the regions the second measured value belongs to, as well as notify the test subject of a history of the current position within the zone relating to exercise intensity, as shown in FIG. 18C. Alternatively, the notification part 70 can notify the test subject of which of the regions the second measured value belongs to, as well as notifying the test sub-

ject of the current position within the zone relating to exercise intensity as shown, e.g., in FIG. 16A. In the example shown in FIG. 18C, the upper limit (e.g., a pulse rate of 145 bpm=exercise intensity of 70%) and the lower limit (e.g., a pulse rate of 109 bpm=exercise intensity of 37%) of the zone are shown by dotted lines. Also, in the example shown in FIG. 18C, the history of the current position in the zone relating to exercise intensity shows that the second measured value (i.e., the pulse rate) is gradually decreasing, and a recent current position is represented by a black vertical bar.

[0102] As shown in FIGS. 18D and 18E, the notification part 70 can also notify the test subject whether the second measured value belongs to, e.g., the “best” region (or in a broader sense, one subregion among the subregions) shown in FIGS. 17C and 17D. The example shown in FIG. 18D shows that the second measured value (e.g., a pulse rate of 139 bpm=exercise intensity of 65%) is equal to or greater than the first threshold value, is equal to or less than the upper limit of the zone, and is within, e.g., the “best” region in FIG. 17C among the subregions. In the example shown in FIG. 18E, the second measured value (e.g., a pulse rate of 128 bpm=exercise intensity of 55%) is less than, e.g., the “best” region in FIG. 17C among the subregions. Therefore, the test subject can be notified that it is not in the “best” region. Being presented with whether it is in a subregion in which the exercise intensity is the highest among the subregions makes it possible for the test subject to perform exercise at a higher exercise intensity.

2.3 First Configuration Example

[0103] FIG. 19 shows an example of a specific configuration of the biological information measuring device in FIG. 15. In the example shown in FIG. 19, the biological information measuring device is a pulse rate monitor; however, the example of a specific configuration of the biological information measuring device is not limited to that shown in FIG. 19. Structures that are identical to those in the example described above are affixed with the same numerals, and a description of the structures is not provided.

[0104] As shown in FIG. 19, the biological information measuring device may further include the input part 40, the conversion part 50, and a judgement part 80. As with the measurement part 10 and the setting part 20, the conversion part 50 and the judgement part 80 may include, e.g., a gate array or another ASIC. All or a some of the functions of the conversion part 50 and the judgement part 80 may also be performed by at least one of the measurement part 10, the setting part 20, and the notification part 70.

[0105] The input part 40 functions in a similar manner to that in the first mode. In the second mode, the biological information measuring device may use the age entered into the input part 40 in the first mode. The age, e.g., may also be re-entered as a previously known biological information parameter into the input part 40 during the second mode.

[0106] In the example shown in FIG. 19, in the second mode, the conversion part 50 can obtain the exercise intensity according to the pulse rate from the measurement part 10 and the age from the input part 40 using a correspondence relationship such as that shown, e.g., in Equation 1, Equation 2, and FIG. 3. The exercise intensity obtained by the conversion part 50 is the second measured value (i.e., an actual physical performance of the test subject during the second exercise period that follows the first exercise period).

[0107] In the example shown in FIG. 19, as with the first mode, e.g., 40% is preset in the setting part 20 as the first exercise intensity threshold value. After the first mode has been performed, the zone (i.e., target value) is stored in, e.g., the memory device. In the example shown in FIG. 19, in the second mode, the judgement part 80 can divide the zone relating to exercise intensity into a plurality of regions according to the first threshold value, and judging which of the regions the second measured value belongs to.

[0108] In the example shown in FIG. 19, in the second mode, the notification part 70 can notify the test subject of a result of the comparison performed by the judgement part 80, i.e., which of the regions the second measured value (i.e., the current exercise intensity) belongs to. Also, in the example shown in FIG. 19, in the second mode, the notification part 70 can relate the second measured value (i.e., the current exercise intensity) to the zone relating to exercise intensity, and thereby notify the test subject of the current position in the zone relating to exercise intensity. Also, in the example shown in FIG. 19, the test subject can be notified of the current pulse rate.

2.4 Example of Operation

[0109] FIG. 20 is a flow chart showing an example of operation of the measurement part 10 in FIG. 19. In the example shown in FIG. 20, the measurement part 10 (or in a broader sense, the biological information measuring device) judges whether the second mode has been set (step S41). In an instance in which the second mode has not been set, the measurement part 10 performs step S41 again. For example, the second mode may be set at the same time as a dedicated operation button or a similar input device for setting the second mode being pressed or otherwise operated.

[0110] In the example shown in FIG. 20, the measurement part 10 (or in a broader sense, the biological information measuring device) judges whether the first mode has been performed (step S42). In an instance in which the first mode has not been performed, the test subject must prepare for, e.g., a six-minute walk, and set the biological information measuring device to the first mode. In an instance in which the first mode has been performed, the test subject performs, e.g., a 30-minute walk, and the measurement part 10 can measure the pulse rate during the exercise period in the second mode. The test subject may perform the walk as long as they desire, or may jog or perform another exercise of their choice. The notification part 70 may also issue a message such as "Please start exercising" or otherwise prompt the test subject after the test subject has set the second mode.

[0111] In the example shown in FIG. 20, the measurement part 10 (or in a broader sense, the biological information measuring device) samples the pulse rate at predetermined intervals (step S43). The measurement part 10 (or in a broader sense, the biological information measuring device) judges whether the second mode has been disengaged (step S44). In an instance in which the second mode has not been disengaged, the measurement part 10 performs step S43 again. For example, the measurement part 10 can measure the pulse rate in real time, and store the pulse rate, e.g., every 10 seconds until the second mode is disengaged. For example, the second mode can be disengaged at the same time as the dedicated operation button or a similar input device for setting the second mode being pressed or otherwise operated again. Alternatively, the second mode can be disengaged at the same time as a dedicated disengage operation button or a similar

input device for disengaging the second mode has been pressed or otherwise operated. The measurement part 10 may measure the time elapsed since the second mode has been set, and automatically disengage the second mode when the elapsed time reaches, e.g., 2 hours.

[0112] FIG. 21 is a flow chart showing an example of operation of the notification part 70 in FIG. 19. In the example shown in FIG. 21, the notification part 70 (or in a broader sense, the biological information measuring device) reads the pulse rate sampled, e.g., by the measurement part 10, and notifies the test subject of the pulse rate that has been read (steps S51, S52). In an instance in which the pulse rate is stored, e.g., every 10 seconds in step S43 in FIG. 20, the notification part 70 can, in steps S51 and S52 in FIG. 21, renew the pulse rate every 10 seconds and display the current pulse rate as shown, e.g., in FIG. 16A. The configuration of the notification part 70 is not limited to that shown, e.g., in FIG. 16A, and the current pulse rate may be outputted, e.g., as an audible message.

[0113] In the example shown in FIG. 21, the notification part 70 (or in a broader sense, the biological information measuring device) notifies the test subject of where the exercise intensity corresponding to the pulse rate sampled, e.g., by the measurement part 10 is positioned in the zone (step S53). The pulse rate may be used as a unit for the second measured value; however, in the example shown in FIGS. 19 and 21, exercise intensity is used as the unit for the second measured value. In an instance in which exercise intensity is used as the unit for the second measured value, the notification part 70 can convert the pulse rate sampled by the measurement part 10 into exercise intensity (i.e., the second measured value), e.g., via the conversion part 50. Although the pulse rate may be used as a unit for the zone relating to exercise intensity, in the example shown in FIGS. 19 and 21, the exercise intensity itself is used as the unit for the zone relating to exercise intensity. Specifically, although a pulse rate zone such as those shown in FIG. 14 may be set into, e.g., the memory device of the setting part 20, an exercise intensity zone is used. In the example shown in FIG. 21, the notification part 70 can use the upper and lower limits of the exercise intensity zone read from, e.g., the setting part 20, as well as an exercise intensity corresponding to the pulse rate sampled by the measurement part 10 (i.e., the second measured value), in Equation 4, and obtain the current position in the zone relating to exercise intensity. The notification part 70 may display the current position as shown, e.g., in FIG. 16A.

[0114] In the example shown in FIG. 21, the notification part 70 (or in a broader sense, the biological information measuring device) judges whether the lower limit of the exercise intensity zone is smaller than the first threshold value (e.g., an exercise intensity of 40%), e.g., via the judgement part 80 and the setting part 20 (step S54). Specifically, the notification part 70 can judge whether the lower limit of the exercise intensity zone (i.e., target value) has been corrected in the first mode. In an instance in which the lower limit of the exercise intensity zone is smaller than the first threshold value and has been corrected, the notification part 70 (or in a broader sense, the biological information measuring device) divides the exercise intensity zone into four regions ("pass" region, "good" region, "better" region, and "best" region), e.g., via the judgement part 80, as shown, e.g., in FIG. 17C (step S55). In an instance in which the lower limit of the exercise intensity zone is equal to or greater than the first threshold value and has not been corrected, the notification

part 70 divides the exercise intensity zone into three regions, e.g., via the judgement part 80 (step S56). In an instance in which the lower limit of the exercise intensity zone has not been corrected, a “pass” region such as that shown, e.g., in FIG. 17C does not exist. Therefore, the first region (exercise intensity of 40% to 70%) can be divided into three regions (i.e., “good” region, “best” region, and “best” region).

[0115] In the example shown in FIG. 21, the notification part 70 (or in a broader sense, the biological information measuring device) judges which of the regions the exercise intensity corresponding to the pulse rate sampled by measurement part 10 (i.e., the second measured value) belongs to, e.g., via the judgement part 80, and notifies the test subject of a result of the judgement (step S57). The notification part 70 may display the result of the judgement as shown, e.g., in FIG. 18B. In an instance in which the result of the judgement indicates that it is in the “pass” region, the notification part 70 (or in a broader sense, the biological information measuring device) may issue an assistance message such as “Increase the exercise pace somewhat to enter the “good” region” as, e.g., an audible message. In an instance in which the result of the judgement shows that it is not in any region, the notification part 70 (or in a broader sense, the biological information measuring device) may issue a warning such as “The exercise pace is not appropriate” as, e.g., an audible message. The warning may be outputted as an alarm sound or another audible signal, as a red light or another light signal, or as a vibration.

2.5 Example of Modification

[0116] Assuming that, in the example shown in FIG. 19, a pulse rate zone is set in the memory device of the setting part 20 as shown in FIG. 4, the notification part 70 in FIG. 19 may treat the pulse rate sampled by the measurement part 10 itself as the second measured value. Specifically, the notification part 70 in FIG. 19 may be modified; the upper and lower limits of the pulse rate zone read from, e.g., the setting part 20, and the pulse rate sampled by the measurement part 10 (i.e., the second measured value) used in Equation 4; and the current position in the zone relating to exercise intensity obtained. The unit handled by the notification part 70 can thus be the pulse rate or exercise intensity.

3 Electronic Device

[0117] The pulse rate monitor or another biological information measuring device may be installed in a clock, a mobile phone, a pager, a PC, or another electronic device; or may be combined with the electronic device. A part of the biological information measuring device, such as the correction part 30, the conversion part 50, and the comparison part 60 in FIG. 2 and the judgement part 80 and other components in FIG. 19, may include an MPU (i.e., a microprocessing unit) of an electronic device installed with, e.g., a biological information detector.

[0118] An aspect of the illustrated embodiment relates to a biological information measuring device, including: a setting part subjected to set a target value relating to exercise intensity; a measurement part subjected to measure biological information that can be converted to exercise intensity; and a correction part subjected to correct the target value according to a first measured value relating to exercise intensity, the first

measured value being determined from biological information measured by the measurement part during a first exercise period.

[0119] According to this aspect, the target value relating to exercise intensity is corrected according to the first measured value relating to the exercise intensity during the first exercise period. The first measured value during the first exercise period (i.e., the actual physical performance of a test subject during the first exercise period) is thus taken into account. It becomes possible to take the actual physical performance of the test subject, e.g., the pulse rate during the first exercise period, into account, and to provide motivation for exercise.

[0120] In a second aspect of the illustrated embodiment, the correction part may obtain the first measured value according to a previously known biological information parameter.

[0121] It is thus possible to obtain the first measured value more accurately according to the previously known biological information parameter. The target value may also be obtained more accurately according to the previously known biological information parameter; and, according to the aspect of the invention described above, the setting part may obtain the target value according to the previously known biological information parameter.

[0122] According to a third aspect of the illustrated embodiment, in an instance in which the first measured value is smaller than a first threshold value, the correction part may correct the target value to the first measured value.

[0123] Using the first measured value as the target value thus makes it possible for biological information during exercise after the first exercise period to readily reach the target value. Therefore, it is possible to provide motivation for exercise.

[0124] According to a fourth aspect of the illustrated embodiment, in an instance in which the first measured value is equal to or less than a second threshold value that is smaller than the first threshold value, the correction part may correct the target value to the second threshold value.

[0125] Using the second threshold value as the target value thus makes it possible to prevent a low target value from being set.

[0126] According to a fifth aspect of the illustrated embodiment, the biological information measuring device may further include a first notification part subjected to notify the test subject of at least one of an ideal exercise pace for the first exercise period and a current pace.

[0127] Being presented with at least one of the ideal exercise pace for the first exercise period and the current pace thus makes it possible for the test subject to maintain the ideal exercise pace or adjust the current pace so as to be nearer the ideal exercise pace. As a result, the biological information measuring device is capable of more accurately obtaining the first measured value during the first exercise period (i.e., the actual physical performance of the test subject during the first exercise period).

[0128] According to a sixth aspect of the illustrated embodiment, the target value may be a lower limit of a zone relating to exercise intensity, and the biological information measuring device may further include a second notification part that notifies the test subject of a current position within the zone according to a second measured value relating to exercise intensity determined from biological information during a second exercise period that follows the first exercise period.

[0129] Being presented with the current position within the zone relating to exercise intensity thus makes it possible for the test subject to obtain an evaluation value for the current exercise intensity during the second exercise period that follows the first exercise period. In an instance in which the biological information measuring device includes the first notification part, the second notification part may be the first notification part. Specifically, the first notification part may notify the test subject of at least one of the exercise pace and the current pace as well as notify the test subject of the current position.

[0130] According to a seventh aspect of the illustrated embodiment, the target value may be a lower limit of a zone relating to exercise intensity; the zone may have a first region from the first threshold value to an upper limit of the zone; the first region may be divided into a plurality of subregions; and the biological information measuring device may further include a notification part that notifies the test subject whether the second measured value relating to exercise intensity determined from biological information during the second exercise period that follows the first exercise period belongs to one of the subregions of the first region.

[0131] Being presented with whether or not in one of the subregions in the first region within the zone relating to exercise intensity thus makes it possible for the test subject to obtain the current exercise intensity during within the second exercise period that follows the first exercise period.

[0132] According to an eighth aspect of the illustrated embodiment, the one of the subregions may be a subregion in which the exercise intensity is the highest among the subregions.

[0133] Being presented with whether or not in the subregion in which the exercise intensity is the highest among the subregions thus makes it possible for the test subject to determine whether the current exercise intensity during the second exercise period that follows the first exercise period is at a high level.

[0134] According to a ninth aspect of the invention, the target value may be a lower limit of a zone relating to exercise intensity; the zone may be divided into a first region from the first threshold value to an upper limit of the zone and a second region from the second threshold value or the first measured value to the first threshold value; and the biological information measuring device may further include a notification part that notifies the test subject whether the second measured value relating to exercise intensity determined from biological information during the second exercise period that follows the first exercise period belongs to one of either the first region or the second region.

[0135] Thus, the test subject is capable of evaluating the current exercise intensity during the second exercise period that follows the first exercise period, and the test subject is capable of increasing the exercise pace so as to, e.g., move from the second region to the first region. The notification part may also perform a function of at least one of the first notification part and the second notification part.

[0136] According to a tenth aspect of the illustrated embodiment, the target value may be a lower limit of a zone relating to exercise intensity; the zone may be divided into a first region from the first threshold value to an upper limit of the zone and a second region from the first measured value to the first threshold value; and the biological information measuring device may further include a notification part that notifies the test subject whether the second measured value

relating to exercise intensity determined from biological information during the second exercise period that follows the first exercise period belongs to one of either the first region or the second region.

[0137] Thus, the test subject is capable of evaluating the current exercise intensity during the second exercise period that follows the first exercise period, and the test subject is capable of increasing the exercise pace so as to, e.g., move from the second region to the first region. The notification part may also perform a function of at least one of the first notification part and the second notification part.

[0138] According to an eleventh aspect of the illustrated embodiment, the measurement part may measure the pulse rate or the heart rate as the biological information, and the correction part may correct the target value according to the first measured value determined from the pulse rate or the heart rate measured by the measurement part during the first exercise period.

[0139] The pulse rate or the heart rate can thus be used as biological information. It is possible to provide a biological information measuring device (a pulse rate monitor or a heart rate monitor) capable of providing motivation for exercise.

[0140] Although the present embodiment has been described in detail above, persons skilled in the art should be able to easily understand that various modifications are possible without substantially departing from the scope and effects of the invention. Accordingly, all of such examples of modifications are to be included in the scope of the invention. For example, terms stated at least once together with different terms having broader sense or identical sense in the specification or drawings may be replaced with those different terms in any and all locations of the specification or drawings.

What is claimed is:

1. A biological information measuring device worn by a subject's body, the device comprising:

a setting part storing a preset target range information representing a suitable range for an exercise intensity, the preset target range information being generated based on an age of the subject;

a measurement part measuring a biological information relating to the exercise intensity performed by the subject;

a correction part correcting the preset target range information stored in the setting part based on the biological information measured by the measurement part during a first exercise period to generate a corrected range information; and

a notification part notifying an information indicative of the exercise intensity with respect to the corrected range information during a second exercise period, which is after the first exercise period, based on the biological information measured by the measurement part during the second exercise period.

2. The biological information measuring device according to claim 1, wherein

each of the preset target range information and the corrected range information is comprised of an upper limit and a lower limit of the biological information.

3. The biological information measuring device according to claim 1, wherein

the corrected range information is comprised of at least one sub-ranges each of which has a different meaning.

4. The biological information measuring device according to claim 1, wherein

the corrected range information is generated using the biological information measured after a predetermined time elapsed from the start of the exercise during the first exercise period.

5. The biological information measuring device according to claim 1, wherein

the corrected range information is generated by walking at a predetermined pace for a predetermined duration with a pacing signal generated by the notification part.

6. The biological information measuring device according to claim 1, wherein

the measurement part measures a pulse rate or a heart rate as the biological information, and
each of the preset target range information and the corrected range information represents a pulse rate range or a heart rate range of the subject.

7. The biological information measuring device according to claim 5, wherein

the pacing signal is not generated when the subject performs the exercise during the second exercise period.

8. The biological information measuring device according to claim 1, wherein

the correction part corrects the preset target range information by comparing the biological information measured by the measurement part during the first exercise period with a first threshold value.

9. A method for measuring a biological information by a device worn by a subject, comprising:

storing a preset target information representing a suitable range for an exercise intensity, the preset target range information being generated based on an age of the subject;

measuring a biological information by a measuring part relating to the exercise intensity performed by the subject;

correcting the preset target range information based on the biological information measured by the measuring part during a first exercise period to generate a corrected range information; and

notifying by a notification part an information indicative of the exercise intensity with respect to the corrected range information during a second exercise period, which is after the first exercise period, based on the biological information measured by the measurement part during the second exercise period.

10. The method according to claim 9, wherein
each of the preset target range information and the corrected range information is comprised of an upper limit and a lower limit of the biological information.

11. The method according to claim 9, wherein
the corrected range information is comprised of at least one sub-ranges each of which has a different meaning.

12. The method according to claim 9, wherein
the corrected range information is generated using the biological information measured after a predetermined time elapsed from the start of the exercise during the first exercise period.

13. The method according to claim 9, wherein
the corrected range information is generated by walking at a predetermined pace for a predetermined duration with a pacing signal generated by the notification part.

14. The method according to claim 9, wherein
the measuring the biological information includes measuring a pulse rate or a heart rate as the biological information, and

each of the preset target range information and the corrected range information represents a pulse rate range or a heart rate range of the subject.

15. The method according to claim 13, wherein
the pacing signal is not generated when the subject performs the exercise during the second exercise period.

16. The method according to claim 9, wherein
the correcting of the preset target range information includes comparing the biological information measured by the measurement part during the first exercise period with a first threshold value.

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专利名称(译)	生物信息测量装置		
公开(公告)号	US20150265160A1	公开(公告)日	2015-09-24
申请号	US14/729336	申请日	2015-06-03
[标]申请(专利权)人(译)	精工爱普生株式会社		
申请(专利权)人(译)	SEIKO EPSON CORPORATION		
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发明人	KATO, HIDETADA SHIHO, KAZUHIRO HEISHI, TOSHIHIRO NAKAZAWA, HIRONORI		
IPC分类号	A61B5/024 A61B5/00 A61B5/11		
CPC分类号	A61B5/024 A61B5/742 A61B5/7405 A61B5/1118 A61B5/02438 A61B5/02455		
优先权	2010020015 2010-02-01 JP 2010218337 2010-09-29 JP		
外部链接	Espacenet USPTO		

摘要(译)

一种由对象身体佩戴的生物信息测量装置，包括设置部分，测量部分，校正部分和通知部分。设置部件存储表示运动强度的合适范围的预设目标范围信息，该预设目标范围信息是基于对象的年龄生成的。测量部分测量与运动强度有关的生物信息。校正部分基于在第一锻炼时段期间由测量部分测量的生物信息来校正存储在设置部分中的预设目标范围信息，以产生校正范围信息。通知部分基于在第二锻炼时段期间由测量部分测量的生物信息，在第二锻炼时段（第一锻炼时段之后）期间通知关于校正范围信息的指示锻炼强度的信息。

