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(54) **PHYSICAL ACTIVITY ASSISTANCE APPARATUS, PHYSICAL ACTIVITY ASSISTANCE SYSTEM, PHYSICAL ACTIVITY ASSISTANCE METHOD, AND PHYSICAL ACTIVITY ASSISTANCE PROGRAM**

(71) Applicant: **Seiko Epson Corporation**, Tokyo (JP)

(72) Inventor: **Daisuke Higashi**, Suwa-shi (JP)

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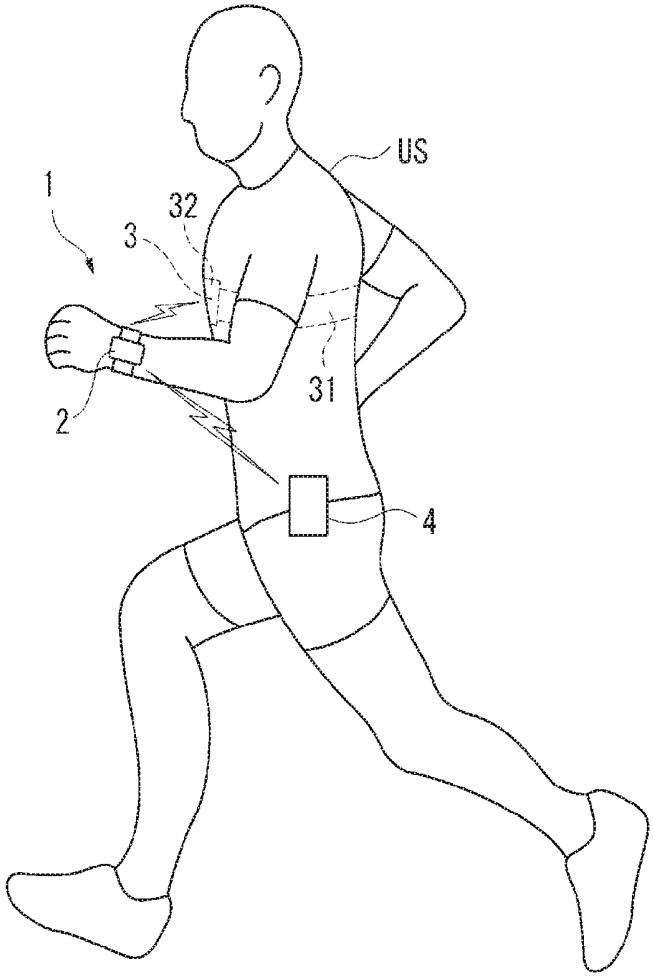
(57) **ABSTRACT**

A physical activity assistance apparatus includes a blood oxygen concentration measurement section (biological information detection section and blood oxygen concentration calculation section) that measures a user's blood oxygen concentration and a breathing instruction section that instructs the user to practice a predetermined breathing method when the blood oxygen concentration is lower than or equal to a first threshold. The thus configured physical activity assistance apparatus can appropriately support the user's physical activity.



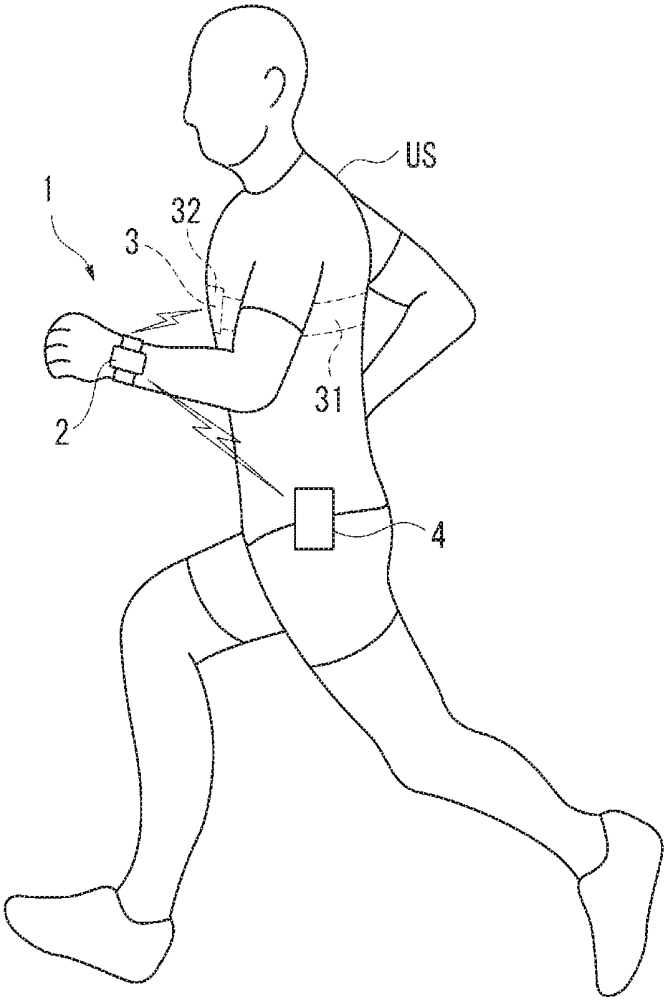



FIG. 1

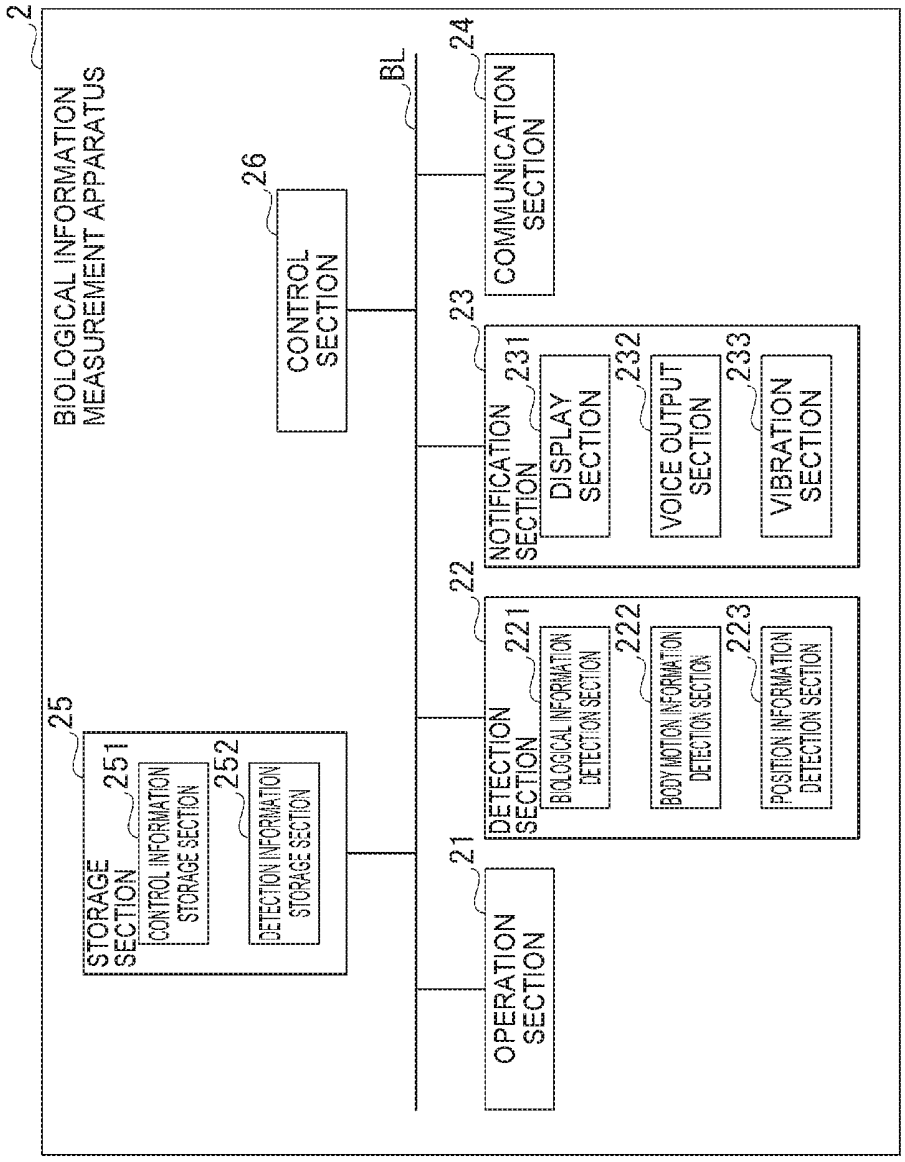

2
BIOLOGICAL INFORMATION MEASUREMENT APPARATUS
25
STORAGE SECTION
251
CONTROL INFORMATION STORAGE SECTION
252
DETECTION INFORMATION STORAGE SECTION
26
CONTROL SECTION
BL
24
COMMUNICATION SECTION
23
NOTIFICATION SECTION
231
DISPLAY SECTION
232
VOICE OUTPUT SECTION
233
VIBRATION SECTION
22
DETECTION SECTION
221
BIOLOGICAL INFORMATION DETECTION SECTION
222
BODY MOTION INFORMATION DETECTION SECTION
223
POSITION INFORMATION DETECTION SECTION
21
OPERATION SECTION

FIG. 2

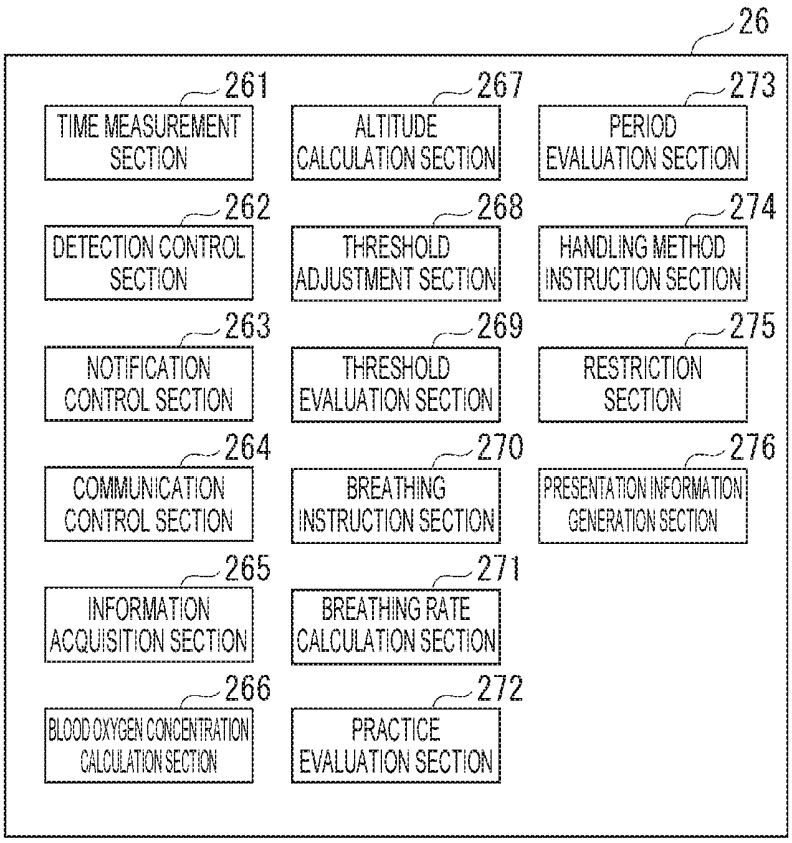

26
261
TIME MEASUREMENT SECTION
262
DETECTION CONTROL SECTION
263
NOTIFICATION CONTROL SECTION
264
COMMUNICATION CONTROL SECTION
265
INFORMATION ACQUISITION SECTION
266
BLOOD OXYGEN CONCENTRATION CALCULATION SECTION
267
ALTITUDE CALCULATION SECTION
268
THRESHOLD ADJUSTMENT SECTION
269
THRESHOLD EVALUATION SECTION
270
BREATHING INSTRUCTION SECTION
271
BREATHING RATE CALCULATION SECTION
272
PRACTICE EVALUATION SECTION
273
PERIOD EVALUATION SECTION
274
HANDLING METHOD INSTRUCTION SECTION
275
RESTRICTION SECTION
276
PRESENTATION INFORMATION GENERATION SECTION

FIG. 3

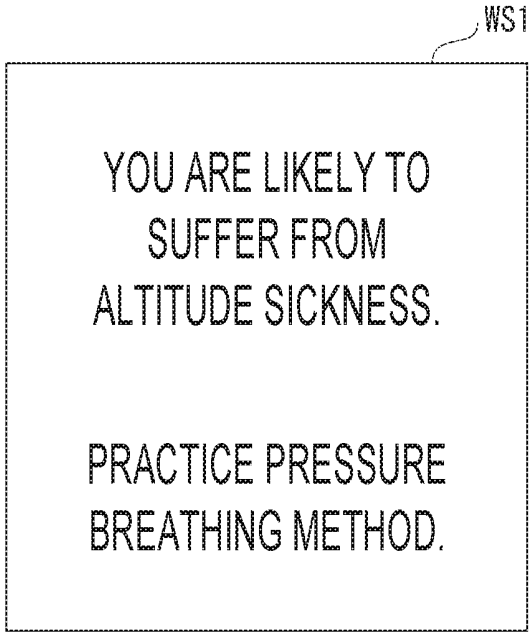

WS1
YOU ARE LIKELY TO SUFFER FROM ALTITUDE SICKNESS.
PRACTICE PRESSURE BREATHING METHOD.

FIG. 4


FIG. 5

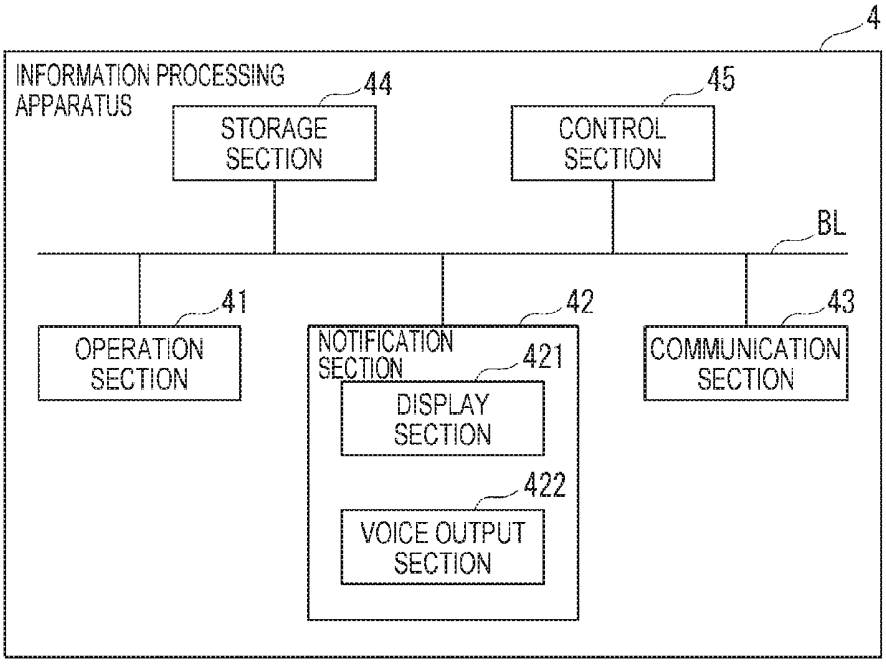

4
INFORMATION PROCESSING APPARATUS
44
STORAGE SECTION
45
CONTROL SECTION
BL
41
OPERATION SECTION
42
NOTIFICATION SECTION
421
DISPLAY SECTION
422
VOICE OUTPUT SECTION
43
COMMUNICATION SECTION

FIG. 6

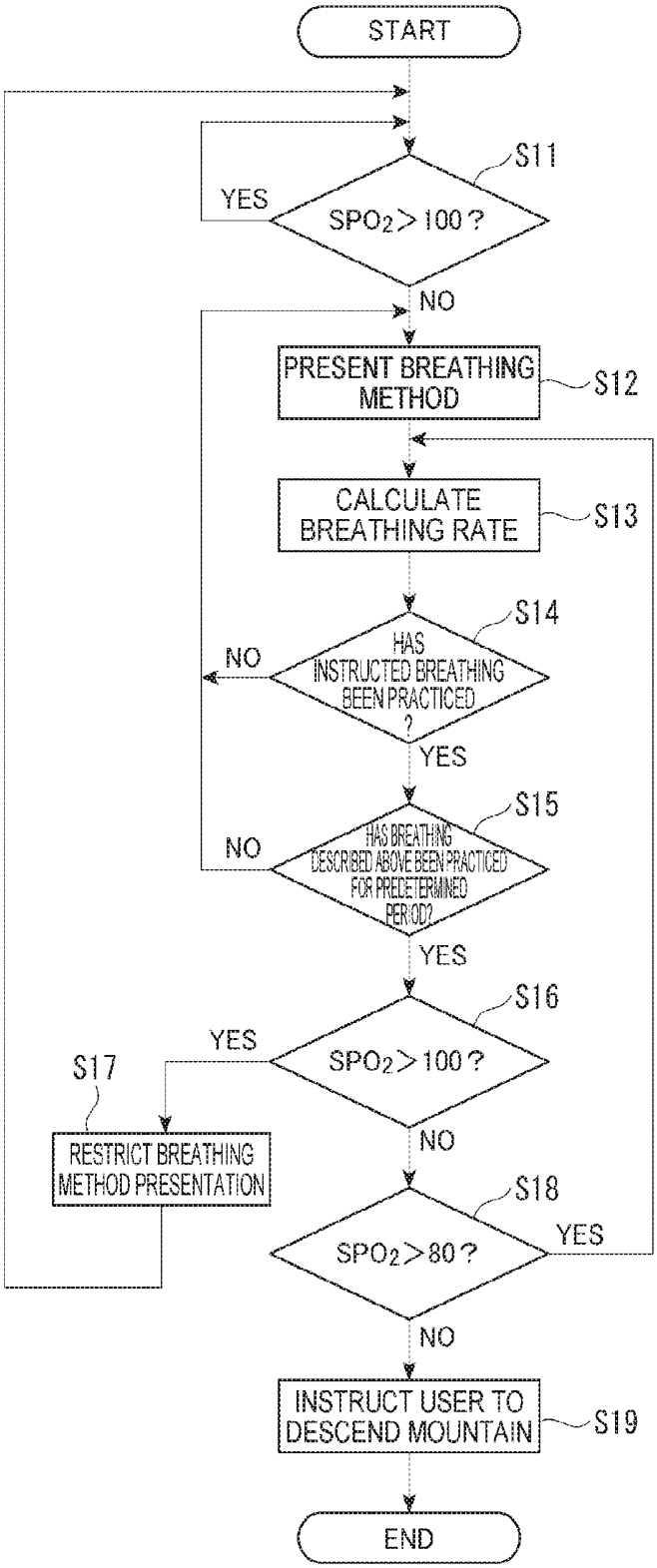

START
S11
YES
SPO2 > 100 ?
NO
PRESENT BREATHING METHOD
S12
CALCULATE BREATHING RATE
S13
S14
NO
HAS INSTRUCTED BREATHING BEEN PRACTICED ?
YES
S15
NO
HAS BREATHING DESCRIBED ABOVE BEEN PRACTICED FOR PREDETERMINED PERIOD?
YES
S16
YES
S17
SPO2 > 100 ?
RESTRICT BREATHING METHOD PRESENTATION
NO
S18
YES
SPO2 > 80 ?
NO
INSTRUCT USER TO DESCEND MOUNTAIN
S19
END

FIG. 7

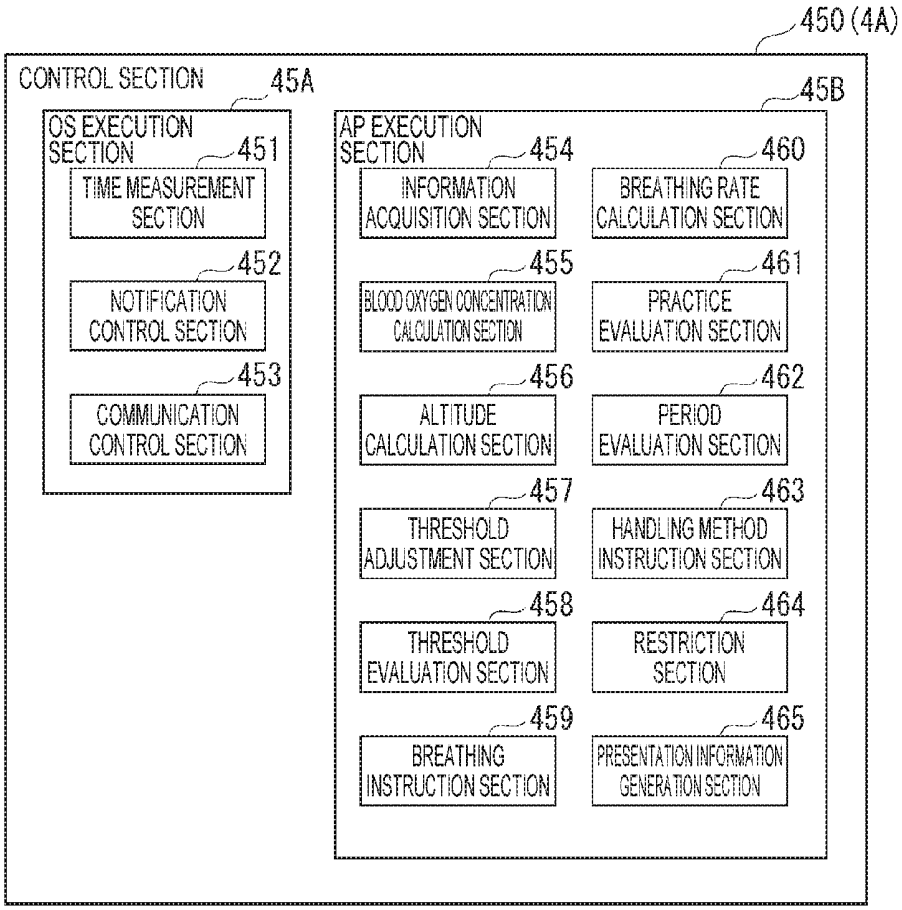

450 (4A)
CONTROL SECTION
45A
OS EXECUTION SECTION
451
TIME MEASUREMENT SECTION
452
NOTIFICATION CONTROL SECTION
453
COMMUNICATION CONTROL SECTION
45B
AP EXECUTION SECTION
454
INFORMATION ACQUISITION SECTION
455
BLOOD OXYGEN CONCENTRATION CALCULATION SECTION
456
ALTITUDE CALCULATION SECTION
457
THRESHOLD ADJUSTMENT SECTION
458
THRESHOLD EVALUATION SECTION
459
BREATHING INSTRUCTION SECTION
460
BREATHING RATE CALCULATION SECTION
461
PRACTICE EVALUATION SECTION
462
PERIOD EVALUATION SECTION
463
HANDLING METHOD INSTRUCTION SECTION
464
RESTRICTION SECTION
465
PRESENTATION INFORMATION GENERATION SECTION

FIG. 8

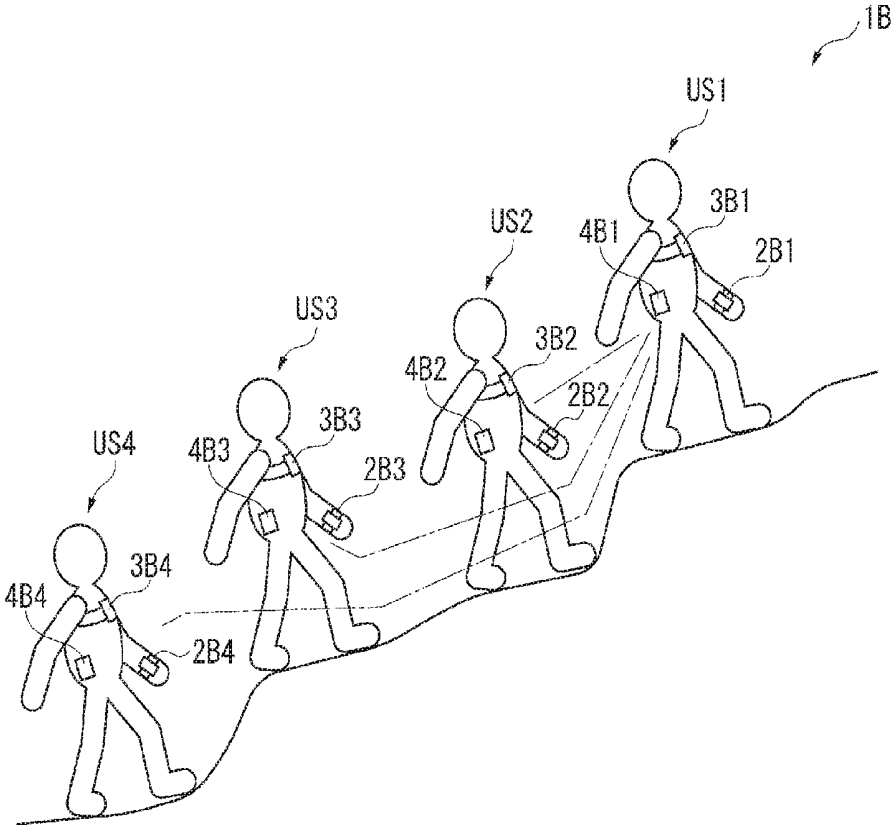

1B
US1
US2
US3
US4
3B1
4B1
2B1
3B2
4B2
2B2
3B3
4B3
2B3
3B4
4B4
2B4

FIG. 9


WS3
WARNING!
US3 IN PARTY IS IN DANGER OF SUFFERING FROM ALTITUDE SICKNESS. LET US3 TO TAKE REST AND PRACTICE PRESSURE BREATHING METHOD.

FIG. 10

# PHYSICAL ACTIVITY ASSISTANCE APPARATUS, PHYSICAL ACTIVITY ASSISTANCE SYSTEM, PHYSICAL ACTIVITY ASSISTANCE METHOD, AND PHYSICAL ACTIVITY ASSISTANCE PROGRAM

## CROSS-REFERENCES TO RELATED APPLICATIONS

**[0001]** This application claims priority to Japanese Patent Application No. 2015-158980, filed Aug. 11, 2015, the entirety of which is herein incorporated by reference.

## BACKGROUND

**[0002]** 1. Technical Field

**[0003]** The present invention relates to a physical activity assistance apparatus, a physical activity assistance system, a physical activity assistance method, and a physical activity assistance program.

**[0004]** 2. Related Art

**[0005]** There has been a known travel assistance information providing system of related art that generates travel assistance information in consideration of a user's physical condition (see JP-A-2013-220182, for example).

**[0006]** The travel assistance information providing system described in JP-A-2013-220182 includes an environment prediction section and a travel assistance information generation section. Out of the two sections, the environment prediction section uses environment information (atmospheric pressure, temperature, humidity, and wind direction, for example) along a path along which the user travels to predict changes in the environment along the path. The travel assistance information generation section uses a result of the predication performed by the environment prediction section and the user's biological information (heart rate, pulse rate, and blood sugar level, for example) to generate travel assistance information including advice on the user's travel. The user then acts on the basis of the travel assistance information to avoid a situation in which the user is involved in a risky state.

**[0007]** In the travel assistance information providing system described in JP-A-2013-220182, in which the travel assistance information is provided on the basis of the user's biological information and the environment information along a path along which the user travels, when the user is, for example, climbing a mountain, the system abruptly recommends the user to descend the mountain on the basis of the information described above. For example, even in a case where the user's condition, such as the degree of altitude sickness, is likely to be improved by causing the user to take a rest for a while or practice a predetermined breathing method, that is, even in a case where the user does not necessarily descend the mountain, the system recommends the user to descend the mountain in some cases. The user cannot therefore continue physical activity (mountain climbing described above, for example) that the user can potentially perform in some cases, and the system undesirably cannot always appropriately support the user's physical activity.

## SUMMARY

**[0008]** An advantage of some aspects of the invention is to provide a physical activity assistance apparatus, a physical activity assistance system, a physical activity assistance method, and a physical activity assistance program capable of appropriately supporting a user's physical activity.

**[0009]** A physical activity assistance apparatus according to a first aspect of the invention includes a blood oxygen concentration measurement section that measures a user's blood oxygen concentration and a breathing instruction section that instructs the user to practice a predetermined breathing method when the blood oxygen concentration is lower than or equal to a first threshold.

**[0010]** A pressure breathing method can be exemplified as the predetermined breathing method described above. In the first aspect, for example, in a case where the first threshold is set at a value below which the user is likely to suffer from altitude sickness, the user is instructed, when the blood oxygen concentration is lower than or equal to the first threshold, to practice a breathing method that allows the blood oxygen concentration to rise, whereby the user can lower a risk of developing altitude sickness by practicing breathing in accordance with the instruction. Therefore, for example, when the user practices the breathing method to successfully cause the blood oxygen concentration to be higher than the first threshold, the user can continue the physical activity. The physical activity assistance apparatus can therefore appropriately support the user's physical activity.

**[0011]** In the first aspect, it is preferable that the physical activity assistance apparatus preferably further include a breathing detection section that detects the user's breathing, a practice evaluation section that evaluates based on a result of the detection performed by the breathing detection section whether or not the user is practicing breathing according to the breathing method, and a handling method instruction section that instructs the user to practice a handling method when the practice evaluation section determines that the user is practicing the breathing according to the breathing method and the measured blood oxygen concentration is lower than or equal to a second threshold lower than the first threshold.

**[0012]** Suspension of the physical activity can be exemplified as the handling method described above. For example, when the user is climbing a mountain, descending the mountain can be exemplified as the handling method.

**[0013]** According to the first aspect with the configuration described above, in a case where the blood oxygen concentration is lower than or equal to the second threshold, which is lower than the first threshold, even after the user practices the breathing method, the user is instructed to practice the handling method, whereby a situation in which the user continues the physical activity and is involved in a risky state (altitude sickness, for example) can be avoided. The physical activity assistance apparatus can therefore appropriately support the user's physical activity.

**[0014]** In the first aspect, it is preferable that the physical activity assistance apparatus further includes a breathing detection section that detects the user' s breathing, a practice evaluation section that evaluates based on a result of the detection performed by the breathing detection section whether or not the user is practicing breathing according to the breathing method, a period acquisition section that acquires, when the practice evaluation section determines that the user is practicing the breathing according to the breathing method, a period for which the user has been practicing the breathing according to the breathing method, and a handling method instruction section that instructs the

user to practice a handling method when the acquired period is longer than a predetermined period and the measured blood oxygen concentration is not higher than a second threshold lower than the first threshold.

**[0015]** According to the first aspect with the configuration described above, in a case where the blood oxygen concentration is not higher than the second threshold even after the user practices the breathing method for the predetermined period, the user is instructed to practice the handling method, whereby a situation in which the user continues the physical activity and is involved in a risky state can be further avoided. The physical activity assistance apparatus can therefore more appropriately support the user's physical activity.

**[0016]** In the first aspect, it is preferable that the breathing detection section includes a first sensor that detects motion of the user's chest.

**[0017]** According to the first aspect with the configuration described above, since the first sensor can detect the motion of the user's chest, the user's breathing rate can be readily measured. The practice evaluation section can therefore evaluate on the basis of the breathing rate whether or not the user is appropriately practicing the breathing method. The physical activity assistance apparatus can therefore more adequately provide the user with a handling method instruction.

**[0018]** In the first aspect, it is preferable that the breathing detection section includes a second sensor that detects the user's body motion, and that the practice evaluation section evaluates based on results of the detection performed with the first sensor and the second sensor whether or not the user is practicing the breathing according to the breathing method.

**[0019]** According to the first aspect with the configuration described above, since the breathing evaluation section evaluates whether or not the user is practicing the breathing method on the basis of the motion of the user's body motion and chest motion, the breathing evaluation section can more accurately evaluate whether or not the user is practicing the breathing method. The physical activity assistance apparatus can therefore further adequately provide the user with a handling method instruction.

**[0020]** In the first aspect, it is preferable that the physical activity assistance apparatus further includes an altitude detection section that detects altitude and an adjustment section that adjusts the first threshold in accordance with the detected altitude.

**[0021]** A GPS (global positioning system), an atmospheric pressure meter, and other devices can be exemplified as the altitude detection section.

**[0022]** In the first aspect with the configuration described above, in the case where the first threshold is set at a value below which the user is likely to suffer from altitude sickness, the first threshold can be adjusted on an altitude basis. The physical activity assistance apparatus can therefore adequately provide the user with a handling method instruction in accordance with the altitude.

**[0023]** In the first aspect, it is preferable that the physical activity assistance apparatus further includes a restriction section that restricts an instruction issued by the breathing instruction section when the blood oxygen concentration is higher than the first threshold.

**[0024]** According to the first aspect with the configuration described above, since the instruction issued by the breathing instruction section is restricted when the blood oxygen concentration is higher than the first threshold, that is, when the user's blood oxygen concentration reaches an appropriate value, the user can recognize that the blood oxygen concentration has reached the appropriate value. The fact the instruction is no longer made therefore allows the user to readily recognize that the user can continue the physical activity (mountain climbing, for example).

**[0025]** A physical activity assistance system according to a second aspect of the invention includes the physical activity assistance apparatus and an information processing apparatus capable of communicating with the physical activity assistance apparatus. The physical activity assistance apparatus transmits a warning signal when the blood oxygen concentration is lower than or equal to the first threshold and the second threshold, and the information processing apparatus includes a notification section that notifies the user of a warning when the warning signal is received.

**[0026]** The second aspect can provide the same advantageous effects as those provided by the physical activity assistance apparatus according to the first aspect. Further, a leader of a mountain climbing party or any other person who possesses the information processing apparatus described above can grasp both a state in which a member of the party is likely to suffer from altitude sickness and a state in which the member has suffered from altitude sickness.

**[0027]** A physical activity assistance method according to a third aspect of the invention is a physical activity assistance method performed with use of an instruction apparatus that instructs a user to practice a breathing method, the method including measuring the user's blood oxygen concentration and instructing the user to practice a predetermined breathing method when the blood oxygen concentration is lower than or equal to a first threshold.

**[0028]** The third aspect can provide the same advantageous effects as those provided by the physical activity assistance apparatus according to the first aspect described above.

**[0029]** A physical activity assistance program according to a fourth aspect of the invention is a physical activity assistance program executed by a computer, the program causing the computer to perform acquiring a user's blood oxygen concentration and instructing the user to practice a predetermined breathing method when the blood oxygen concentration is lower than or equal to a first threshold.

**[0030]** The fourth aspect, in which the computer executes the physical activity assistance program, can provide the same advantageous effects as those provided by the physical activity assistance apparatus according to the first aspect described above.

**[0031]** The physical activity assistance program may be recorded on a computer readable recording medium.

**[0032]** The configuration described above, in which the computer reads and executes as appropriate the physical activity assistance program recorded on the recording medium, can provide the same advantageous effects as those provided by the physical activity assistance apparatus according to the first aspect described above. As the recording medium, a magnetic tape, a magnetic disk, an optical disk, a magneto-optical disk, an HDD (hard disk drive), and a semiconductor memory can be employed. The physical activity assistance program can be not only installed in the computer and executed but also readily distributed by using any of the recording media described above. Further, the

physical activity assistance program may be acquired from a server or any other apparatus on a network, installed in a computer and executably distributed.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0033]** The invention will be described with reference to the accompanying drawings, wherein like numbers reference like elements.

**[0034]** FIG. **1** is a diagrammatic view showing the configuration of a physical activity assistance system according to a first embodiment of the invention.

**[0035]** FIG. **2** is a block diagram showing the configuration of a biological information measurement apparatus that forms the physical activity assistance system according to the first embodiment.

**[0036]** FIG. **3** is a block diagram showing the configuration of a control section of the biological information measurement apparatus according to the first embodiment.

**[0037]** FIG. **4** shows an example of a breathing method presentation screen displayed in a breathing method presentation process according to the first embodiment.

**[0038]** FIG. **5** shows an example of a handling method presentation screen displayed in a handling method presentation process according to the first embodiment.

**[0039]** FIG. **6** is a block diagram showing the configuration of an information processing apparatus that forms the physical activity assistance system according to the first embodiment.

**[0040]** FIG. **7** is a flowchart showing a notification control process carried out by a physical activity assistance apparatus according to the first embodiment.

**[0041]** FIG. **8** is a block diagram showing the configuration of a control section of an information processing apparatus that forms a physical activity assistance system according to a second embodiment of the invention.

**[0042]** FIG. **9** is a diagrammatic view showing the configuration of a physical activity assistance system according to a third embodiment of the invention.

**[0043]** FIG. **10** shows an example of a warning screen displayed in a notification control process according to the third embodiment.

## DESCRIPTION OF EXEMPLARY EMBODIMENTS

### First embodiment

**[0044]** A first embodiment of the invention will be described below with reference to the drawings.

### Schematic Configuration of Physical Activity Assistance System

**[0045]** FIG. **1** is a diagrammatic view showing a schematic configuration of a physical activity assistance system **1** according to the present embodiment.

**[0046]** The physical activity assistance system **1** according to the present embodiment includes a biological information measurement apparatus **2** (hereinafter referred to as measurement apparatus in some cases), a breathing detection apparatus **3**, which forms part of the measurement apparatus **2**, and an information processing apparatus **4**, which communicates with the measurement apparatus **2**, as shown in FIG. **1**. Among the components described above, the measurement apparatus **2** (instruction apparatus) and the breathing detection apparatus **3** correspond to the physical activity assistance apparatus according to an aspect of the invention.

**[0047]** The physical activity assistance system **1** is used by a user US who performs physical activity (mountain climbing, for example). In the physical activity assistance system **1**, when the user US who is performing the physical activity is likely to be involved in an abnormal physical condition, the measurement apparatus **2** and the breathing detection apparatus **3** instruct the user to practice a predetermined breathing method, and even when the user US is still involved in the abnormal physical condition after the user US practices the breathing method, the measurement apparatus **2** and the breathing detection apparatus **3** instruct the user to practice a handling method for eliminating the abnormal physical condition.

**[0048]** Specifically, the physical activity assistance system **1** evaluates whether or not the user US is in danger of suffering from altitude sickness on the basis of biological information detected by the measurement apparatus **2** and the breathing detection apparatus **3**, and when a result of the evaluation shows that the user US is in danger of suffering from altitude sickness, the physical activity assistance system **1** causes display sections of the measurement apparatus **2** and the breathing detection apparatus **3** to display a screen that instructs the user to practice the breathing method described above. Further, even after the user US practices the breathing method, when it is evaluated on the basis of the biological information described above, the breathing rate, and other factors that the user US is likely to be suffering from altitude sickness, the physical activity assistance system **1** causes the display sections of the measurement apparatus **2** and the breathing detection apparatus **3** to display a screen that instructs the user to descend the mountain.

**[0049]** The physical activity is not limited to mountain climbing and refers to general physical activity that involves motion of the body, such as high-altitude walking, running, and sports.

**[0050]** The measurement apparatus **2**, the breathing detection apparatus **3**, and the information processing apparatus **4** will be described below.

### Configuration of Biological Information Measurement Apparatus

**[0051]** FIG. **2** is a block diagram showing the configuration of the biological information measurement apparatus **2**.

**[0052]** The biological information measurement apparatus **2** is a wearable apparatus that is attached to the user US, as shown in FIG. **1**, and detects and analyzes the user US's biological information and body motion information. The thus configured measurement apparatus **2** includes an operation section **21**, a detection section **22**, a notification section **23**, a communication section **24**, a storage section **25**, and a control section **26**, and these sections are connected to one another via a bus line BL, as shown in FIG. **2**.

### Configuration of Operation Section

**[0053]** The operation section **21** has a plurality of buttons (not shown) disposed on an exterior case of the measurement apparatus **2** and outputs an operation signal according to a button that receives input operation (pressed-down button)to the control section **26**. The operation section **21** does not necessarily have the configuration having buttons

and may instead be a touch panel disposed on a display section **231**, which will be described later, or may instead be configured to detect the user's tap operation.

Configuration of Detection Section

**[0054]** The detection section **22** includes a biological information detection section **221**, a body motion information detection section **222**, and a position information detection section **223**.

**[0055]** The biological information detection section **221** detects the user's biological information and outputs the biological information to the control section **26** under the control of the control section **26**. The biological information detection section **221** detects the biological information in the form of the blood oxygen concentration and may be configured to further detect the pulse, heart rate, blood pressure, blood sugar level, body temperature, sweat rate, and other factors.

**[0056]** Specifically, the biological information detection section **221** applies infrared light to the blood flowing through the user US's blood vessel and detects the luminosity of light reflected off hemoglobin and oxyhemoglobin, which emit light in accordance with the applied infrared light.

**[0057]** The body motion information detection section **222** corresponds to the second sensor according to an aspect of the invention, detects body motion information representing the user's body motion, and outputs the body motion information to the control section **26** under the control of the control section **26**. In the present embodiment, the body motion information detection section **222** detects the body motion information in the form of an acceleration signal that changes in accordance with the user's body motion. The body motion information detection section **222** may further detect angular velocity that changes in accordance with the user's body motion as well as the acceleration.

**[0058]** The position information detection section **223** acquires position information representing the current position of the measurement apparatus **2** (that is, position information representing current position of user US). For example, the position information detection section **223** corresponds to a satellite positioning system, such as a GPS (global positioning system), and acquires position information representing the current position described above on the basis of a radio wave received from a satellite. The position information detection section **223** then outputs the acquired position information to the control section **26**. In place of the configuration described above, a configuration in which a communication radio wave is used to calculate the position information may be employed.

Configuration of Notification Section

**[0059]** The notification section **23** notifies the user of a variety of pieces of information under the control of the control section **26**. The notification section **23** includes a display section **231**, a voice output section **232**, and a vibration section **233**.

**[0060]** The display section **231** has a display unit, such as a liquid crystal display panel or any of a variety of other display panels and a plurality of LEDs (light emitting diodes), and displays information inputted from the control section **26**. For example, the display section **231** displays the biological information and the body motion information detected by the detection section **22** described above. The display section **231** further displays a warning screen (breathing method presenting screen and handling method presenting screen) and other screens based on presentation information generated by the control section **26**.

**[0061]** The voice output section **232** includes a voice output unit, such as a loudspeaker, and outputs voice according to a voice signal inputted from the control section **26**.

**[0062]** The vibration section **233** has a motor the action of which is controlled by the control section **26** and notifies the user of, for example, a warning in the form of vibration produced by the driven motor.

Configuration of Communication Section

**[0063]** The communication section **24** includes a communication module that can communicate with the breathing detection apparatus **3** and the information processing apparatus **4** described above. The communication section **24** acquires data on the user US's breathing detected by the breathing detection apparatus **3**. The communication section **24** transmits not only the biological information and the body motion information detected and acquired by the measurement apparatus **2** but also warning information that notifies the user US's abnormal physical condition and other pieces of information to the information processing apparatus **4**.

**[0064]** In the present embodiment, the communication section **24** communicates with the information processing apparatus **4** in accordance with a short-range wireless communication scheme. Instead, the communication section **24** may communicate with the information processing apparatus **4** via a cradle or any other relay device or may communicate with the information processing apparatus **4** via a cable. The communication section **24** may still instead communicate with the information processing apparatus **4** and other external apparatus via a network.

Configuration of Storage Section

**[0065]** The storage section **25** is formed of a storage unit including a flash memory or any other storage device and includes a control information storage section **251** and a detection information storage section **252**.

**[0066]** The control information storage section **251** stores control information, such as a variety of programs and data necessary for the action of the measurement apparatus **2**. As examples of the programs, the control information storage section **251** stores a control program that controls the measurement apparatus **2** and a notification control program for carrying out a physical activity assistance process including a breathing method notification process and a handling method notification process. The notification control process will be described later in detail.

**[0067]** The control information storage section **251** further stores, as the data described above, connection information necessary for communication connection with the breathing detection apparatus **3** and the information processing apparatus **4** and setting information inputted, for example, by the user. The setting information contains a first threshold and a second threshold of the blood oxygen concentration ($SPO_2$).

**[0068]** The first threshold and the second threshold are indices used to evaluate whether or not the user US is capable of mountain climbing. Out of the two thresholds, the first threshold is a value below which the user US is likely

to suffer from altitude sickness and set and stored in advance by the user US or a medical worker. The second threshold is a value below which the user US has possibly suffered from altitude sickness and set and stored in advance by the user US or a medical worker, as in the case of the first threshold. For example, in the present embodiment, the first threshold is set at 100 $SPO_2$, and the second threshold is set at 80 $SPO_2$.

**[0069]** In the present embodiment, the first threshold and the second threshold can be changed as appropriate, as will be described later in detail, in accordance with the current location (altitude) where the user US is present.

**[0070]** The setting information described above further contains a breathing method practice limit period (10 minutes in initial state) and a restriction implementation limit period (3 minutes in initial state) in addition to the first threshold and the second threshold.

**[0071]** Among the parameters contained in the setting information, the breathing method practice limit period and the restriction implementation limit period are inputted and set by the user US or a medical worker via a setting screen displayed in the display section **23**.

**[0072]** The detection information storage section **252** stores the biological information and the body motion information detected by the detection section **22** described above and results of analysis of the biological information and the body motion information (blood oxygen concentration and breathing rate, for example) performed by the control section **26**. The detection information storage section **252** is configured to successively store these pieces of information and overwrite the information stored at the earliest point of time with newly acquired information in a case where the detection information storage section **252** is short of storage capacity.

Configuration of Control Section

**[0073]** FIG. **3** is a block diagram showing the configuration of the control section **26**.

**[0074]** The control section **26** includes a processing circuit, such as a CPU (central processing unit), and controls the action of the measurement apparatus **2** autonomously or in accordance with an operation signal inputted via the operation section **21** described above. The control section **26** has a time measurement section **261**, a detection control section **262**, a notification control section **263**, a communication control section **264**, an information acquisition section **265**, a blood oxygen concentration calculation section **266**, an altitude calculation section **267**, a threshold adjustment section **268**, a threshold evaluation section **269**, a breathing instruction section **270**, a breathing rate calculation section **271**, a practice evaluation section **272**, a period evaluation section **273**, a handling method instruction section **274**, a restriction section **275**, and a presentation information generation section **276** as functional sections achieved when the processing circuit executes the program stored in the control information storage section **251**, as shown in FIG. **3**.

**[0075]** The time measurement section **261** measures the current date and time.

**[0076]** The detection control section **262** controls the action of the detection section **22** described above. For example, the detection control section **262**, when it determines that the measurement apparatus **2** is not attached to the user, causes the biological information detection section **221** to stop detecting the biological information to lower power consumption.

**[0077]** The notification control section **263** controls the action of the notification section **23**. For example, the notification control section **263** outputs notification information containing display and voice representing the state of the action of the measurement apparatus **2**, results of the detection performed by the detection section **22**, and other pieces of information to the notification section **23** to cause the notification section **23** to notify the notification information. The notification control section **263** further causes a setting screen where a variety of settings of the measurement apparatus **2** are inputted and changed to be displayed. The notification control section **263** further drives the motor of the vibration section **233** as required to notify predetermined information in the form of vibration produced by the driven motor.

**[0078]** The communication control section **264** controls the action of the communication section **24** described above.

**[0079]** The information acquisition section **265** acquires a variety of signals and a variety of pieces of information inputted from the operation section **21**, the detection section **22**, and the communication section **24**. For example, the information acquisition section **265** acquires the content of an input to the setting screen described above on the basis of an operation signal according to input operation performed on the setting screen. The information acquisition section **265** further acquires the biological information (for example, information on luminosity of light reflected off hemoglobin and oxyhemoglobin in user US's blood), the body motion information, and the position information inputted from the detection section **22** and causes the storage section **25** (detection information storage section **252**) to store these pieces of information. The information acquisition section **265** further acquires data on the breathing (breathing information) detected by the breathing detection apparatus **3** and causes the storage section **25** (detection information storage section **252**) to store the data.

**[0080]** The blood oxygen concentration calculation section **266** calculates the user US's blood oxygen concentration on the basis of the biological information inputted from the biological information detection section **221**. Specifically, the blood oxygen concentration calculation section **266** detects the user US's blood oxygen concentration on the basis of the information, detected by the biological information detection section **221** and acquired by the information acquisition section **265**, on the luminosity of light reflected off hemoglobin and oxyhemoglobin in the blood flowing through the user US's blood vessel. The blood oxygen concentration of a typical user US who is at rest is, for example, 100 $SPO_2$.

**[0081]** The altitude calculation section **267** calculates the altitude at the current location where the user US is present on the basis of the position information detected by the position information detection section **223** and acquired by the information acquisition section **265**.

**[0082]** The threshold adjustment section **268** has a function of adjusting the first threshold and the second threshold described above on the basis of the altitude calculated by the altitude calculation section **267**. For example, when the altitude calculation section **267** shows that the altitude at the current location where the user US is present is lower than 1800 m above sea level, the threshold adjustment section

**268** does not change (adjust) the first threshold (100 $SPO_2$) and the second threshold (80 $SPO_2$) set in advance. On the other hand, when the altitude at the current location where the user US is present is higher than or equal to 1800 m above sea level, the threshold adjustment section **268** sets the first threshold, for example, at 95 $SPO_2$ and adjusts the second threshold, for example, to 75 $SPO_2$.

**[0083]** It is noted that 100 $SPO_2$ means that a measured value of the blood oxygen concentration is 100%, and 80 $SPO_2$ means that a measured value of the blood oxygen concentration is 80%. Each of these expressions can instead be interpreted to mean that the expression represents a relative amount with respect to the blood oxygen concentration measured in a reference state. For example, assuming that the blood oxygen concentration measured at home is 100%, these expressions may be interpreted in such a way that 100 $SPO_2$ means that it is equal to the blood oxygen concentration measured at home, and 80 $SPO_2$ means that at corresponds to 80% the blood oxygen concentration measured at home.

**[0084]** The threshold evaluation section **269** has a function of evaluating whether or not the user US's blood oxygen concentration is higher than the first threshold and the second threshold. Specifically, the threshold evaluation section **269** evaluates whether or not the blood oxygen concentration detected by the blood oxygen concentration calculation section **266** is higher than the first threshold and the second threshold adjusted by the threshold adjustment section **268**. In detail, the threshold evaluation section **269** performs the evaluation of whether or not the user US's blood oxygen concentration is higher than the first threshold, for example, every 5 minutes. Further, when the practice evaluation section **272**, which will be described later, determines that the user US is practicing a pressure breathing method, the threshold evaluation section **269** evaluates whether or not the user US's blood oxygen concentration is higher than the first threshold. Further, when a result of the evaluation shows that the user US's blood oxygen concentration is not higher than the first threshold, the threshold evaluation section **269** evaluates whether or not the blood oxygen concentration is higher than the second threshold.

**[0085]** The breathing instruction section **270** has a function of instructing the user US to practice a pressure breathing method, which is a predetermined breathing method, when the threshold evaluation section **269** determines that the user US's blood oxygen concentration is not higher than the first threshold. Specifically, the breathing instruction section **270** causes the presentation information generation section **276**, which will be described later, to generate a breathing method presentation screen.

**[0086]** FIG. **4** shows a breathing method presentation screen WS**1**.

**[0087]** The breathing instruction section **270** causes the presentation information generation section **276** to generate the breathing method presentation screen WS**1** shown in FIG. **4** and causes the display section **231** to display the breathing method presentation screen WS**1**. The breathing instruction section **270** further causes the communication control section **264** to transmit the breathing method presentation screen WS**1** as warning information via the communication section **24** to the information processing apparatus **4**. On the breathing method presentation screen WS**1** are displayed letters that notify the user that the user is likely to suffer from altitude sickness and prompts the user to practice the pressure breathing method.

**[0088]** The pressure breathing method is a breathing method in which a person inhales a large amount of air, stops breathing for about **2** seconds, and exhales the inhaled air slowly out of the mouth while straining the abdomen and pressuring the chest so that the blood oxygen concentration is increased. Therefore, since the user US who visually recognizes the breathing method presentation screen WS**1** displayed in the display section **231** and a display section **421** (see FIG. **6**) of the information processing apparatus **4** is likely to practice the pressure breathing method, practicing the breathing method is likely to increase the user US's blood oxygen concentration.

**[0089]** The breathing instruction section **270** may instead transmit information representing that the user US needs to practice the pressure breathing method in place of the breathing method presentation screen WS**1** as the warning information, and a control section **45** (see FIG. **6**) of the information processing apparatus **4** may cause the breathing method presentation screen WS**1** to be displayed on the basis of the warning information.

**[0090]** The breathing detection apparatus **3** will now be described in detail. The breathing detection apparatus **3** corresponds to the breathing detection section according to an aspect of the invention and detects breathing information on the breathing of the user US to whom the breathing detection apparatus **3** is attached. Specifically, the breathing detection apparatus **3** includes a band section **31** and a control section **32**, as shown in FIG. **1**. Out of the two sections, the band section **31**, which is attached to the user US's chest, is configured to be expandable and contractible in accordance with the user US's breathing. The control section **32** acquires the breathing information on the user US's breathing in the form of data on the expansion/contraction of the band section **31** (data representing expansion/contraction in the form of wavelength, for example) and transmits the data to the measurement apparatus **2** via a communication section that is not shown. That is, the breathing detection apparatus **3** corresponds to the first sensor according to an aspect of the invention and detects the motion of the user US's chest.

**[0091]** Referring back to FIG. **3**, the breathing rate calculation section **271** calculates the user US's breathing rate on the basis of the breathing information detected by the breathing detection apparatus **3** and stored in the storage section **25** and the body motion information. Specifically, the breathing rate calculation section **271** calculates the breathing rate over a predetermined period after the breathing instruction section **270** described above instructs the user to practice the pressure breathing method on the basis of the breathing information (motion of user US's chest) and the body motion information.

**[0092]** The practice evaluation section **272** evaluates whether or not the user US is practicing the pressure breathing method as instructed by the breathing instruction section **270**. Specifically, the practice evaluation section **272** evaluates whether nor not the pressure breathing method has been practiced on the basis of the breathing rate over the predetermined period (3 minutes after the breathing instruction section **270** described above instructs the user to practice the pressure breathing method, for example) calculated by the breathing rate calculation section **271**.

**[0093]** When the practice evaluation section **272** determines that the user US is practicing the pressure breathing method, the period evaluation section **273** acquires the period for which the user US has been practicing breathing according to the pressure breathing method and evaluates whether or not the period for which the user US has been practicing the pressure breathing method is longer than, for example, 10 minutes, that is, whether or not the breathing method practice limit period has elapsed. The period evaluation section **273** corresponds to the period acquisition section according to an aspect of the invention.

**[0094]** When the period evaluation section **273** determines that the acquired period is longer than the predetermined period, and the threshold evaluation section **269** determines that the user US's blood oxygen concentration is lower than or equal to the second threshold, the handling method instruction section **274** instructs the user to practice a handling method. Specifically, the handling method instruction section **274** causes the presentation information generation section **276**, which will be described later, to generate a handling method presentation screen.

**[0095]** FIG. **5** shows a handling method presentation screen WS**2**.

**[0096]** The handling method instruction section **274** causes the presentation information generation section **276** to generate the handling method presentation screen WS**2** shown in FIG. **5** and causes the communication control section **264** to transmit the handling method presentation screen WS**2** to the information processing apparatus **4** via the communication section **24**. On the handling method presentation screen WS**2** are displayed letters that prompt the user to descend the mountain.

**[0097]** Therefore, the user US who visually recognizes the handling method presentation screen WS**2** displayed in the display section **231** and the display section **421** of the information processing apparatus **4** is likely to descend the mountain, and descending the mountain is likely to increase the user US's blood oxygen concentration and improve the condition of the user who suffers from the altitude sickness.

**[0098]** The handling method instruction section **274** may instead transmit information representing that the user US is suffering from altitude sickness in place of the handling method presentation screen WS**2** as the warning information, and the control section **45** of the information processing apparatus **4** may display the handling method presentation screen WS**2** on the basis of the warning information.

**[0099]** Referring back to FIG. **3**, when the user US's blood oxygen concentration is higher than the first threshold, the restriction section **275** restricts the instruction issued by the breathing instruction section **270**. Specifically, the restriction section **275** restricts the display of the breathing method presentation screen WS**1**, which the breathing instruction section **270** has caused the presentation information generation section **276** to generate and which prompts the user to practice the pressure breathing method, in the information processing apparatus **4**. For example, the restriction section **275** restricts the display of the breathing method presentation screen WS**1** in the display section **231** and transmits a restriction signal that restricts the presentation of the breathing method presentation screen WS**1** in the information processing apparatus **4** under the control of the communication control section **264**.

**[0100]** The presentation information generation section **276** generates presentation information to be presented to the user. Specifically, the presentation information generation section **276** generates the breathing method presentation screen WS**1** and the handling method presentation screen WS**2** described above on the basis of instructions from the breathing instruction section **270** and the handling method instruction section **274**.

Configuration of Information Processing Apparatus

**[0101]** FIG. **6** is a block diagram showing the configuration of the information processing apparatus **4**, which forms the physical activity assistance system according to the present embodiment.

**[0102]** The information processing apparatus **4** includes an operation section **41**, a notification section **42**, a communication section **43**, a storage section **44**, and the control section **45**, and the sections **41** to **45** are electrically connected to one another via a bus line BL, as shown in FIG. **6**.

Configuration of Operation Section

**[0103]** The operation section **41** accepts an operator's input operation and outputs an operation signal according to the input operation to the control section **45**, as in the operation section **21** described above does. The thus configured operation section **41** can be formed, for example, of physical keys or a touch panel provided on an enclosure of the information processing apparatus **4** or can be formed, for example, of a keyboard and a pointing device connected to the information processing apparatus **4** in a wired or wireless manner.

Configuration of Notification Section

**[0104]** The notification section **42** notifies the operator of a variety of pieces of information under the control of the control section **45**. The notification section **42** includes the display section **421** and a voice output section **422**.

**[0105]** The display section **421** has a liquid crystal display panel or any of a variety of other display panels and displays a predetermined image under the control of a notification control section **452**, which will be described later. Examples of the image may include an image generated by a presentation information generation section **465**, which will be described later.

**[0106]** The voice output section **42** includes a voice output unit, such as a loudspeaker, and outputs voice according to voice information inputted from the control section **45**.

**[0107]** The notification section **42** includes no vibration section, unlike the notification section **23** of the measurement apparatus **2** described above. However, when the information processing apparatus **4** is formed, for example, of a smartphone or a tablet, the notification section **42** may include a vibration section.

Configuration of Communication Section

**[0108]** The communication section **43** includes a first communication module that can communicate with the measurement apparatus **2** described above and a second communication module that can communicate with an external apparatus on a network, such as the Internet, and communicates with both the apparatus under the control of the control section **45**. The communication section **43** only needs to include one of the first communication module and the second communication module in a case where the communication section **43** can communicate with the exter-

nal apparatus in the same communication scheme in accordance with which the communication section **43** communicates with the measurement apparatus **2**. Further, in a case where the communication section **43** does not need to communicate with an external apparatus on a network, the communication section **43** does not need to include the second communication module.

Configuration of Storage Section

**[0109]** The storage section **44** is formed, for example, of an HDD (hard disk drive), an SSD (solid state drive), or a flash memory and stores a variety of programs and data necessary for the action of the information processing apparatus **4**. As an example of the programs, the storage section **44** stores a control program that controls the information processing apparatus **4**. The storage section **44** further stores, as the setting information described above, for example, connection information for communication connection with the measurement apparatus **2** described above.

Configuration of Control Section

**[0110]** The control section **45** includes a CPU (central processing unit) and executes the program stored in the storage section **44** to control the action of the information processing apparatus **4**. For example, when the measurement apparatus **2** transmits the breathing method presentation screen WS**1** and the handling method presentation screen WS**2** as a warning signal, and the control section **45** receives the presentation screens WS**1** and WS**2**, the control section **45** causes the display section **421** to display the breathing method presentation screen WS**1** and the handling method presentation screen WS**2**.

**[0111]** The thus configured information processing apparatus **4** is connected to the measurement apparatus **2** via the communication section **43**, and the measurement apparatus **2** along with the information processing apparatus **4** carries out a notification control process shown below.

Notification Control Process

**[0112]** The control section **26** of the measurement apparatus **2** described above executes the notification control program stored in the control information storage section **251** to carry out a breathing method presentation process and a handling method presentation process contained in the notification control process (physical activity assistance process) independently of each other. That is, the notification control process is a process including the physical activity assistance method according to an aspect of the invention.

**[0113]** The notification control process will be described below in detail.

**[0114]** FIG. **7** is a flowchart showing the notification control process.

**[0115]** The notification control process is a physical activity assistance process including the breathing method presentation process for presenting the pressure breathing method and the handling method presentation process for presenting a handling method in accordance with the user US's blood oxygen concentration.

**[0116]** As preprocessing performed before the notification control process described above is carried out, the threshold adjustment section **268** adjusts the first threshold and the second threshold on the basis of the altitude calculated by the altitude calculation section **267** described above. For example, the first threshold is adjusted to 100 $SPO_2$, and the second threshold is set at 80 $SPO_2$.

**[0117]** When the user US starts physical activity, the threshold evaluation section **269** performs the evaluation of whether or not the user US's blood oxygen concentration is higher than the first threshold (100 $SPO_2$), for example, every 5 minutes (step S**11**), as shown in FIG. **7**. When a result of the evaluation in the evaluation process instep S**11** shows that the user US's blood oxygen concentration is higher than the first threshold, the threshold evaluation section **269** continues carrying out the process in the step S**11** every 5 minutes.

**[0118]** On the other hand, when a result of the evaluation in the evaluation process in step S**11** shows that the user US's blood oxygen concentration is not higher than the first threshold, the breathing instruction section **270** causes the presentation information generation section **276** to generate the breathing method presentation screen WS**1**, causes the display section **231** to display the breathing method presentation screen WS**1**, and transmits the breathing method presentation screen WS**1** via the communication section **24** to the information processing apparatus **4** to cause the display section **421** of the information processing apparatus **4** to display the breathing method presentation screen WS**1** (step S**12**).

**[0119]** When the process in step S**12** is carried out, the breathing rate calculation section **271** calculates the breathing rate over the predetermined period after the breathing instruction section **270** instructs the user to practice the pressure breathing method on the basis of the breathing information and the body motion information described above (step S**13**).

**[0120]** The practice evaluation section **272** then evaluates whether or not the pressure breathing method has been practiced on the basis of the breathing rate over the predetermined period calculated by the breathing rate calculation section **271** (step S**14**). When a result of the evaluation in step S**14** shows that the pressure breathing method has not been practiced, the breathing instruction section **270** carries out the processes in steps S**12** and S**13** again.

**[0121]** On the other hand, when a result of the evaluation in step S**14** shows that the pressure breathing method has been practiced, the practice evaluation section **272** acquires the period for which the user US has been practicing breathing according to the pressure breathing method and evaluates whether or not the period for which the user US has been practicing the pressure breathing method is longer than the predetermined period (step S**15**). When a result of the evaluation instep S**15** shows that the period for which the user US has been practicing the pressure breathing method is not longer than the predetermined period, the breathing instruction section **270** carries out the process in step S**12** again.

**[0122]** On the other hand, when a result of the evaluation in step S**15** shows that the period for which the user US has been practicing the pressure breathing method is longer than the predetermined period, the threshold evaluation section **269** evaluates whether or not the user US's blood oxygen concentration is higher than the first threshold (100 $SPO_2$) (step S**16**).

**[0123]** When a result of the evaluation in step S**16** shows that the user US's blood oxygen concentration is higher than the first threshold, the restriction section **275** restricts the

display of the breathing method presentation screen WS1, which the breathing instruction section **270** has caused the presentation information generation section **276** to generate and which prompts the user to practice the pressure breathing method, in the display section **231** and the display section **421** of the information processing apparatus **4** (step S17). The control then returns to the process in step S11.

**[0124]** On the other hand, when a result of the evaluation in step S16 shows that the user US's blood oxygen concentration is not higher than the first threshold, the threshold evaluation section **269** evaluates whether or not the user US's blood oxygen concentration is higher than the second threshold (80 $SPO_2$) (step S18).

**[0125]** When a result of the evaluation in step S18 shows that the user US's blood oxygen concentration is higher than the second threshold, the control returns to the process in step S13, where the process described above is carried out.

**[0126]** On the other hand, when a result of the evaluation in step S18 shows that the user US's blood oxygen concentration is not higher than the second threshold, the handling method instruction section **274** causes the presentation information generation section **276** to generate the handling method presentation screen WS2, causes the display section **231** to display the handling method presentation screen WS2, and causes the communication control section **264** to transmit the handling method presentation screen WS2 to the information processing apparatus **4** via the communication section **24** to cause the display section **421** of the information processing apparatus **4** to display the handling method presentation screen WS2 (step S19).

**[0127]** After the handling method presentation process in step S19 is carried out, the notification control process is completed.

## Advantageous Effects of First Embodiment

**[0128]** The physical activity assistance system **1** according to the present embodiment described above provides the following advantageous effects.

**[0129]** Since the first threshold is set at a value below which the user is likely to suffer from altitude sickness (100 $SPO_2$, for example), the user US is instructed, when the user US's blood oxygen concentration is lower than or equal to the first threshold, to practice the pressure breathing method, which allows the blood oxygen concentration to rise, whereby the user can lower a risk of developing altitude sickness by practicing breathing in accordance with the instruction. Therefore, when the user US practices the breathing method to successfully cause the blood oxygen concentration to be higher than the first threshold, the user US can continue the physical activity. The physical activity assistance system **1** can therefore appropriately support the user US's physical activity.

**[0130]** In a case where the blood oxygen concentration is lower than or equal to the second threshold (80 $SPO_2$), which is lower than the first threshold (100 $SPO_2$), even after the user US practices the pressure breathing method, the user is instructed to descend the mountain as the handling method, whereby a situation in which the user US continues the mountain climbing and is involved in a risky state (altitude sickness, for example) can be avoided. The physical activity assistance system **1** can therefore appropriately support the user US's physical activity (mountain climbing).

**[0131]** In a case where the blood oxygen concentration is not higher than the second threshold even after the user US practices the pressure breathing method for the predetermined period, the user is instructed to descend the mountain as the handling method, whereby a situation in which the user US continues the mountain climbing and is involved in a risky state can be further avoided. The physical activity assistance system **1** can therefore more appropriately support the user US's physical activity (mountain climbing).

**[0132]** Since the breathing detection apparatus **3** as the first sensor can detect the motion of the user US's chest, the user US's breathing rate can be readily measured. The physical activity assistance system **1** can therefore evaluate on the basis of the breathing rate whether or not the user US is appropriately practicing the pressure breathing method. The physical activity assistance system **1** can therefore more adequately provide the user US with a handling method instruction.

**[0133]** Since the physical activity assistance system **1** evaluates whether or not the user US is practicing the pressure breathing method on the basis of the motion of the user US's body motion information and chest motion (breathing information), the physical activity assistance system **1** can more accurately evaluate whether or not the user is practicing the pressure breathing method. The physical activity assistance system **1** can therefore further adequately provide the user US with a handling method instruction.

**[0134]** Since the threshold adjustment section **268** can adjust the first threshold and the second threshold on an altitude basis, the physical activity assistance system **1** can adequately provide the user US with breathing method and handling method instructions in accordance with the altitude.

**[0135]** Since the instruction issued by the breathing instruction section **270** is restricted when the blood oxygen concentration is higher than the first threshold, that is, when the user US's blood oxygen concentration reaches an appropriate value, the user US can recognize that the blood oxygen concentration has reached the appropriate value. The fact that the display section **231** and the display section **421** stop displaying the instruction therefore allows the user US to readily recognize that the user US can continue the physical activity (mountain climbing, for example).

## Second Embodiment

**[0136]** A second embodiment of the invention will next be described.

**[0137]** A biological information measurement apparatus that forms a physical activity assistance system according to the present embodiment has a configuration similar to that of the biological information measurement apparatus **2** described above, but part of the control section **26** is configured differently. Further, an information processing apparatus that form the physical activity assistance system according to the present embodiment has a configuration similar to that of the information processing apparatus **4** described above, but part of the control section is configured differently. Specifically, the information processing apparatus according to the present embodiment differs from the information processing apparatus **4** in that it acquires the biological information, the body motion information, and the position information detected by the measurement apparatus and uses these pieces of information to carry out the same notification control process (physical activity assistance process) carried out by the biological information measurement apparatus **2**. The biological information mea-

surement apparatus and the information processing apparatus according to the present embodiment differ from the biological information measurement apparatus **2** and the information processing apparatus **4** described above with regard to these points. In the following description, the same or roughly the same portions as those having already been described have the same reference characters and will not be described.

Configuration of Biological Information Measurement Apparatus

**[0138]** The biological information measurement apparatus according to the present embodiment has a configuration similar to that of the biological information measurement apparatus **2** described above. The control section of the biological information measurement apparatus according to the present embodiment does not include the blood oxygen concentration calculation section **266**, the altitude calculation section **267**, the threshold adjustment section **268**, the threshold evaluation section **269**, the breathing instruction section **270**, the breathing rate calculation section **271**, the practice evaluation section **272**, the period evaluation section **273**, the handling method instruction section **274**, the restriction section **275**, or the presentation information generation section **276** described above.

Configuration of Information Processing Apparatus

**[0139]** An information processing apparatus **4**A according to the present embodiment has a configuration similar to that of the information processing apparatus **4** described above. Specifically, the information processing apparatus **4**A includes the operation section **41**, the notification section **42**, the communication section **43**, and the storage section **44** and further includes a control section **450** in place of the control section **45** described above.

Configuration of Control Section

**[0140]** FIG. **8** is a block diagram showing the configuration of the control section **450**.

**[0141]** The control section **450** includes a CPU (central processing unit) and executes a program stored in the storage section **44** to control the action of the information processing apparatus **4**A. The thus configured control section **450** includes an OS execution section **45**A and an AP execution section **45**B, as shown in FIG. **8**.

Configuration of OS Execution Section

**[0142]** The OS execution section **45**A is a functional section that executes an OS stored in the storage section **44** and includes a time measurement section **451**, a notification control section **452**, and a communication control section **453**.

**[0143]** The time measurement section **451** measures the current date and time.

**[0144]** The notification control section **452** includes, although not shown, a display control section and a voice output control section. Out of the two sections, the display control section acquires, from the AP execution section **45**B, an image of a screen displayed when a program, such as the OS or any of a variety of applications, is executed and causes the display section **421** to display the image. The voice output control section outputs a voice signal generated when the program is executed to cause the voice output section **422** to output voice according to the voice signal.

**[0145]** The communication control section **453** controls communication between the communication section **43** and an external apparatus.

Configuration of AP Execution Section

**[0146]** The AP execution section **45**B executes, among applications stored in the storage section **44**, an application specified by the OS execution section **45**A in accordance with an operation signal inputted via the operation section **41**. The AP execution section **45**B includes an information acquisition section **454**, a blood oxygen concentration calculation section **455**, an altitude calculation section **456**, a threshold adjustment section **457**, a threshold evaluation section **458**, a breathing instruction section **459**, a breathing rate calculation section **460**, a practice evaluation section **461**, a period evaluation section **462**, a handling method instruction section **463**, a restriction section **464**, and a presentation information generation section **465**, each of which functions when the CPU executes the physical activity assistance application that causes the AP execution section **45**B to carry out the notification control process.

**[0147]** The information acquisition section **454** acquires a variety of signals and a variety of pieces of information inputted through the operation section **41** and the communication section **43**. For example, the information acquisition section **454** acquires the content of an input to the setting screen described above on the basis of an operation signal according to input operation performed on the setting screen. The information acquisition section **454** further acquires the biological information, the body motion information, and the position information received from the measurement apparatus **2** and causes the storage section **44** to store these pieces of information. The information acquisition section **454** further acquires data on the breathing detected by the breathing detection apparatus **3** (breathing information) and causes the storage section **44** to store the data.

**[0148]** The blood oxygen concentration calculation section **455** calculates the user US's blood oxygen concentration on the basis of the biological information acquired by the information acquisition section **454**.

**[0149]** The altitude calculation section **456** calculates the altitude at the current location where the user US is present on the basis of the position information acquired by the information acquisition section **454**.

**[0150]** The threshold adjustment section **457** adjusts the first threshold and the second threshold described above on the basis of the altitude calculated by the altitude calculation section **456**.

**[0151]** The threshold evaluation section **458** evaluates whether or not the user US's blood oxygen concentration is higher than the first threshold and the second threshold.

**[0152]** The breathing instruction section **459** instructs the user US to practice the pressure breathing method, which is the predetermined breathing method, when the threshold evaluation section **458** determines that the user US's blood oxygen concentration is lower than or equal to the first threshold.

**[0153]** The breathing rate calculation section **460** calculates the user US's breathing rate on the basis of the

breathing information and the body motion information detected by the breathing detection apparatus **3** and stored in the storage section **25**.

**[0154]** The practice evaluation section **461** evaluates whether or not the user US is practicing the pressure breathing method that the user has been instructed to practice by the breathing instruction section **459**.

**[0155]** When the practice evaluation section **461** determines that the user US is practicing the pressure breathing method, the period evaluation section **462** acquires the period for which the user US has been practicing breathing according to the pressure breathing method and evaluates whether or not the period for which the user US has been practicing the pressure breathing method is longer than, for example, 10 minutes.

**[0156]** When the period evaluation section **462** determines that the acquired period is longer than the predetermined period, and the threshold evaluation section **458** determines that the user US's blood oxygen concentration is lower than or equal to the second threshold, the handling method instruction section **463** instructs the user to practice a handling method.

**[0157]** When the user US's blood oxygen concentration is higher than the first threshold, the restriction section **464** restricts the instruction issued by the breathing instruction section **459**.

**[0158]** The presentation information generation section **465** generates presentation information to be presented to the user.

**[0159]** The control section **450** described above executes a notification control program stored in the storage section **44** to carry out the breathing method presentation process and the handling method presentation process contained in the notification control process (physical activity assistance process) independently of each other. That is, the control section **450** carries out the processes described above in accordance with the flowchart shown in FIG. **7** to assist the user US's physical activity, as the control section **26** of the measurement apparatus **2** in the first embodiment does.

## Advantageous Effects of Second Embodiment

**[0160]** The physical activity assistance system according to the second embodiment described above provides the following advantageous effects as well as the same advantageous effects provided by the physical activity assistance system I described above.

**[0161]** In the present embodiment, the information processing apparatus **4**A carries out the physical activity assistance process (notification control process) including the breathing method presentation process and the handling method presentation process described above, which are processes that consume a large amount of electric power and impose a heavy processing burden on the CPU, whereby the biological information measurement apparatus according to the present embodiment can be operated for a relatively long period, and cost reduction is achieved.

## Third Embodiment

**[0162]** A third embodiment of the invention will next be described.

**[0163]** A physical activity assistance system according to the present embodiment has a configuration similar to that of the physical activity assistance system according to the second embodiment described above but differs therefrom in that it includes a plurality of biological information measurement apparatus and information processing apparatus that are the same as the biological information measurement apparatus and the information processing apparatus that form the physical activity assistance system according to the second embodiment and that the plurality of information processing apparatus are so connected to one another as to communicate with one another. In the following description, the same or roughly the same portions as those having already been described have the same reference characters and will not be described.

**[0164]** FIG. **9** is a diagrammatic view showing a physical activity assistance system **1**B according to the present embodiment.

**[0165]** The physical activity assistance system **1**B according to the present embodiment includes a biological information measurement apparatus **2**B**1** (hereinafter referred to as measurement apparatus in some cases), a breathing detection apparatus **3**B**1**, and an information processing apparatus **4**B**1**, which are used by a user US**1**, a measurement apparatus **2**B**2**, a breathing detection apparatus **3**B**2**, and an information processing apparatus **4**B**2**, which are used by a user US**2**, a measurement apparatus **2**B**3**, a breathing detection apparatus **3**B**3**, and an information processing apparatus **4**B**3**, which are used by a user US**3**, and a measurement apparatus **2**B**4**, a breathing detection apparatus **3**B**4**, and an information processing apparatus **4**B**4**, which are used by a user US**4**, as shown in FIG. **9**.

**[0166]** Each of the plurality of measurement apparatus **2**B**1** to **2**B**4** has the same configuration as that of the measurement apparatus according to the second embodiment. Each of the plurality of breathing detection apparatus **3**B**1** to **3**B**4** has the same configuration as that of the breathing detection apparatus **3** described above. Each of the plurality of information processing apparatus **4**B**1** to **4**B**4** has the same configuration as that of the information processing apparatus **4**A described above. In addition, the information processing apparatus **4**B**1** among the plurality of information processing apparatus **4**B**1** to **4**B**4** is connected to the other information processing apparatus **4**B**2** to **4**B**4** via the communication sections **43**.

**[0167]** For example, when a foursome party (unit) formed of the users US**1** to US**4** climbs a mountain, a leader walks first and a subleader walks last in many cases. In this case, the user US**1**, who is the leader, needs to grasp the body conditions of the other users US**2** to US**4**, who form the party. To this end, for example, when the users US**1** to US**4** form one party and climb a mountain, the information processing apparatus **4**B**1** to **4**B**4** are so set before the mountain climbing that the information processing apparatus **4**B**1** of the user US**1**, who is the leader, receives measurement information and warning information transmitted from the other information processing apparatus **4**B**2** to **4**B**4**.

**[0168]** Specifically, when the control section **450** of any of the information processing apparatus **4**B**2** to **4**B**4** causes the breathing method presentation screen WS**1** to be displayed in the display section **421** of the corresponding one of the information processing apparatus **4**B**2** to **4**B**4**, an instruction issued by the breathing instruction section **459** is transmitted as the warning information to the information processing apparatus **4**B**1** of the user US**1** via the communication section **43**. The control section **450** of the information

processing apparatus **4B1**, when it acquires the warning information, causes the presentation information generation section **465** to generate a warning screen WS**3** and causes the display section **421** of the information processing apparatus **4B1** to display the warning screen WS**3**.

**[0169]** FIG. **10** shows the warning screen WS**3**.

**[0170]** The control section **450** of the information processing apparatus **4B1** causes the presentation information generation section **465** to generate the warning screen WS**3** shown in FIG. **10** and causes the display section **421** to display the warning screen WS**3**. On the warning screen WS**3** are displayed letters that state that the user US**3**, who carries the information processing apparatus **4B3**, which has transmitted the warning information, is likely to suffer from altitude sickness and prompt the user US**3** to practice the pressure breathing method. Therefore, since the user US**1** who visually recognizes the warning screen WS**3** is likely to prompt the user US**3** to practice the pressure breathing method, practicing the breathing method is likely to increase the user US**3**'s blood oxygen concentration.

**[0171]** Similarly, when the control section **450** of any of the information processing apparatus **4B2** to **4B4** causes the handling method presentation screen WS**2** to be displayed in the display section **421** of the corresponding one of the information processing apparatus **4B2** to **4B4**, an instruction issued by the handling method instruction section **463** is transmitted as the warning information to the information processing apparatus **4B1** of the user US**1** via the communication section **43** as in the case in which the breathing method presentation screen WSI is displayed. The control section **450** of the information processing apparatus **4B1**, when it acquires the warning information, causes the presentation information generation section **465** to generate a warning screen (not shown) and causes the display section **421** of the information processing apparatus **4B1** to display the warning screen.

**[0172]** For example, the control section **450** causes the display section **421** to display a warning screen on which information stating that the user U**53** has suffered from altitude sickness and is instructed to descend the mountain is displayed.

## Advantageous Effects of Third Embodiment

**[0173]** The physical activity assistance system **1B** according to the third embodiment described above provides the following advantageous effects as well as the same advantageous effects provided by the physical activity assistance system **1** described above.

**[0174]** When the information processing apparatus **4B1** of the user US**1**, who is the leader of the party, receives the warning information described above transmitted from any of the information processing apparatus **4B2** to **4B4** of the other users US**2** to US**4**, the warning screen WS**3** is displayed in the display section **421**. The user US**1** can therefore grasp both a state in which one of the members (users US**2** to US**4**) of the party is likely to suffer from altitude sickness and a state in which the member has suffered from altitude sickness.

**[0175]** Further, since the user US**1** can readily visually recognize a handling method to be taken in the state in which any of the users US**2** to US**4** is likely to suffer from altitude sickness and the state in which the user has suffered from altitude sickness, a situation in which any of the other users US**2** to US**4** is involved in a risky state can be avoided. The user US**1** can therefore assist and help the physical activities of the users US**2** to US**4**.

## Variations of Embodiments

**[0176]** The invention is not limited to the embodiments described above, and variations, improvements, and other modifications to the extent that the advantage of the invention is achieved fall within the scope of the invention.

**[0177]** In each of the embodiments described above, the breathing detection apparatus **3** is provided. The invention does not, however, necessarily have the configuration. For example, the breathing detection apparatus **3** may not be provided. In this case, the control section **26** or **45** may not include the breathing rate calculation section **271** or **460** or the practice evaluation section **272** or **461**, and after a predetermined period elapses since the breathing instruction section **459** displayed the breathing method presentation screen WS**1** in the display section **231** and the display section **421** of the information processing apparatus **4** or **4A**, and the evaluation of whether or not the user US's blood oxygen concentration is lower than or equal to the second threshold performed by the threshold evaluation section **269** shows that the blood oxygen concentration is lower than or equal to the second threshold, the handling method instruction sections **274** and **463** may display the handling method presentation screen WS**2** in the display section **231** and the information processing apparatus **4**. That is, in place of the processes in step S**13** to S**15** in the flowchart of FIG. **7**, the process of evaluating whether or not the predetermined period has elapsed since the breathing method presentation screen WS**1** was displayed may be carried out, and the processes in step S**16** and the following steps may be carried out in a case where the predetermined period has elapsed in the process.

**[0178]** In each of the embodiments described above, the control sections **26** and **450** include the handling method instruction sections **274** and **463**, respectively. The invention does not, however, necessarily have the configuration. For example, the control section **26** or **450** may not include the handling method instruction section **274** or **463**. Even in this case, since the breathing instruction sections **270** and **459** cause the breathing method presentation screen WS**1** to be displayed in the display section **231** and the display section **421** of the information processing apparatus **4** or **4A**, the user US' s physical activity can be assisted. That is, the processes in steps S**18** and S**19** in the flowchart shown in FIG. **7** may not be carried out.

**[0179]** In each of the embodiments described above, the control sections **26** and **450** include the period evaluation sections **273** and **462**, respectively, each of which acquires, when it is determined that the user US is practicing breathing according to the pressure breathing method, the period for which the user US has been practicing the breathing according to the pressure breathing method and evaluates whether or not the period is longer than a predetermined period. The invention does not, however, necessarily have the configuration. For example, the control section **26** or **450** may not include the period evaluation section **273** or **462**. In this case, the handling method instruction sections **274** and **463** may instruct the user US to practice a handling method when it is determined that the user US is practicing the breathing according to the pressure breathing method and the measured blood oxygen concentration is lower than or equal to

the second threshold. That is, the process in step S15 in the flowchart shown in FIG. 7 may not be carried out. Further, the breathing method is not limited to the pressure breathing method and may be deep breathing, abdominal breathing, and other types of breathing that allow the user to inhale oxygen through the breathing.

**[0180]** In each of the embodiments described above, the breathing rate calculation sections **271** and **460** calculate the breathing rate on the basis of the breathing information detected by the breathing detection apparatus **3** and the body motion information detected by the body motion information detection section **222**. The invention does not, however, necessarily have the configuration. For example, the breathing rate calculation sections **271** and **460** may calculate the breathing rate on the basis only of the breathing information. That is, the measurement apparatus **2** may not include the body motion information detection section **222**.

**[0181]** In each of the embodiments described above, the breathing detection apparatus **3** includes the band section **31** and the control section **32**, and the breathing rate calculation sections **271** and **460** calculate the breathing rate from the wavelength (breathing information) based on the extraction/contraction of the band section **31**. The invention does not, however, necessarily have the configuration. For example, instead of the breathing detection apparatus **3**, the biological information detection section **221** may detect an electrocardiogram and perform frequency analysis on the electrocardiogram to calculate the breathing rate. The biological information detection section **221** may still instead acquire a breathing component from the waveform of the electrocardiogram and analyze the breathing component to calculate the breathing rate.

**[0182]** In each of the embodiments described above, when the altitude of the current location where the user US is present is higher than or equal to **1800** m, the first threshold and the second threshold are adjusted. The invention does not, however, necessarily have the configuration. For example, when the altitude described above is higher than or equal to 2500 m, the first threshold and the second threshold may be adjusted, or the first threshold and the second threshold may be lowered as the altitude increases.

**[0183]** Instead, the first threshold and the second threshold may not be adjusted. In this case, the control section **26** may not include the altitude calculation section **267** or **456** or the threshold adjustment section **268** or **457**. Further, for example, the processes carried out by the altitude calculation sections **267** and **456** may be carried out every one hour, and when the altitude calculated by the altitude calculation sections **267** and **456** changes from the altitude acquired in the preceding calculation by at least a predetermined value, the process by the threshold adjustment section **268** may be carried out.

**[0184]** In each of the embodiments described above, the threshold adjustment sections **268** and **457** adjust the first threshold and the second threshold on the basis of the current location (altitude) where the user US is present and which is calculated by the altitude calculation sections **267** and **456**. The invention does not, however, necessarily have the configuration. For example, the first threshold and the second threshold may be set in advance in accordance with the user US's physical strength or may be changed in accordance with the user US's physical strength and the altitude. In this case, the measurement apparatus **2** may not include the position information detection section **223** or the altitude calculation section **267** or **456**.

**[0185]** The threshold adjustment sections **268** and **457** may set the user US's blood oxygen concentration before mounting climbing to be the first threshold and may set the second threshold at a value corresponding to the first threshold. Further, the first threshold and the second threshold may be so set as not to be changed from values set in advance or may be inputted and set by the user US and a medical worker via the setting screen displayed in the display section **231**.

**[0186]** Further, the threshold adjustment sections **268** and **457** adjust both the first threshold and the second threshold in the above description. The invention does not, however, necessarily have the configuration. For example, the threshold adjustment sections **268** and **457** may adjust only one of the first threshold and the second threshold.

**[0187]** In each of the embodiments described above, on the breathing method presentation screen WS1 are displayed only letters that prompt the user to practice the pressure breathing method. The invention does not, however, necessarily have the configuration. For example, in place of or in addition to the letters described above, a pattern, video images, and other objects that prompt the user to practice the pressure breathing method may be displayed. Instead, an explanatory note for allowing the user to practice the pressure breathing method and a pattern, video images, and other objects that explain the pressure breathing method may be displayed.

**[0188]** In each of the embodiments described above, the control sections **26** and **450** include the restriction sections **275** and **464**, respectively. The invention does not, however, necessarily have the configuration. For example, the control section **26** or **450** may not include the restriction section **275** or **464**.

**[0189]** In each of the embodiments described above, the measurement apparatus **2** includes the biological information detection section **221**, the body motion information detection section **222**, and the position information detection section **223** as the detection section **22**. The invention does not, however, necessarily have the configuration. For example, the measurement apparatus **2** may additionally include an atmospheric pressure detection section that detects the atmospheric pressure. The atmospheric pressure detection section allows the altitude calculation section **267** to calculate the altitude on the basis of the position information and the atmospheric pressure information. Further, the handling method instruction section **274** instructs the user US to descend the mountain when the user US's blood oxygen concentration is lower than the second threshold. The invention does not, however, necessarily have the configuration. For example, the handling method instruction section **274** may instruct the user to descend the mountain when it is likely to rain on the basis of the atmospheric pressure information or when it is likely to rain even in a case where the user US's blood oxygen concentration is higher than or equal to the second threshold but lower than the first threshold.

**[0190]** In each of the embodiments described above, the breathing method presentation screen WS1 and the handling method presentation screen WS2 are displayed in the display section **241** and the display section **421** of the information processing apparatus **4** or **4**A. The invention does not, however, necessarily have the configuration. For example, the breathing method presentation screen WS1 and the

handling method presentation screen WS2 may be displayed only in the display section **241** of the measurement apparatus **2** or the display section **421** of the information processing apparatus **4** or **4**A. For example, in the case where the breathing method presentation screen WS1 and the handling method presentation screen WS2 are displayed only in the display section **241**, the physical activity assistance system **1** described above is formed only of the measurement apparatus **2**.

**[0191]** Further, when the breathing method presentation screen WS1 and the handling method presentation screen WS2 are displayed in the display section **231** of the measurement apparatus **2**, the voice output section **232** may be allowed to output voice, or the vibration section **233** may be allowed to vibrate.

**[0192]** In each of the embodiments described above, mountain climbing is exemplified as the physical activity. The invention does not, however, relate to mountain climbing. For example, in a case where the physical activity is any other physical activity, when the blood oxygen concentration is higher than the first threshold, a breathing method suitable for that physical activity may be presented. That is, the invention implemented in the form of each of the embodiments described above is also applicable to physical activities other than mountain climbing.

**[0193]** In each of the embodiments described above, the biological information detection section **221** detects the user US's blood oxygen concentration as the biological information. The invention does not, however, necessarily have the configuration. For example, the biological information detection section **221** may detect the user US's pulse wave, heart rate, blood sugar level, and other factors as well as the blood oxygen concentration. In this case, for example, the first threshold and the second threshold may be set on the basis of detected biological information as well as the blood oxygen concentration.

**[0194]** In the third embodiment described above, the warning information described above is transmitted only to the information processing apparatus **4**B**1** of the user US**1**, who is the leader. The destination of the warning information is not limited to the information processing apparatus **4**B**1**, and the warning information may also be transmitted, for example, to the information processing apparatus **4**B**4** of the user US**4**, who is the subleader. Further, the information processing apparatus **4**B**1** to **4**B**4** of all the users US**1** to US**4** maybe connected to one another, and when any of the users US**1** to US**4** is in danger of suffering from altitude sickness, the warning screen WS**3** described above may be displayed in the information processing apparatus of the other users out of the information processing apparatus **4**B**1** to **4**B**4**.

**[0195]** In the third embodiment described above, the information processing apparatus **4**B**1** to **4**B**4** of the users US**1** to US**4** are connected to one another. The invention does not, however, necessarily have the configuration. For example, the measurement apparatus **2**B**1** to **2**B**4** of the users US**1** to US**4** may be connected to one another. In this case, the measurement apparatus and the information processing apparatus may have the same configurations as those of the measurement apparatus **2** and the information processing apparatus **4** according to the first embodiment.

**[0196]** For example, in a case where among the measurement apparatus **2**B**2** to **2**B**4**, the measurement apparatus **2**B**1** of the user US**1**, who is the leader, is so set before mountain climbing that the warning information is transmitted thereto from the other measurement apparatus **2**B**2** to **2**B**4**, when the control section **26** of any of the measurement apparatus **2**B**2** to **2**B**4** causes the breathing method presentation screen WS**1** to be displayed in the display section **231** of the corresponding one of the measurement apparatus **2**B**2** to **2**B**4**, the control section **26** transmits an instruction issued by the breathing instruction section **270** as the warning information to the measurement apparatus **2**B**1** of the user US**1** via the communication section **24**. The control section **26** of the measurement apparatus **2**B**1**, when it acquires the warning information, causes the presentation information generation section **276** to generate the warning screen WS**3** and causes the display section **231** of the measurement apparatus **2**B**1** to display the warning screen WS**3**.

**[0197]** As a result, also in the case where the measurement apparatus **2**B**1** to **2**B**4** are connected to one another, the same advantageous effects provided by the third embodiment described above can be provided.

**[0198]** In the third embodiment described above, the information processing apparatus **4**B**1** to **4**B**4** of the users US**1** to US**4** can be connected to one another. The invention does not, however, necessarily have the configuration. For example, the measurement apparatus **2**B**1** to **2**B**4** or the information processing apparatus **4**B**1** to **4**B**4** may be connected to another electronic apparatus over a network line. In this case, for example, when any of the users US**1** to US**4** has suffered from altitude sickness, the electronic apparatus can receive information on the occurrence of altitude sickness (warning information). As a result, since another person other than the users of the party who are performing mountain climbing can recognize the situation of the users US**1** to US**4**, the party can be quickly rescued, for example, when three of the users US**1** to US**4** or the users US**1** to US**3** suffer from altitude sickness or any other problem.

**[0199]** In each of the embodiments described above, the control sections **26** and **450** read the notification control program stored in the storage sections **25** and **44** and execute the program. The invention does not, however, necessarily have the configuration. For example, the notification control program may be read from a recording medium and executed when the notification control process is carried out. Examples of the recording medium may include a magnetic tape, a magnetic disk, an optical disk, a magneto-optical disk, an HDD (hard disk drive), and a semiconductor memory. The notification control program can be not only installed in the information processing apparatus **4**A and **4**B (computer) and executed but also readily distributed by using any of the recording media described above. Further, the notification control program may be acquired from an apparatus on a network and executed.

What is claimed is:

**1**. A physical activity assistance apparatus comprising:

a blood oxygen concentration measurement section that measures a user's blood oxygen concentration; and

a breathing instruction section that instructs the user to practice a predetermined breathing method when the blood oxygen concentration is lower than or equal to a first threshold.

**2**. The physical activity assistance apparatus according to claim **1**, further comprising:

a breathing detection section that detects the user's breathing;

a practice evaluation section that evaluates based on a result of the detection performed by the breathing

detection section whether or not the user is practicing breathing according to the breathing method; and

a handling method instruction section that instructs the user to practice a handling method when the practice evaluation section determines that the user is practicing the breathing according to the breathing method and the measured blood oxygen concentration is lower than or equal to a second threshold lower than the first threshold.

**3**. The physical activity assistance apparatus according to claim **1**, further comprising:

a breathing detection section that detects the user's breathing;

a practice evaluation section that evaluates based on a result of the detection performed by the breathing detection section whether or not the user is practicing breathing according to the breathing method;

a period acquisition section that acquires, when the practice evaluation section determines that the user is practicing the breathing according to the breathing method, a period for which the user has been practicing the breathing according to the breathing method; and

a handling method instruction section that instructs the user to practice a handling method when the acquired period is longer than a predetermined period and the measured blood oxygen concentration is not higher than a second threshold lower than the first threshold.

**4**. The physical activity assistance apparatus according to claim **2**,

wherein the breathing detection section includes a first sensor that detects motion of the user's chest.

**5**. The physical activity assistance apparatus according to claim **4**,

wherein the breathing detection section includes a second sensor that detects the user's body motion, and

the practice evaluation section evaluates based on results of the detection performed with the first sensor and the second sensor whether or not the user is practicing the breathing according to the breathing method.

**6**. The physical activity assistance apparatus according to claim **1**, further comprising:

an altitude detection section that detects altitude; and

an adjustment section that adjusts the first threshold in accordance with the detected altitude.

**7**. The physical activity assistance apparatus according to claim **1**, further comprising

a restriction section that restricts an instruction issued by the breathing instruction section when the blood oxygen concentration is higher than the first threshold.

**8**. A physical activity assistance system comprising:

the physical activity assistance apparatus according to claim **1**; and

an information processing apparatus capable of communicating with the physical activity assistance apparatus,

wherein the physical activity assistance apparatus transmits a warning signal when the blood oxygen concentration is lower than or equal to the first threshold and the second threshold, and

the information processing apparatus includes a notification section that notifies the user of a warning when the warning signal is received.

**9**. A physical activity assistance system comprising:

the physical activity assistance apparatus according to claim **2**; and

an information processing apparatus capable of communicating with the physical activity assistance apparatus,

wherein the physical activity assistance apparatus transmits a warning signal when the blood oxygen concentration is lower than or equal to the first threshold and the second threshold, and

the information processing apparatus includes a notification section that notifies the user of a warning when the warning signal is received.

**10**. A physical activity assistance method performed with use of an instruction apparatus that instructs a user to practice a breathing method, the method comprising:

acquiring the user's blood oxygen concentration; and

instructing the user to practice a predetermined breathing method when the blood oxygen concentration is lower than or equal to a first threshold.

**11**. The physical activity assistance method according to claim **10**, further comprising:

detecting the user's breathing;

evaluating based on a result of the detection of the breathing whether or not the user is practicing breathing according to the breathing method; and

instructing the user to practice a handling method when a result of the evaluation shows that the user is practicing the breathing according to the breathing method and the measured blood oxygen concentration is lower than or equal to a second threshold lower than the first threshold.

**12**. The physical activity assistance method according to claim **10**, further comprising:

detecting the user's breathing;

evaluating based on a result of the detection of the breathing whether or not the user is practicing breathing according to the breathing method;

when a result of the evaluation shows that the user is practicing the breathing according to the breathing method, acquiring a period for which the user has been practicing the breathing according to the breathing method; and

instructing the user to practice a handling method when the acquired period is longer than a predetermined period and the blood oxygen concentration is not higher than a second threshold lower than the first threshold.

**13**. The physical activity assistance method according to claim **10**, further comprising:

detecting altitude; and

adjusting the first threshold in accordance with the detected altitude.

**14**. The physical activity assistance method according to claim **10**, further comprising

restricting an instruction of the handling method when the blood oxygen concentration is higher than the first threshold.

**15**. A physical activity assistance program executed by a computer, the program causing the computer to perform;

acquiring a user's blood oxygen concentration; and

instructing the user to practice a predetermined breathing method when the blood oxygen concentration is lower than or equal to a first threshold.

**16**. A physical activity assistance system comprising:

a physical activity assistance apparatus including

a blood oxygen concentration measurement section that measures a user's blood oxygen concentration,

a first control section that generates warning information based on a result of analysis of the blood oxygen concentration, and

a first communication section that transmits the warning information; and

an information processing apparatus including

a second communication section that receives the warning information, and

a second control section that carries out a breathing method presentation process that instructs, based on the warning information, the user to practice a predetermined breathing method.

**17**. The physical activity assistance system according to claim **16**,

wherein the first control section generates the warning information when the blood oxygen concentration is lower than or equal to a first threshold.

**18**. The physical activity assistance system according to claim **16**,

wherein the physical activity assistance apparatus includes a first sensor that detects motion of the user's chest.

**19**. The physical activity assistance system according to claim **17**,

wherein the physical activity assistance apparatus includes an altitude detection section that detects altitude, and

the first control section adjusts the first threshold in accordance with the detected altitude.

**20**. The physical activity assistance system according to claim **17**, further comprising

a restriction section that restricts an instruction issued by the breathing instruction section when the blood oxygen concentration is higher than the first threshold.

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|---|---|---|---|
| 专利名称(译) | 身体活动辅助设备，身体活动辅助系统，身体活动辅助方法和身体活动辅助程序 | | |
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| 当前申请(专利权)人(译) | SEIKO EPSON CORPORATION | | |
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摘要(译)

一种身体活动辅助装置，包括：测量使用者的血氧浓度的血氧浓度测量部（生物体信息检测部和血氧浓度计算部）;以及呼吸指示部，该呼吸指示部指示使用者在血氧浓度低于或等于第一阈值。这样配置的体育运动辅助设备可以适当地支持用户的身体活动。