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(54) **PHYSICAL TRAINING SYSTEM**

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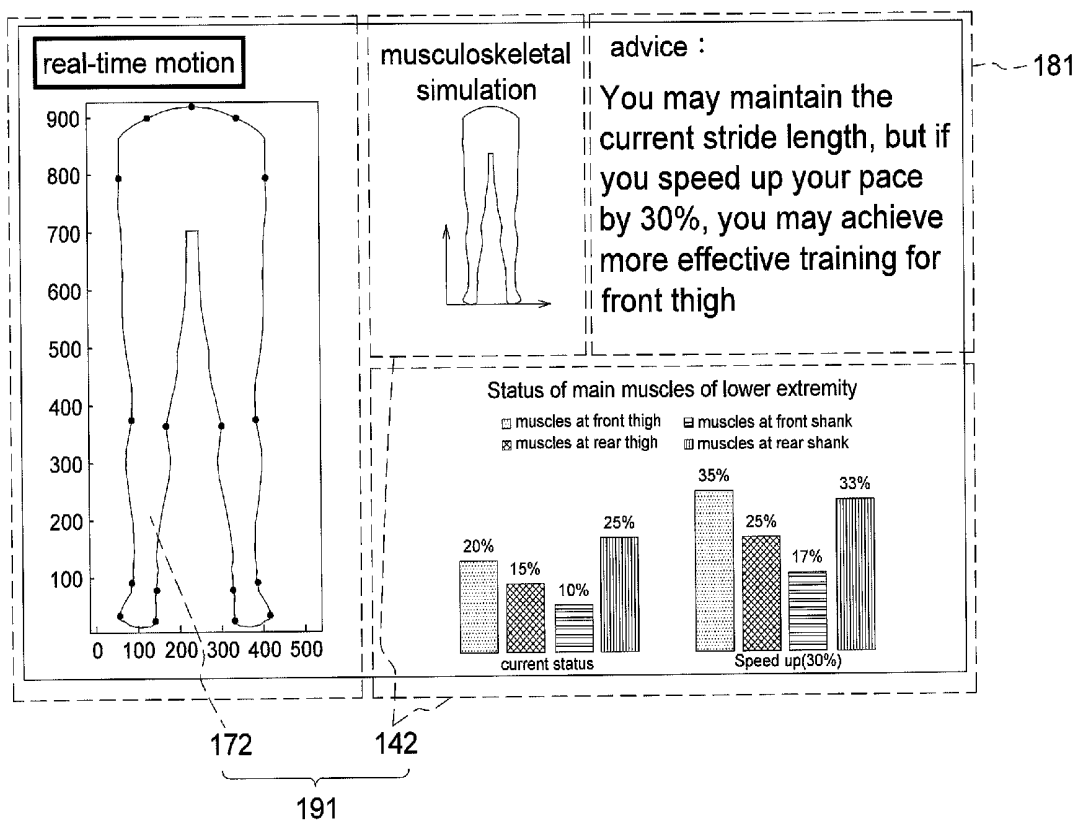
(57) **ABSTRACT**

A physical training system is provided combining biomechanics and neurophysiological measurement for providing users with instant advisory feedback about adjustment to body movements of a user or parameter setting of a gymnastic apparatus for a training objective, especially for specific muscle groups, without incurring sports injuries.

Fig.1

Fig.2

181

musculoskeletal simulation

advice :

You may maintain the current stride length, but if you speed up your pace by 30%, you may achieve more effective training for front thigh

Status of main muscles of lower extremity

☐ muscles at front thigh   ☐ muscles at front shank
☒ muscles at rear thigh   ⊞ muscles at rear shank

35%

25%

17%

33%

Speed up(30%)

20%

15%

25%

10%

current status

real-time motion

900
800
700
600
500
400
300
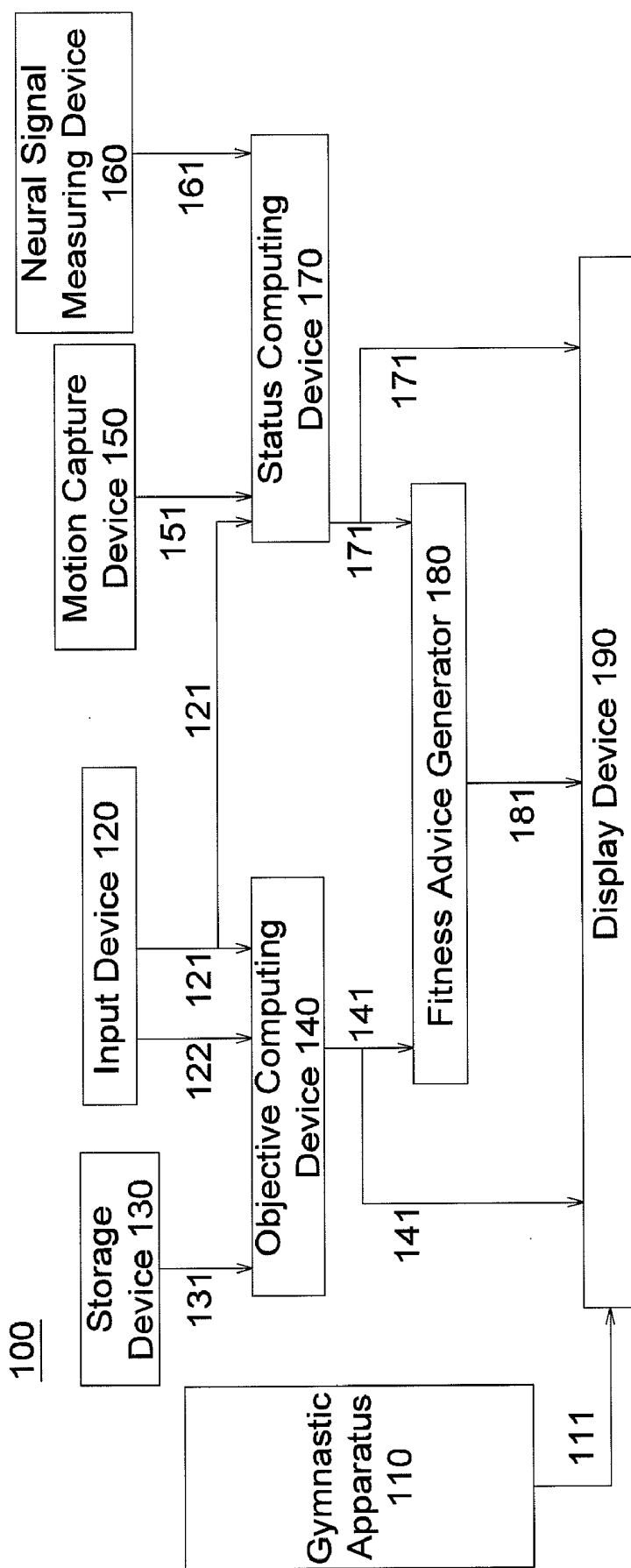200
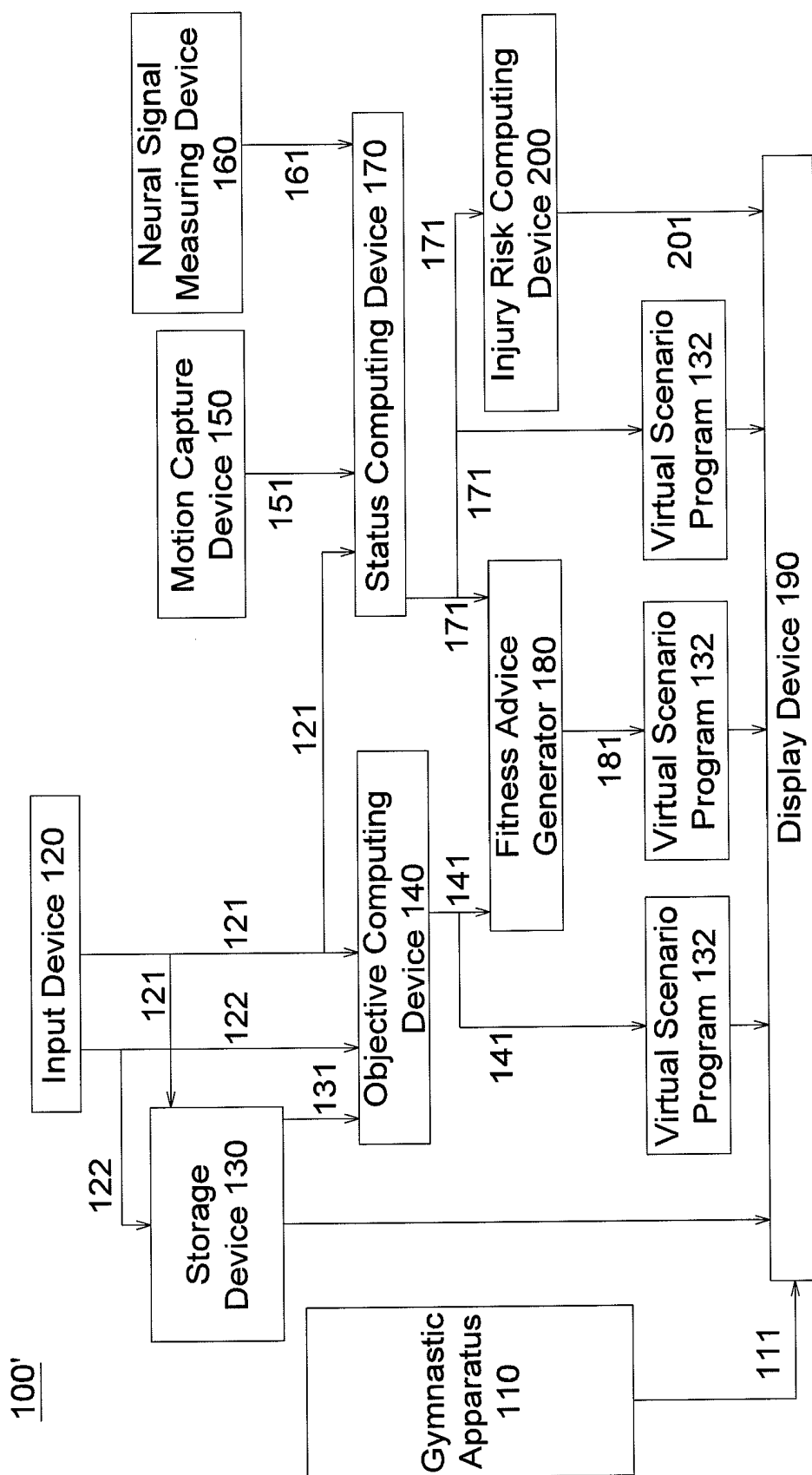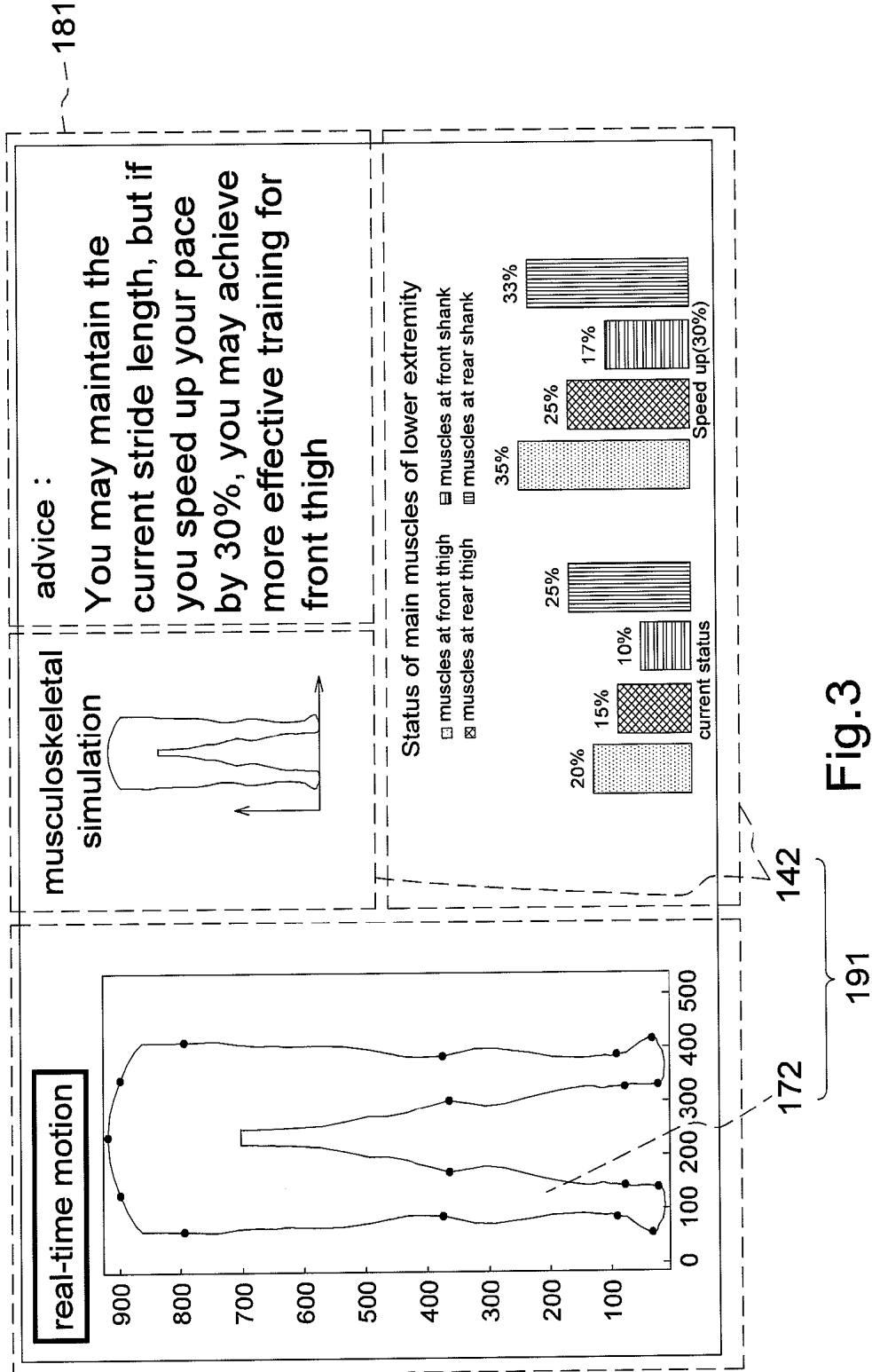100

0 100 200 300 400 500

142

191

172

Fig.3

PHYSICAL TRAINING SYSTEM

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a physical training system and more particularly to a physical training system combining biomechanics and neurophysiological measurements for providing users with instant advisory feedback about how to adjust body movements or parameter setting of a gymnastic apparatus for a training objective without incurring sports injuries.

[0003] 2. Description of the Prior Art

[0004] In general, a gymnastic apparatus is directed to physical training for improving fitness. Parameters of the gymnastic apparatus should be set with respect to the physical status of a user, and an appropriate parameter setting allows the user to improve physical fitness step by step without overloading the body.

[0005] However, while utilizing the conventional gymnastic apparatus, the user may only acquire some fundamental physiological information, such as heartbeat rate and calorie consumption. The conventional gymnastic apparatus cannot provide feedback or advice about parameter settings according to the physical status of the user or objectives which the user wants to accomplish. The objectives include muscle-group training objectives or fitness training objectives. Furthermore, sports injuries may occur when the user operates the gymnastic apparatus inappropriately.

[0006] The user may acquire professional advice and instructions by hiring a personal trainer; however, personal privacy and time limit of exercise are some other issues arised.

SUMMARY OF THE INVENTION

[0007] The present invention is directed to providing a physical training system combining biomechanics and neurophysiological measurements for providing users with instant advisory feedback about how to adjust body movements or parameter setting of a gymnastic apparatus for a training objective, especially for specific muscle groups, without incurring sports injuries.

[0008] To achieve these advantages and the purpose of the invention, an embodiment of the physical training system comprises a gymnastic apparatus, an input device, a storage device, an objective computing device, a motion capture device, a neural signal measuring device, a status computing device, a training advice generator and a display device. The gymnastic apparatus has at least one parameter to be adjusted; the input device allows a user to input a physical information and a training objective information; the storage device is configured for storing an operation information of the gymnastic apparatus; the objective computing device is configured for receiving the physical information, the training objective information and the operation information of the gymnastic apparatus and outputting a recommended parameter information; the motion capture device is disposed on the body of the user and configured for capturing the motion of the user and outputting a motion information; the neural signal measuring device is disposed on the body of the user and configured for measuring at least one neuromuscular signal of the user and outputting a muscle information; the status computing device is configured for receiving the physical information, the motion information and the muscle infor-

mation and outputting a real-time status information, wherein the real-time status information comprises information about movement or force exerted on muscles and joints of the user; the training advice generator is configured for receiving the recommended parameter information from the objective computing device and the real-time status information from the status computing device and generating a training advice information for providing the user with a training advice focusing on the training objective corresponding to the training objective information; the display device is configured for displaying information selected from a group consisting of the parameter of the gymnastic apparatus, the physical information, the training objective information, the motion information, the muscle information, the recommended parameter information, the real-time status information, the training advice information, and combinations thereof.

[0009] Other advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings wherein are set forth, by way of illustration and example, certain embodiments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The foregoing aspects and many of the accompanying advantages of this invention will become more readily appreciated as the same becomes better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

[0011] FIG. 1 a block diagram of a physical training system according to one embodiment of the present invention;

[0012] FIG. 2 a block diagram of a physical training system according to another embodiment of the present invention;

[0013] FIG. 3 is a diagram illustrating a diagram displayed on a display device 190 of the physical training system 100' according to one embodiment of the present invention;

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] FIG. 1 is a block diagram of a physical training system 100 according to one embodiment of the present invention. The physical training system 100, in reference to FIG. 1, comprises a gymnastic apparatus 110, an input device 120, a storage device 130, an objective computing device 140, a motion capture device 150, a neural signal measuring device 160, a status computing device 170, a training advice generator 180 and a display device 190. The gymnastic apparatus 110 comprises a treadmill, an exercise bike, an elliptical trainer, a rower or an apparatus operated with musculoskeletal system of human body, and the gymnastic apparatus 110 comprises at least one parameter 111 to be adjusted, such as the incline, the speed or the tension of the gymnastic apparatus 110. The gymnastic apparatus 110 of the physical training system 100 can be, but not limited to, a treadmill. The input device 120 allows a user to input a physical information 121 (such as, the weight, the height, the gender or the age of the user) and a training objective information 122 (such as, the position of muscles or limbs about to be exercised or an object in a metric for assessing the condition of muscles or limbs). The storage device 130 is configured for storing an operation information 131 of the gymnastic apparatus 110. The objective computing device 140 is configured for receiving the physical information 121, the training objective information 122 and the operation information 131 of the gymnastic appa-

ratus 110 and performing an optimization of biomechanics simulation of musculoskeletal system of human body using a simulation software such as, Anybody Package (Anybody Technology, Denmark), or OpenSim Software, and then outputting a recommended parameter information 141. In one embodiment, the recommended parameter information 141 includes a quantitative suggestion with respect to the speed or the incline of the treadmill.

[0015] The motion capture device 150, still in reference to FIG. 1, is disposed on the body of the user and configured for capturing the motion of the user and outputting a motion information 151 in real time. Similarly, the neural signal measuring device 160 is disposed on the body of the user and configured for measuring at least one neuromuscular signal (such as a electromyographic signal) of the user and outputting a muscle information 161. The status computing device 170 computes a real-time status information 171 by performing an inverse dynamics operation of musculoskeletal and biomechanical system on the physical information 121 from the input device 120, the motion information 151 from the motion capture device 150 and the muscle information 161 from the neural signal measuring device 160, wherein the real-time status information 171 comprises information about the movement or force exerted on muscles and joints of the user. The training advice generator 180 is configured for receiving the recommended parameter information 141 from the objective computing device 140 and the real-time status information 171 from the status computing device 170 and generating a training advice information 181 for providing the user with a training advice focusing the training objective corresponding to the training objective information 122. It should be noted that the training advice generator 180 generates the training advice information 181 by comparing a projected status (such as the projected utilization rate of the objective muscle group) according to the recommended parameter information 141 of the objective computing device 140 and a real-time status (such as the current utilization rate of the objective muscle group) based on the real-time status information 171 of the status computing device 170. The display device 190 is configured for displaying information selected from a group consisting of the parameter 111 of the gymnastic apparatus 110, the physical information 121, the training objective information 122, the motion information 151, the muscle information 161, the recommended parameter information 141, the real-time status information 171, the training advice information 181, and combinations thereof. For example, the display device 190 in FIG. 1 according to one embodiment can be, but not limited to, configured for displaying the parameter 111 of the gymnastic apparatus 110, the recommended parameter information 141, the real-time status information 171 and the training advice information 181.

[0016] It should be noted that the motion capture device 150 is disposed on the body of the user noninvasively and configured for capturing the motion of the user in real time and outputting the motion information 151. The motion capture device 150 is a device capable of capturing human motion. For example, the motion capture device 150 comprises an accelerometer, a gyroscope or a plurality of lightened balls or reflective balls disposed on the body of the user and collocating with a camera. Further, the neural signal measuring device 160 is disposed on the body of the user

noninvasively and configured for measuring at least one neuromuscular signal of the user and outputting the muscle information 161 in real time.

[0017] Please refer to FIG. 2 and FIG. 3. FIG. 2 is a block diagram of a physical training system 100' according to another embodiment of the present invention. FIG. 3 is a diagram illustrating a diagram displayed on the display device 190 of the physical training system 100' according to the embodiment of the present invention. As shown in FIG. 2, the difference between the physical training system 100 and the physical training system 100' is that the storage device 130 of the physical training system 100' may store the physical information 121 and the physical training objective information 122 to achieve self-management of health.

[0018] The physical training system 100' further comprises a virtual scenario program 132 corresponding to the operation information 131 of the gymnastic apparatus 110. In one embodiment, the virtual scenario program 132 generates an image 191, as shown in FIG. 3, comprising an objective image 142 based on the recommended parameter information 141 received, and a real-time image 172 based on the real-time status information 171 received, and outputs the image 191 to the display device 190. The training advice information 181 is displayed on the display device 190 in text, in images, in numbers or in combinations thereof, as shown in FIG. 3. In another embodiment, it should be understood that the virtual scenario program 132 may also process the training advice information 181 and generate a signal to be displayed on the display device 190. The physical training system 100' further comprises an injury risk computing device 200 connected with the status computing device 170 and the display device 190, wherein the injury risk computing device 200 receives the real-time status information 171 from the status computing device 170, computes a plurality of injury risks based on the real-time status information 171 and a plurality of predetermined threshold force values that different kinds of muscles and joints may sustain without injury and outputs a warning information 201 to the display device 190. It should be noted that the predetermined threshold force values are stored in the injury risk computing device 200. In another embodiment, a physical training system 100' further comprises an automatic control device (not shown) connected between the gymnastic apparatus 110 and the training advice generator 180, wherein the automatic control device is capable of adjusting the parameter 111 of the gymnastic apparatus 110 according to the training advice information 181 from the training advice generator 180, so as to improve the functionality of the physical training system 100'.

[0019] In summary, the present invention provides a physical training system combining biomechanics and neurophysiological measurements for providing users with instant advisory feedback about how to adjust body movements or parameter setting of a gymnastic apparatus for a training objective, especially for specific muscle groups, without incurring sports injuries.

[0020] While the invention is susceptible to various modifications and alternative forms, a specific example thereof has been shown in the drawings and is herein described in detail. It should be understood, however, that the invention is not to be limited to the particular form disclosed, but to the contrary, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the appended claims.

What is claimed is:

1. A physical training system comprising:

a gymnastic apparatus with at least one parameter to be adjusted;

an input device allowing a user to input a physical information and a training objective information;

a storage device configured for storing an operation information of said gymnastic apparatus;

an objective computing device configured for receiving said physical information, said training objective information and said operation information of said gymnastic apparatus and outputting a recommended parameter information;

a motion capture device disposed on the body of said user and configured for capturing the motion of said user and outputting a motion information;

a neural signal measuring device disposed on the body of said user and configured for measuring at least one neuromuscular signal of said user and outputting a muscle information;

a status computing device configured for receiving said physical information, said motion information and said muscle information and outputting a real-time status information, wherein said real-time status information comprises information about movement or force exerted on muscles and joints of said user;

a training advice generator configured for receiving said recommended parameter information from said objective computing device and said real-time status information from said status computing device and generating a training advice information for providing said user with a training advice focusing the training objective corresponding to said training objective information; and

a display device configured for displaying information selected from a group consisting of said parameter of said gymnastic apparatus, said physical information, said training objective information, said motion information, said muscle information, said recommended parameter information, said real-time status information, said training advice information, and combinations thereof.

2. The physical training system according to claim 1, wherein said storage device is further capable of storing said physical information and said training objective information from said input device.

3. The physical training system according to claim 1, further comprising a virtual scenario program corresponding to said operation information of said gymnastic apparatus.

4. The physical training system according to claim 3, wherein said virtual scenario program generates an image comprising an objective image based on said recommended parameter information received and a real-time image based on said real-time status information received, and outputs said image to said display device.

5. The physical training system according to claim 1, further comprising an injury risk computing device connected with said status computing device and said display device, wherein said injury risk computing device receives said real-time status information from said status computing device, computes a plurality of injury risks based on said real-time

status information and a plurality of predetermined threshold force values that different kinds of muscles and joints may sustain without injury and outputs a warning information to said display device, wherein said predetermined threshold force values are stored in said injury risk computing device.

6. The physical training system according to claim 1, wherein said motion capture device is disposed on the body of said user noninvasively and configured for capturing the motion of said user and outputting said motion information in real time.

7. The physical training system according to claim 1, wherein said motion capture device comprises an accelerometer or a gyroscope.

8. The physical training system according to claim 1, wherein said motion capture device comprises a plurality of lightened balls or reflective balls collocating with a camera.

9. The physical training system according to claim 1, wherein said motion capture device is a device capable of capturing human motion.

10. The physical training system according to claim 1, wherein said neural signal measuring device is disposed on the body of said user noninvasively and configured for measuring at least one neuromuscular signal of said user and outputting said muscle information in real time.

11. The physical training system according to claim 1, further comprising an automatic control device connected between said gymnastic apparatus and said training advice generator, wherein said automatic control device is capable of adjusting said parameter of said gymnastic apparatus based on said training advice information from said training advice generator.

12. The physical training system according to claim 1, wherein said gymnastic apparatus comprises a treadmill, an exercise bike, an elliptical trainer, a rower or an apparatus operated with musculoskeletal system of human body.

13. The physical training system according to claim 1, wherein said objective computing device is configured for performing an optimized simulation of biomechanics of musculoskeletal system of human body according to said physical information, said training objective information and said operation information of said gymnastic apparatus, and outputting said recommended parameter information.

14. The training system according to claim 1, wherein said status computing device computes said real-time status information by performing an inverse dynamics operation of musculoskeletal and biomechanical system on said physical information, said motion information and said muscle information.

15. The physical training system according to claim 1, wherein said training advice generator generates said training advice information by comparing a projected status according to said recommended parameter information of said objective computing device and a real-time status based on said real-time status information of said status computing device.

16. The physical training system according to claim 1, wherein said training advice information is implemented in text, in images, in numbers or in combinations thereof displayed on said display device.

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