(54) Title: FITNESS PRESCRIPTION SYSTEM AND METHOD

(57) Abstract: Disclosed is a fitness prescription system and method in which the statuses of fitness equipments are controlled to correct errors for the fitness program prescribed using the pulse frequency measured when the exerciser exercises using fitness equipments and the exerciser is guided to exercise according to an updated fitness program suitable for the measured fitness made by actual exercises. The fitness prescription system measures pulse frequency of an exerciser with fitness equipments so as to prescribe a fitness program for the exerciser, and includes: pulse frequency measuring means for measuring the pulse frequency of the exerciser; and fitness program update means for calculating maximum oxygen intake amount based on the pulse frequency measured by the pulse frequency measuring means and updating the fitness program for the exerciser based on the maximum oxygen intake amount.
FITNESS PRESCRIPTION SYSTEM AND METHOD

Technical Field

The present invention relates to a fitness prescription system and method in which a fitness program is updated to be suitable for an exerciser’s fitness increased due to the exerciser’s steady exercise, and more particularly, to a fitness prescription system and method in which the status of a fitness equipment is controlled to correct an error on the fitness program prescribed using the pulse frequency measured when an exerciser exercises using the fitness equipment, and the exerciser is guided to exercise according to an updated fitness program suitable for the measured fitness made by actual exercises.

Accordingly, the present invention relates to a fitness equipment control system and method to automatically control fitness equipments according to the fitness program updated in accordance with fitness status and fitness history of an exerciser when the exerciser exercises using fitness equipments, and more particularly, to a fitness equipment control system and method in which whether the current fitness is excessive or lack is determined using the pulse frequency measured when the exerciser exercises using fitness equipments, fitness equipments are controlled according to the result of the determination, a maximum oxygen intake amount is estimated according to the fitness history, and the fitness load is controlled according to the maximum oxygen intake amount so that the fitness is gradually improved.

Background Art

When an exerciser exercises using a fitness equipment such as a treadmill, the
exerciser wants to exercise moderately for fitness and to improve his or her fitness and maintain a healthy life by continuing exercises. The exerciser wishes to record his or her fitness status and train his or her fitness according to the fitness history. The various objects of the exerciser include endurance enhancement, cardiopulmonary ability enhancement, calorie consumption for healing corpulence, and so on. Because of the aforementioned reasons, the patent application No. 10-2000-23432 which was filed in the name of the applicant of the present invention discloses a fitness system that controls the exercise load due to pulse frequency change. However, since the fitness program provided to the exerciser should be newly made by a manager who manages exercises when the exerciser’s fitness is improved due to improved cardiopulmonary ability, each fitness program for each client should be updated when clients are connected to a central server. In addition, this conventional fitness program may have various errors.

15 Disclosure of the Invention

The present invention is directed to obviate the above-mentioned problems and an object of the present invention is to provide fitness a prescription system and method to update the fitness program based on the fitness history of the exerciser and enhance the exerciser’s fitness.

Another object of the invention is to provide a fitness prescription system and method that detects the excessive fitness to reduce the running speed and thus reduce a danger of the exerciser, and detects the lack fitness to increase the running speed and thus maintain the proper exercise effects.

A further object of the invention is to provide a fitness prescription system and
method that can be used to heal corpulence by determining the running time according to calorie consumption.

Still another object of the invention is to provide a fitness prescription system and method that can be individually adapted to the fitness equipments of an exerciser and operated by data transmission and reception of the central server connected to communication network.

A further still another object of the invention is to provide a fitness prescription system and method that enables to control exercise intensity according to the exercise recognition.

The objects and characteristics will be understood more clearly through embodiment to be described below.

To accomplish the above objects and advantages, there is provided a fitness prescription system for measuring pulse frequency of an exerciser with a treadmill so as to update a fitness program for the exerciser, the fitness prescription system comprising: pulse frequency measuring means for measuring the pulse frequency of the exerciser; exercise amount control means for comparing pulse frequency represented by the pulse frequency measuring means with pulse frequency indicated by the fitness program and if there exists difference, changing a driving status of the treadmill and driving the treadmill; and fitness program update means for comparing any one of actual oxygen intake amount, exercise hardness and maximum oxygen intake amount of the exerciser with any one of oxygen intake amount, exercise hardness and maximum oxygen intake amount indicated by the fitness program and if there exists difference, updating the fitness program so as to correct the oxygen intake amount, the exercise hardness and the maximum oxygen intake amount.
Preferably, the fitness program update means calculates the oxygen intake amount, the exercise hardness and the maximum oxygen intake amount of the exerciser by using Expressions 1, 2 and 3 respectively, calculating the driving status of the treadmill by using a predetermined exercise hardness, and updating a fitness program.

Expression 1

\[
\text{oxygen intake amount} = \text{moving speed} \times a + \text{slope (\%)} \times \text{moving speed (m/min)} \times b + c
\]

where a, b and c are adjust coefficients depending on statistics group.

Expression 2

\[
\text{exercise hardness} = \frac{\text{present pulse frequency} - \text{stable pulse frequency}}{\text{maximum pulse frequency} - \text{stable pulse frequency}}
\]

Expression 3

\[
\text{maximum oxygen intake amount} = \frac{\text{oxygen intake amount}}{\text{exercise hardness}}
\]

According to another aspect of the invention, there is provided a fitness prescription system comprising at least one fitness equipment having a driver operated according to data indicated by a fitness program and a central server connected to the at least one fitness equipment through communication network, wherein the central server comprises: storage means for storing the fitness program prescribed for an exerciser; exercise amount control means for comparing pulse frequency of the exerciser who is exercising by using the at least one fitness equipment operated by the fitness program with pulse frequency indicated by the fitness program and if there exists difference, sending the driver data for controlling the at least one fitness equipment so as to correct the difference; and fitness program update means for comparing any one of actual oxygen intake amount, exercise hardness and maximum oxygen intake amount of the exerciser with any one of oxygen intake amount, exercise hardness and maximum
oxygen intake amount indicated by the fitness program and if there exists difference, updating the fitness program so as to correct the oxygen intake amount, the exercise hardness and the maximum oxygen intake amount.

Preferably, the fitness program update means calculates the oxygen intake amount, the exercise hardness and the maximum oxygen intake amount of the exerciser by using Expressions 4, 2 and 3 respectively, calculating the driving status of the treadmill by using a predetermined exercise hardness, and updating a fitness program.

Expression 4

\[
\text{oxygen intake amount} = \text{moving speed} \times a + X \times \text{moving speed (m/min)} \times b + c
\]

where \(a\), \(b\) and \(c\) are adjust coefficients depending on statistics group.

According to another aspect of the invention, there is provided a fitness prescription method for updating a fitness program for an exerciser who exercises according to the fitness program representing exercise hardness, pulse frequency and fitness equipment driving status related to the exerciser, the method comprising the steps of: (a) comparing a pulse frequency indicated by the fitness program for the exerciser with actual pulse frequency of the exerciser; (b) if there exists difference between the indicated pulse frequency and the actual pulse frequency, controlling the fitness equipment driving status so as to correct the difference; and (c) calculating at least one of the exercise hardness, actual oxygen intake amount, and maximum oxygen intake amount based on the actual pulse frequency of the exerciser by using Expressions 2, 3 and 4 and updating the fitness program.

Preferably, the step (c) further comprises the step of: when the exerciser selects grouped exercise recognition, updating the pulse frequency represented by the fitness program according to the selected exercise recognition.
Preferably, the fitness prescription method further comprising the steps of: (d) calculating expended calorie of the exerciser; and (e) terminating the fitness equipment when the expended caloric reaches a predetermined value.

5 Brief Description of the Drawings

The above object, other features and advantages of the present invention will become more apparent by describing the preferred embodiment thereof with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of a system according to an embodiment of the present invention;

FIG. 2 is a block diagram illustrating a control process of a system according to the embodiment of the present invention shown in FIG. 1;

FIG. 3 is a flow chart illustrating the embodiment of the present invention;

FIG. 4 is a graph representing height of the exercise course;

FIG. 5 is a flow chart illustrating an operation process of an exercise amount control module and a fitness program update module in the embodiment of the present invention;

FIG. 6 illustrates an example of the readout fitness program of the present invention; and

FIG. 7 illustrates another embodiment of the present invention.

Best Mode for Carrying Out the Invention

The preferred embodiment of the present invention will be described in detail referring to the accompanied drawings.
FIG. 1 is a perspective view of a system according to an embodiment of the present invention. FIG. 2 is a block diagram illustrating a control process of a system according to the embodiment of the present invention shown in FIG. 1.

A treadmill 10 that is a fitness equipment of the first embodiment shown in FIG. 1 is provided with driving apparatuses the running speed and the slope of which are controlled by motors. The driving apparatuses are controlled by controller 20 having a fitness program.

The controller 20 is connected to a control unit 200 for performing arithmetic operation and logic operation and generating a control signal to control a control object, an input unit 201 connected to the control unit 200 for receiving data, and a card reader 202 for reading a card. Here, the input unit 201 can have any input manner such as key input manner, monitor touch input manner and so on. The card reader 202 can be contact card reader or non-contact RF card reader. The control unit 200 is connected to ROM 203 for storing a control program of the control unit 200 and a RAM 204 for storing temporary data, an interface 240 connected to exterior for transmitting and receiving data, a monitor driver 206 for driving a monitor 207, and a fitness equipment driver 208 for controlling a driving apparatus in a treadmill 10.

The control unit 200 is connected to a pulse frequency measuring unit 230 for measuring pulse frequency of the exerciser who is exercising using a treadmill 10, a calorie calculation module 205 for calculating expended calorie of the exerciser and controlling the treadmill 10 according to expended calorie amount, a fitness program update module 220 for updating the fitness program, and a exercise amount control module 209 for measuring running distance and exercise amount using treadmill 10 and controlling the running speed and slope of the treadmill 10. Here, the term module can
be a pure program, a firmware which is combination of hardware and software or a pure hardware. The module can be manufactured in an integrated circuit chip or a separated chip. The module can be embedded in the control unit 200 or separated from the control unit 200. These specifications can be varied variously in design. The control unit 200 is connected to a data storage 210 for storing various database. The data storage 210 includes personal information database 215 for storing personal information on every exerciser, fitness program database 211 for storing a fitness program of each exerciser, exercise history database 212 for storing exercise history of every exerciser, running course database 213 for storing running course data selectable by each exerciser, and moving picture database 214 for storing moving picture of each course.

FIG. 3 is a flow chart illustrating the embodiment of the present invention.

When the exerciser inputs his or her information to the card reader 202 or the input unit 201, the control unit 200 compares the inputted personal information with the information stored in the personal information database 215 and authenticates the exerciser to use the treadmill 10 if the exerciser is a member but guides the exerciser to subscribe newly if the exerciser is not a member (S10 and S20).

The control unit 200 reads out moving picture list from the running course moving picture database 214 and displays the moving picture list on the monitor 207 so that the exerciser selects one from the list. If a specific moving picture item is selected, the selected moving picture is displayed so that the exerciser starts playing the moving picture. The control unit 200 reads out the graph shown in FIG. 4 illustrating aspect of distance to height of the selected running course from the running course database 213 and displays the graph on the monitor if a specific moving picture item is selected (S30 and S40).
The fitness program update module 220 reads out the exerciser’s exercise history for a week from the exercise history database 212 and updates the fitness program. Here, the fitness program update module 220 calculates corrected value according to the exercise status of the exerciser. If there exists the corrected value, the fitness program update module 220 updates the fitness program newly and drives the treadmill 10 (S40 and S41). If there does not exist the corrected value, the fitness program update module 220 reads out the conventional fitness program from the fitness program database 211 and drives the treadmill 10 (S50).

When the treadmill 10 is driven by the fitness program, the control unit 200 makes a moving picture displayed according to exercise of the exerciser and displays the running distance calculated by the exercise amount control module 209 on the dotted marked course shown in FIG. 4 with a dotted line. The calorie calculation module 205 calculates the expended calorie of the exerciser and the calculated expended calorie is used to control the exercise at the settings of the exerciser. This will be described later (S60).

When the exerciser is running on the course shown in FIG. 4, the exercise amounts, that is, slope and speed of the treadmill 10 are controlled according to the exercise state of the exerciser. When the course shown in FIG. 4 is selected, the slope to distance is fixed and the speed of the treadmill 10 is controlled to control the amount of exercise. However, if the course is not selected, any one of the speed and the slope is fixed and the other can be varied (S60).

When exercising or starting exercise, the exerciser can vary the amount of exercise according to the recognition. The detailed description on it will be made later (S60).
When the exercise is ended, the exercise history of the running distance, the expended calorie and the maximum oxygen intake amount is updated to be stored in the exercise database 213 (S70).

The process to calculate the running speed of treadmill at the predetermined slope calculated by the fitness program update module will be described.

The maximum pulse frequency of the exerciser who is exercising is calculated by Expression 5 and the targeted pulse frequency which is given as the object to the exerciser by the fitness program in exercise is represented as Expression 6.

Expression 5

Maximum pulse frequency = 220 – age of the exerciser

Expression 6

Targeted pulse frequency = (maximum pulse frequency – stable pulse frequency) × exercise hardness + stable pulse frequency

where the exercise hardness (%HRR) is calculated as percentage of the maximum oxygen intake amount (%VO₂max). In other words, the exercise hardness (50%HRR) means 50VO₂max.

In addition, the oxygen intake amount is represented by Expression 7.

Expression 7

oxygen intake amount = horizontal element intake amount + vertical element intake amount + rest element intake amount

where the horizontal element intake amount is oxygen intake amount to be taken in when moving along horizontal surface, the vertical element intake amount is
oxygen intake amount to be taken in with vertical movement by slope of the treadmill, and the rest element intake amount is oxygen intake amount to be taken in when resting. The coefficients of the factors to determine each intake amount depend on whether the exercise is running or walking.

Expression 8

\[ \text{oxygen intake amount} = \text{moving speed} \times a + X \% \times \text{moving speed (m/min)} \times b + c \]

where \( a, b \) and \( c \) are variable coefficients that depend on running speed application range of the fitness equipment or statistics group of the exercisers, and \( X \) is a slope if the fitness equipment is a treadmill.

Hereafter, the fitness equipment will be limited to treadmill for convenience of description.

The oxygen intake amount when walking on the treadmill is represented by Expression 9. This expression is applied more exactly in the range of walking speed of 50 ~ 100 m/min (3 ~ 6 km/hr).

Expression 9

\[ \text{Oxygen intake amount} = \text{running speed (m/min)} \times 0.1 \ (\text{ml/kg/min}) \]

\[ + \text{slope (}) \times \text{running speed (m/min)} \times 1.8 \ (\text{ml/kg/min}) \]

\[ + 3.5 \ (\text{ml/kg/min}) \]

If the exerciser whose oxygen intake amount and targeted pulse frequency are 20 ml/kg/min and 120 /min walks with the slope of 0 %, the running speed of the exerciser can be obtained from Expression 9.

In other words, \( 20 = \text{running speed} \times 0.1 + 3.5 \)

Therefore, running speed = 165 m/min

In addition, when the slope is 2 %, the running speed of the exerciser can be
obtained from Expression 9.

\[ 20 = \text{running speed} \times 0.1 + 0.02 \times \text{running speed} \times 1.8 + 3.5 \]

Therefore, running speed = 121.3 m/min

In addition, when the slope is 5 %, the running speed of the exerciser can be obtained from Expression 9.

\[ 20 = \text{running speed} \times 0.1 + 0.05 \times \text{running speed} \times 1.8 + 3.5 \]

Therefore, running speed = 86.8 m/min

As described above, when physical condition (oxygen intake amount) of the exerciser and a predetermined slope are given, the running speed of the exerciser related to the slope is determined from Expression 9.

When running, the oxygen intake amount of the exerciser is determined from Expression 10 and Expression 10 can be applied more exactly within the range of 134 – 268 m/min (8 – 16 Km/hr) that is a proper running speed for exercise.

Expression 10

\[
\begin{align*}
\text{Oxygen intake amount} &= \text{running speed (m/min)} \times 0.2 \text{ (ml/kg/min)} \\
& + \text{slope (\%)} \times \text{running speed (m/min)} \times 1.8 \text{ (ml/kg/min)} \times 0.5 \\
& + 3.5 \text{ (ml/kg/min)}
\end{align*}
\]

If the exerciser whose oxygen intake amount is 20 ml/kg/min and whose targeted pulse frequency is 120 /min runs on the slope of 0 %, the running speed of the exerciser can be obtained from Expression 10.

In other words, \[ 20 = \text{running speed} \times 0.2 + 3.5 \]

Therefore, running speed = 82.5 m/min

In addition, when the slope is 2 %, the running speed of the exerciser can be obtained from Expression 10.
20 = running speed \times 0.2 + 0.02 \times \text{running speed} \times 1.8 \times 0.5 + 3.5

Therefore, running speed = 75.7 \text{ m/min}

In addition, when the slope is 5 \%, the running speed of the exerciser can be obtained from Expression 10.

5 \quad 20 = \text{running speed} \times 0.2 + 0.05 \times \text{running speed} \times 1.8 \times 0.5 + 3.5

Therefore, running speed = 67.3 \text{ m/min}

The process in which the running speed is varied according to exercise pulse frequency compared physical condition by using exercise amount control module 209 will be described using an example of the woman exerciser who is 40 years old, whose maximum oxygen intake amount VO_{2\text{max}}, stable pulse frequency and weight are 40 \text{ ml/kg/min}, 60 /\text{min} and 60 \text{ Kg} respectively, and who is prescribed to exercise with exercise hardness of 50 \%.

The targeted pulse frequency of the exerciser is 120 /\text{min} according to Expression 2 and if the exerciser’s pulse frequency is 130 /\text{min}, the exerciser’s pulse frequency exceeds the targeted pulse frequency by 10 /\text{min}. The exerciser’s exercise hardness can be obtained from Expression 11 that is modified version of Expression 2.

Expression 11

\[
\text{Present pulse frequency} = (\text{maximum pulse frequency} - \text{stable pulse frequency}) \\
\times \text{present exercise hardness} + \text{stable pulse frequency}
\]

In other words,

\[
\text{exercise hardness} = \frac{\text{present pulse frequency} - \text{stable pulse frequency}}{\text{maximum pulse frequency} - \text{stable pulse frequency}}
\]

\[
= \frac{130 - 60}{(220 - 40) - 60} = 0.58 = 58\%
\]

As understood from the calculation described above, it can be noticed that the
exerciser exceeds the exercise hardness of 50 % by 8 %.

The exercise amount control module 209 controls the speed of the treadmill to match the prescribed fitness program.

If the present slope is 5 % and the exerciser walks at 6 Km/hr (=100 m/min), the oxygen intake amount can be calculated using Expression 8.

In other words,

\[
\text{oxygen intake amount} = \text{running speed (m/min)} \times 0.1 \text{ (ml/kg/min)} + \text{slope (%) \times running speed (m/min)} \times 1.8 \text{ (ml/kg/min)} + 3.5 \text{ (ml/kg/min)} \\
= 100 \text{ (m/min)} \times 0.1 \text{ (ml/kg/min)} + 0.05 \times 100 \text{ (m/min)} \times 1.8 \text{ (ml/kg/min)} + 3.5 \text{ (ml/kg/min)} \\
= 22.5 \text{ (ml/kg/min)}
\]

In addition, since the oxygen intake amount is proportional to the exercise hardness, the maximum oxygen intake amount can be calculated using Expression 12.

Expression 12

\[
\text{maximum oxygen intake amount} = \frac{\text{present oxygen intake amount}}{\text{exercise hardness}}
\]

Accordingly, since the maximum oxygen intake amount of the exerciser is 22.5 ml/kg/min at exercise hardness of 58 %, 22.5 / 0.58 \approx 38.8 ml/kg/min. The oxygen intake amount of the exerciser whose maximum oxygen intake amount is 38.8 ml/kg/min and who exercises at exercise hardness of 50 % is 19.4 ml/kg/min and the running speed of the treadmill is determined by Expression 4.

In other words, 19.4 = \text{running speed} \times 0.1 + 0.05 \times \text{running speed} \times 1.8 + 3.5

Therefore, running speed \approx 83.7 m/min

The exercise hardness is controlled by reducing the present speed from 100 m/min to 83.7 m/min.
Any one of exercise hardness, oxygen intake amount and maximum oxygen intake amount of the actual exercise is compared with an indicated fitness program to calculate and estimate the changed values. Hereafter, the estimating method of the maximum oxygen intake amount will be described.

To estimate the maximum oxygen intake amount, exercise hardness is calculated according to Expression 11 and the maximum oxygen intake amount is found from Expression 12 by using the found exercise hardness but the maximum oxygen intake amount is found by measuring maximum oxygen intake amounts periodically after a predetermined time (about 3 minutes) elapsed after exercise is started actually after warming up and calculating average.

The maximum oxygen intake amount can be defined as Expression 13 from Expressions 11 and 12.

Expression 13

\[
\text{maximum oxygen intake amount} = \frac{\text{present oxygen intake amount} \times (\text{maximum pulse frequency} - \text{stable pulse frequency})}{\text{present pulse frequency} - \text{stable pulse frequency}}
\]

As a result, the maximum oxygen intake amount is increased if the present pulse frequency is low. If the exerciser repeats to exercise, the present pulse frequency is decreased to reduce the exercise hardness even though exercising according to the same fitness program on the same course.

Accordingly, the low present pulse frequency at the same exercise hardness means that the maximum oxygen intake amount is high and the exerciser is healthy.

Generally, the fitness program includes a warming-up step, a main exercise step and finishing action step. When the exerciser exercises, the maximum oxygen intake amount is determined according to Expression 13 so as to update the fitness program for
next exercise. Here, the maximum oxygen intake amounts are calculated periodically at the main exercise step and the average of the maximum oxygen intake amounts is determined to be the maximum oxygen intake amount to update the fitness program.

The process to update the fitness program will be described.

The process to update the fitness program will be described using an example of the woman exerciser who is 40 years old, whose maximum oxygen intake amount $\text{VO}_{2\text{max}}$, stable pulse frequency and weight are 40 ml/kg/min, 60 /min and 60 Kg respectively, and who is prescribed to exercise walking with exercise hardness of 50 % without slope.

The oxygen intake amount of the exerciser is 20 ml/kg/min according to Expression 12. The targeted pulse frequency of the exerciser is 120 /min according to Expression 6. The running speed $V_1$ of the treadmill is set to be 165 m/min according to Expression 7. If the exerciser gets healthy owing to exercise and the exerciser’s pulse frequency is measured to be 110 /min at the same running speed of the treadmill, since the exerciser’s exercise hardness is calculated to be 0.417 according to Expression 11 and the oxygen intake amount is 20 ml/kg/min, the maximum oxygen intake amount of the exerciser should be corrected to be 47.962 ml/kg/min. The fitness program is updated according to the updated maximum oxygen intake amount to set the exercise hardness to be 50 %. In other words, the oxygen intake amount of the exerciser is determined to be 23.981 ml/kg/min according to Expression 12 and the running speed $V_2$ of the treadmill is set to be 204.810 m/min at the exercise hardness of 50 %. The exercise amount of the exerciser is increased by $\Delta V = V_2 - V_1 = 39.810$ m/min by the fitness program to maintain the same exercise hardness. The updating process of the fitness program is described on a predetermined time. However, in the main exercise
step, the maximum oxygen intake amounts are calculated periodically and averaged to be applied to the next exercise step but the mean maximum oxygen intake amount is calculated for a predetermined period in exercising so that the calculated mean maximum oxygen intake amount can be set to applied for the next exercise and according to the updated fitness program.

In addition, the fitness program can be corrected due to the exercise recognition. The exercise recognition is the method to determine the exercise hardness based on the recognized determination of the exerciser. Table 1 shows an example illustrating grouping criterion and pulse frequency adjustment according to the grouping criterion.

<table>
<thead>
<tr>
<th>Grouping criterion</th>
<th>Recognition</th>
<th>Pulse frequency adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very very light</td>
<td>Very very light</td>
<td>+ 30</td>
</tr>
<tr>
<td>Very light</td>
<td>Very light</td>
<td>+ 20</td>
</tr>
<tr>
<td>Light</td>
<td>Light</td>
<td>+ 10</td>
</tr>
<tr>
<td>Fairly hard</td>
<td>Fairly hard</td>
<td>0</td>
</tr>
<tr>
<td>Hard</td>
<td>Hard</td>
<td>- 10</td>
</tr>
<tr>
<td>Very hard</td>
<td>Very hard</td>
<td>- 20</td>
</tr>
<tr>
<td>Very very hard</td>
<td>Very very hard</td>
<td>- 30</td>
</tr>
</tbody>
</table>

The selection menu to select exercise recognition is displayed on a monitor in exercising. When the exerciser selects the exercise recognition that he or she feels, in the exercise amount control module 209 applies pulse frequency adjustment according to the exercise recognition to the actual pulse frequency and controls the running speed and the slope according to the actual pulse frequency.

Since the calorie calculation module 205 calculates the oxygen intake amount per unit time in exercising and consumes the heat of 0.225 Kcal per oxygen of 1L, the
calorie calculation module 205 calculates the calorie expended during exercising and the exerciser or the fitness prescription program sets the desired calorie and subtracts the expended heat from the desired calorie to control the treadmill to stop when the subtraction is zero.

FIG. 5 is a flow chart illustrating an operation process of an exercise amount control module and a fitness program update module in the embodiment of the present invention.

The fitness program update module reads out the fitness program of the exerciser from the fitness program database 211 of the storage 220 and displays the fitness program on the monitor 207 (S61). FIG. 6 illustrates an example of the readout fitness program of the present invention. The fitness program shown in FIG. 6 includes a warming-up step (for five minutes after exercise starts), a main exercise step (from five minutes elapsed to thirty five minutes elapsed) and a finishing action step (from thirty five minutes elapsed to exercise end). The solid line 61 of pulse frequency displaying lines is a pulse frequency graph of the fitness program displayed first on the monitor. The dotted line implies actual pulse frequency detected when the exerciser exercises. Here, the running speeds according to time of the treadmill to be driven by the fitness program and the actually measured running speed can be displayed on the monitor. The desired exercise hardness and the actual exercise hardness can be displayed comparatively. When a predetermined moving picture of the moving picture database 214 is selected, the slope of each location can be displayed using the moving picture and an exercise course database 213 working with the moving picture.

When the exerciser adjust the fitness program in accordance with the exercise recognition, the fitness program update module 230 displays a selection screen shown in
Table 1 on the monitor 207. If the exerciser is allowed to select predetermined exercise recognition, the targeted pulse frequency is changed and the new targeted pulse frequency, the new running speed and the new slope are used to update the fitness program (S62). Here, when a predetermined course is selected, the slope is fixed at a predetermined location and the running speed is adjusted. When the predetermined course is not selected, the slope is fixed arbitrarily and only the running speed is adjusted or the running speed is fixed and the slope is varied on the contrary.

If the fitness program is updated and the treadmill is driven to allow the exerciser to exercise (S63), the exercise amount control module 209 compares the actual pulse frequency of the exerciser measured by the pulse frequency measuring unit 230 with the pulse frequency of the fitness program to control the running speed of the treadmill (S64). The control unit 200 receives the information of the running speed controlled by the running speed to drive the treadmill (S63). The fitness program update module 220 calculates the mean maximum oxygen intake amount while the treadmill 10 operates or after the treadmill 10 ends. The mean maximum oxygen intake amount is calculated based on Expression 11 and Expressions related to Expression 11 and the new targeted pulse frequency and the fitness program is updated according to the new pulse frequency and the new running speed based on the new mean maximum oxygen intake amount (S65 and S66).

The calorie calculation module 205 of the treadmill 10 calculates the expended calorie (S67). The desired exercise calorie is compared with the present expended calorie when calorie control mode is set to determine the end of the treadmill 10 according to the expended calorie. If the expended calorie is the same as the desired exercise calorie, the calorie calculation module 205 transmits the end signal to the
control unit 200 to end the treadmill 10.

FIG. 7 illustrates another embodiment of the present invention. The fitness prescription program shown in FIG. 1 is for the case that one fitness equipment is operated separately but FIG. 7 illustrates that a plurality of fitness equipments are connected to one client through LAN and a plurality of clients are connected to a central server 70 through Internet or intranet.

Here, the central server 70 stores information on a plurality of exercisers and includes a fitness program update module, an exercise amount control module, a calorie calculation module of the fitness prescription system shown in FIG. 2. The central server 70 receives the pulse frequency measured during the exerciser's exercising from the client and compares the pulse frequency with the prescribed fitness program. The central server 70 transmits a control signal for changing the exercise amount to clients according to the comparison.

The client 71 receives the pulse frequency of the exerciser who exercises using the fitness equipments 72, and transmits the received pulse frequency to the central server 70. The client 71 receives the fitness program from the central server and transmits the driving signal for driving the fitness equipments according the exercise amount (the running speed and the exercise amount according to the slope in the case of the treadmill) of the fitness program to the fitness equipments 72 connected to the clients.

The fitness equipment 72 includes a monitor connected to clients, for displaying image from the image signal transmitted from the client 71, a driving unit for driving the fitness equipments according to the driving signal inputted from the client 71, a cartridge for receiving the personal information of the exerciser and transferring
the personal information to the client 71 to authenticate the fitness equipment 72, and an input unit for transmitting the input signal using input key or touch panel of the monitor to the client 71. The roles of the client 71 and the fitness equipment 72 can be allocated to them variously. Different from the embodiment shown in FIG. 7, an embedded chip is mounted on the fitness equipments and the fitness equipments can be connected to the central server 70. The control unit 200 shown in FIG. 1 is provided to control the fitness equipments by the control signal according to the exercise amount.

While the functional clothing of the present invention have been described in detail with reference to the preferred embodiments, those skilled in the art will appreciate that various modifications and substitutions can be made thereto without departing from the spirit and scope of the present invention as set forth in the appended claims.

**Industrial Applicability**

As described above, according to the present invention, the exerciser exercises according to the fitness program suitable to the exerciser’s physical condition so that the exerciser can increase his or her fitness. The manager of the fitness can manage each exerciser economically without managing each exerciser separately by automatically updating the fitness program according to the fitness condition of the exerciser.
Claims:

1. A fitness prescription system for measuring pulse frequency of an exerciser with fitness equipments so as to prescribe a fitness program for the exerciser, the fitness prescription system comprising:
   pulse frequency measuring means for measuring the pulse frequency of the exerciser; and
   fitness program update means for calculating maximum oxygen intake amount based on the pulse frequency measured by the pulse frequency measuring means and updating the fitness program for the exerciser based on the maximum oxygen intake amount.

2. A fitness prescription system for measuring pulse frequency of an exerciser with a treadmill so as to update a fitness program for the exerciser, the fitness prescription system comprising:
   pulse frequency measuring means for measuring the pulse frequency of the exerciser;
   exercise amount control means for comparing pulse frequency represented by the pulse frequency measuring means with pulse frequency indicated by the fitness program and if there exists difference, changing a driving status of the treadmill and driving the treadmill; and
   fitness program update means for comparing any one of actual oxygen intake amount, exercise hardness and maximum oxygen intake amount of the exerciser with any one of oxygen intake amount, exercise hardness and maximum oxygen intake...
amount indicated by the fitness program and if there exists difference, updating the fitness program so as to correct the oxygen intake amount, the exercise hardness and the maximum oxygen intake amount.

3. The fitness prescription system of claim 2, wherein the fitness program update means calculates the oxygen intake amount, the exercise hardness and the maximum oxygen intake amount of the exerciser by using Expressions 14, 15 and 16 respectively, calculating the driving status of the treadmill by using predetermined exercise hardness, and updating a fitness program.

**Expression 14**

\[
\text{oxygen intake amount} = \text{moving speed} \times a + \text{slope (\%)} \times \text{moving speed (m/min)} \times b + c
\]

where \(a\), \(b\) and \(c\) are adjust coefficients depending on statistics group

**Expression 15**

\[
\text{exercise hardness} = \frac{\text{present pulse frequency} - \text{stable pulse frequency}}{\text{maximum pulse frequency} - \text{stable pulse frequency}}
\]

**Expression 16**

\[
\text{maximum oxygen intake amount} = \frac{\text{oxygen intake amount}}{\text{exercise hardness}}
\]

4. A fitness prescription system comprising at least one fitness equipment having a driver operated according to data indicated by a fitness program and a central server connected to the at least one fitness equipment through communication network, wherein the central server comprises:

- storage means for storing the fitness program prescribed for an exerciser;
- exercise amount control means for comparing pulse frequency of the exerciser.
who is exercising by using the at least one fitness equipment operated by the fitness program with pulse frequency indicated by the fitness program and if there exists difference, sending the driver data for controlling the at least one fitness equipment so as to correct the difference; and

fitness program update means for comparing any one of actual oxygen intake amount, exercise hardness and maximum oxygen intake amount of the exerciser with any one of oxygen intake amount, exercise hardness and maximum oxygen intake amount indicated by the fitness program and if there exists difference, updating the fitness program so as to correct the oxygen intake amount, the exercise hardness and the maximum oxygen intake amount.

5. The fitness prescription system of claim 4, wherein the fitness program update means calculates the oxygen intake amount, the exercise hardness and the maximum oxygen intake amount of the exerciser by using Expressions 17, 18 and 19 respectively, calculating the driving status of the treadmill by using predetermined exercise hardness, and updating a fitness program.

Expression 17

\[
\text{oxygen intake amount} = \text{moving speed} \times a + X \times \text{moving speed (m/min)} \times b + c
\]

where a, b and c are adjust coefficients depending on statistics group

Expression 18

\[
\text{exercise hardness} = \frac{\text{present pulse frequency} - \text{stable pulse frequency}}{\text{maximum pulse frequency} - \text{stable pulse frequency}}
\]

Expression 19

\[
\text{maximum oxygen intake amount} = \frac{\text{oxygen intake amount}}{\text{exercise hardness}}
\]
6. A fitness prescription method for updating a fitness program for an exerciser who exercises according to the fitness program representing exercise hardness, pulse frequency and fitness equipment driving status related to the exerciser, the method comprising the steps of:

(a) comparing a pulse frequency indicated by the fitness program for the exerciser with actual pulse frequency of the exerciser;

(b) if there exists difference between the indicated pulse frequency and the actual pulse frequency, controlling the fitness equipment driving status so as to correct the difference; and

(c) calculating at least one of the exercise hardness, actual oxygen intake amount, and maximum oxygen intake amount based on the actual pulse frequency of the exerciser and updating the fitness program.

7. The fitness prescription method of claim 6, wherein the step (c) comprises the steps of:

(c-1) calculating the oxygen intake amount, the exercise hardness and the maximum oxygen intake amount of the exerciser by using Expressions 20, 21 and 22, respectively;

(c-2) calculating the fitness equipment driving status by using a predetermined exercise hardness; and

(c-3) updating the fitness program.

Expression 20

\[ \text{oxygen intake amount} = \text{moving speed} \times a + X \times \% \times \text{moving speed (m/min)} \times b + c \]
where a, b and c are adjust coefficients depending on statistics group

Expression 21

\[
\text{exercise hardness} = \frac{\text{present pulse frequency} - \text{stable pulse frequency}}{\text{maximum pulse frequency} - \text{stable pulse frequency}}
\]

Expression 22

\[
\text{maximum oxygen intake amount} = \frac{\text{oxygen intake amount}}{\text{exercise hardness}}
\]

8. The fitness prescription method of claim 6 or 7, wherein the step (c) further comprises the step of: (c-4) when the exerciser selects grouped exercise recognition, updating the pulse frequency represented by the fitness program according to the selected exercise recognition.

9. The fitness prescription method of claim 6 or 7, further comprising the steps of:

(d) calculating expended calorie of the exerciser; and

(c) terminating the fitness equipment when the expended calorie reaches a predetermined value.
**FIG. 3**

1. **INPUTTING PERSONAL INFORMATION**
   - **S10**
   - **S20**
     - **AUTHENTICATED?**
     - **NO**
     - **S30**
     - **YES**
     - **DISPLAYING MOVING PICTURE**
     - **S40**
     - **DISPLAYING DISTANCE GRAPH**
   - **S40**
   - **NO**
   - **SUBSCRIBING?**
   - **NO**
   - **Error**

2. **CORRECTION VALUE?**
   - **YES**
   - **S80**
     - **UPDATING FITNESS PROGRAM ACCORDING TO CORRECTION VALUE**
   - **NO**
   - **S60**
     - **CALCULATING PRESENT EXERCISE AMOUNT, CALORIE EXPENDED ACCORDING TO EXERCISE, CONTROL AMOUNT ACCORDING TO EXERCISE AND CORRECTION VALUE ACCORDING TO RECOGNITION**
     - **S70**
     - **EXERCISE ENDED?**
   - **NO**
   - **S70**
     - **CALCULATING EXERCISE HISTORY**
     - **END**
   - **S81**
     - **DRIVING BY FITNESS EQUIPMENTS BY USING UPDATED FITNESS PROGRAM**
FIG. 6
TARGETED PULSE FREQUENCY AND EXERCISE TIME

<table>
<thead>
<tr>
<th>STABLE</th>
<th>WARMING UP</th>
<th>MAIN EXERCISE</th>
<th>FINISHING ACTION</th>
<th>RECOVERY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5-10 MIN</td>
<td>10-30 MIN</td>
<td>5-10 MIN</td>
<td></td>
</tr>
</tbody>
</table>

PULSE FREQUENCY

| 200 |
| 180 |
| 160 |
| 140 |
| 120 |
| 100 |
| 80  |
| 60  |

MINIMUM TARGETED PULSE FREQUENCY

61

MAXIMUM TARGETED PULSE FREQUENCY

62

EXERCISE START

5 10 15 20 25 30 35 EXERCISE ENDED (MIN)

EXERCISE TIME

FIG. 7

CENTRAL SERVER

CLIENT

FITNESS PRESCRIPTION SYSTEM

CLIENT

FITNESS PRESCRIPTION SYSTEM
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G06F 17/60

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 G06F 17/60, A63B 24/00, A61B 5/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applicants for inventions since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Paj, Fpd, Patrom

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>KR 02-0030755(NURY TEC INC.) A 25 APRIL 2002 (Family None)</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>* whole documents</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>JP 12-14828(YA MAN LTD.) 18 JANUARY 2000 (Family None)</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>* whole documents</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>WO 97/35514(SEIKO EPSON CORP.) A 02 OCTOBER 1997 (Family None)</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>* whole documents</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>JP 09-38051 (KIYOKUKOU BUSSAN KK.) 10 FEBRUARY 1997 (Family None)</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>* whole documents</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>JP 06-7478 (MATSUSHITA ELECTRIC WORKS LTD.) 18 JANUARY 1994 (Family None)</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>* whole documents</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>JP 05-176913 (TAWARA HIDEJI.) 20 JULY 1993 (Family None)</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>* whole documents</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>JP 09-299353(MEGURO TADAMICHI, KINKI UNIV.) 25 NOVEMBER 1997 (Family None)</td>
<td>1-9</td>
</tr>
<tr>
<td></td>
<td>* whole documents</td>
<td></td>
</tr>
</tbody>
</table>

* Further documents are listed in the continuation of Box C.  
* See patent family annex.

* Special categories of cited documents:
  *A* document defining the general state of the art which is not considered
to be of particular relevance
  *E* earlier application or patent but published on or after the international
  filing date
  *L* document which may throw doubts on priority claim(s) or which is
cited to establish the publication date of citation or other
  special reason (as specified)
  *O* document referring to an oral disclosure, use, exhibition or other
  means
  *P* document published prior to the international filing date but later
  than the priority date claimed
  *T* later document published after the international filing date or priority
date and not in conflict with the application but cited to understand
  the principle or theory underlying the invention
  *X* document of particular relevance; the claimed invention cannot be
  considered novel or cannot be considered to involve an inventive
  step when the document is taken alone
  *Y* document of particular relevance, the claimed invention cannot be
  considered to involve an inventive step when the document is
  combined with one or more other such documents, such combination
  being obvious to a person skilled in the art
  *&* document member of the same patent family

Date of the actual completion of the international search

09 MARCH 2004 (09.03.2004)

Date of mailing of the international search report

09 MARCH 2004 (09.03.2004)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
920 Dusan-dong, Seo-gu, Daejeon 302-701, Republic of Korea
Facsimile No 82-42-472-7140

Authorized officer

CHOI, Bong Mook
Telephone No 82-42-481-5994

Form PCT/ISA/210 (second sheet) (January 2004)