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(54) **FEEDBACK DEVICE FOR GUIDING AND SUPERVISING PHYSICAL EXERCISES**

RÜCKMELDUNGSVORRICHTUNG ZUR AUSFÜHRUNG UND ÜBERWACHUNG VON TRAININGSÜBUNGEN

DISPOSITIF DE RÉTROACTION POUR GUIDER ET SURVEILLER DES EXERCICES PHYSIQUES

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Description

FIELD OF THE INVENTION

[0001] The present invention is related to a feedback device for guiding and supervising physical exercises, in particular home rehabilitation exercises.

BACKGOUND OF THE INVENTION

[0002] Stroke is the most prominent cause of permanent disability in industrialized countries. Motor disabilities are the most common deficits after stroke. Rehabilitation exercises are proven to be efficient to regain motor control, provided the training is intense, the patient is guided in the therapy and receives adequate feedback.

[0003] Training devices for teaching manual skills in sports fields have been known for decodes, as for example described in US 3353282. Recently, training devices for unsupervised home use have been introduced.

These devices work without a therapist, which means that, once a patient has been introduced to the device, the patient may carry out rehabilitation exercises more frequently, which again increases and accelerates his recovery.

[0004] Technical solutions for unsupervised home stroke rehabilitation require the use of sensors for acquiring the patient's posture during exercises. These sensors can be either inertial sensors such as the popular MT9 sensor provided by XSENS, or camera-based Systems such as e.g. the Opti Track system manufactured by Natural Point, respectively.

[0005] In both devices, the patient's movements are recorded, compared to a template posture and/or movement and the difference is then reported to the patient in a suitable way. The Core:Tx system manufactured by Performance Health uses a rendered human-like figure for displaying the template posture and/or movement that the patient is supposed to perform. The patient wears an inertial sensor on the affected limb. His own movement is not displayed on screen. A green or red light indicates agreement or disagreement of template and patient movement. These devices are for example described in US 6834436.

[0006] Displaying the difference between the provided template and the patient's movement is crucial for the effectiveness of a home rehabilitation system, as stroke victims , are often not aware of their deficits and show genuine surprise that their performance does not reflect the movement templates.

[0007] The existing approaches to home rehabilitation, as for example described in US 6231527, use feedback systems that the user finds difficult to get acquainted with. Existing systems use a rendered figure for displaying the patient's movement, It is difficult for the user to identify himself with such a rendered figure. However, as mentioned above, perceiving one's own movement as being not according to the template is a crucial step on the road to recovery for this patient group.

[0008] Furthermore, existing Systems use a Computer screen for displaying feedback. However, stroke victims are mostly elderly persons that are not acquainted with Computers. Therefore it is desirable to use a feedback device that provides advantages in terms of ease of use, intuitivity of use, and efficiency of use, especially for elderly people.

SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to provide a feedback device for guiding and supervising physical exercises, in particular home rehabilitation exercises, which avoids the above identified shortcomings. It is another object of the present invention to provide such a feedback device which is easy to use especially for elderly people.

[0010] Yet another object of the present invention is to provide such a feedback device which gives the patient the possibility to observe his own movements, and /or which makes it easy for the patient to identify himself with a computer-generated animation that displays the patient's movement.

[0011] This object is achieved by a device and/or a method according to the independent claims. The dependent claims indicate preferred embodiments. In this context it is noteworthy to mention that all ranges given in the following are to be understood to include the values defining these ranges.

[0012] According to the invention, a feedback device for guiding and supervising physical exercises, in particular home rehabilitation exercises of a person, is provided. The device comprises

a) a computer device having a CPU and a memory,
b) a mirror display device comprising a conventional display device having a reflective surface, and
c) position-sensing means for a person disposed before the device.

[0013] Said person is for example a patient that undergoes home rehabilitation exercises. However, in the following, the terms "patient" and person" will be used synonymously, i.e. that all considerations related to a "patient" will also be applicable to a "person", and vice versa.

[0014] The term "conventional display device", as used herein, relates to a device which is capable of displaying a computer-generated animation. Such displays are well known to the skilled person, and may be selected from CRT (Cathode Ray Tubes), LCD (Liquid Crystal Displays) and the like.

[0015] The term "mirror display device", as used herein, refers to a combination of a mirror function and a display function. For example, such a device may comprise a combination of a semi-transparent mirror with a flat-screen monitor. In another embodiment, the device may

consist of a flatscreen monitor having a front screen which is coated with a semi-transparent coating.

[0016] In a preferred embodiment of the present invention it is provided that the device comprises means for controlling the transmission and/or reflectance of the reflective surface. Such a device may, in a preferred embodiment, consist of a flatscreen monitor, like an LCD, the panel of which is coated with a polarizing film that adjusts the whole, or a portion, of its surface so as to be either transmissive, reflective, or semi-reflective. By this means, the mirror display device can either display computer-generated animations, or it can (passively) display the mirrored image of an object disposed before the display, or it can display both at the same time. Such a product has recently been developed and protected with IP rights by the applicant, and it is being marketed under the trademark "Mirror TV".

[0017] The term "computer-generated animation", as used herein, refers to both still images and animated images. In said device, the body posture of the person standing before the mirror is first detected by the position-sensing means, and then an image is generated and displayed which is overlaid over the person's mirror image.

[0018] Then, a predetermined body posture or movement (in the following called: "template posture and/or movement") is displayed, which the person can perceive and is then supposed to perform.

[0019] Upon performing the posture or movement, the person will immediately perceive any deviations between the template posture or movement and his own posture or movement by comparing the computer-generated animation and his own mirrored image, and will thus receive feedback which enables him to correct his posture or movement.

[0020] Moreover, position-sensing may be used to detect deviations between the template posture and/or movement and the movements carried out by the person. These deviations can be reported to the person in real time by displaying them in an educative fashion on the display, or by creation of a warning sound, in order to tell the person whether or not he has correctly performed the template posture and/or movements. In addition thereto, the person can figure out deviations between the template posture and/or movements and his own movements by comparing the computer-generated animation and his own mirrored image. The person will thus be able to correct his movements on the basis of the above feedback information. The information is provided in such a way that it is perceived intuitively, so that the person may pick up the information while concentrating on the exercises.

[0021] By these means, an easy-to-use real-time feedback device is accomplished, which helps persons suffering from post-stroke motor disabilities to carry out therapeutic rehabilitation exercises which are proven to be efficient to regain motor control, provided the training is intense, the person is guided in the therapy and receives adequate feedback. The system is particularly suited for home use. This means a person can carry out therapeutic rehabilitation exercises without supervision by a therapist, which means that exercise frequency and/or intensity can be substantially increased, which results in a better and faster rehabilitation.

[0022] In the present invention, it is provided that the device comprises means for generating an animation of the person, based on data provided by the position-sensing means, and displaying said animation on the mirror display device in such a way that the displayed animation and a reflected image of the person are overlaid, one on top of the other.

[0023] Again, the term "animation", as used herein, refers to both still images and animated images. The person is thus enabled to directly compare the template posture or movements to his own body posture or movements. This feature enhances the intuitive information uptake by the person and does thus contribute to a better concentration on the exercises which the person is supposed to carry out, and will consequently support the rehabilitation process.

[0024] In preferred embodiments of the present invention, it is provided that the position-sensing means for the person comprises either body-worn sensors or markers, and/or a camera system.

[0025] These sensors or markers can be inertial sensors such as MEMS (Micro-Electro-Mechanical System) sensors (commonly known as movement trackers), which are for example used in movie animation, training sciences and the like, and which are for example supplied by the company Xsens movement technologies. These embodiments can be collectively referred to as "active sensors or markers".

[0026] Likewise, optical markers comprising colours can be used. In a preferred embodiment, the markers comprise means which are fluorescent or detectable under infrared illumination. These embodiments can be collectively referred to as "passive sensors or markers".

[0027] Camera-based systems may for example consist of a camera mounted in the frame of the mirror display device, which creates recordings of the person's body movements, which will then form the basis for the later analyses and image generation processes.

[0028] In a preferred embodiment, the position-sensing means for the person comprises both body-worn sensors or markers and a camera system. In this case, the markers comprise detectable devices (i.e. IR-LED or the like) which are detected by the camera in order to precisely determine the positions of the limbs etc. Such devices are for example supplied by the company Natural Point.

[0029] In another preferred embodiment, the camera system is a stereo camera system. In this case, dedicated body-worn sensors or markers are not necessary, as the camera system can calculate the positions of the person's limbs by analysing the stereo images. However, even in such a system the detection of the person's body will be easier if the latter is equipped with body-worn sen-

sors or markers.

[0030] Furthermore, a feedback method for guiding and supervising physical exercises, in particular home rehabilitation exercises of a person, is provided. Said method comprises the steps of

a) disposing a person before a feedback device comprising: a CPU and a memory, a mirror display device comprising a conventional display device having a reflective surface, and position-sensing means for the person,
b) detecting the person's body posture and/or body movements, and
c) generating and displaying a computer-generated animation on the mirror display device, which represents a template posture and/or movement.

[0031] In this embodiment, the CPU memory contains predetermined template postures and movements which the person is supposed to perform.

[0032] In a preferred embodiment of this method, the method further comprises detecting any deviations between the template posture and/or movement and the person's body posture and/or body movements.

[0033] This means that the person's body posture and/or body movements are monitored throughout the exercise. Any deviations detected can then be reported to the person in order to generate feedback information according to said deviation. The feedback information may for example consist of a dotted line on the mirror display device, which symbolizes the limb deviating in its posture from the template posture (see Fig. 1). Feedback information can also be presented in the form of an audible signal. The person skilled in the art can easily select other feedback information channels and/or devices, and these fall under the scope of the present invention as well.

[0034] In a preferred embodiment of the method according to the invention, a feedback device according to the invention is used for carrying out said method.

[0035] In yet another preferred embodiment of the method according to the invention it is provided that the method comprises the execution of an algorithm selected from the group consisting of:

a) an algorithm to detect the 3D positions of the person and his limbs when disposed before the mirror display device,
b) an algorithm to compute the coordinates of the mirror image of the person and/or his limbs on the surface of the mirror display,
c) an algorithm for creating a computer-generated image of a figure the limbs of which appear at the same points on the surface of the mirror display as in the mirror image, as computed by the algorithm mentioned in point b),
d) an algorithm to animate the computer-generated image according to the template posture and/or movement, and/or
e) an algorithm to generate feedback information according to the deviation of the person's posture and/or movement from the template posture and/or movement.

[0036] The term "posture" herein refers to the positions and orientations of the person's limbs, his head, his backbone and other parts of his body.

[0037] Furthermore, a method for carrying out, guiding and/or supervising physical exercises and movements is provided, comprising procedural steps according to the above described feedback method. It is to be understood that such a method provides the advantages set forth hereinabove in connection with the feedback device and the feedback method.

[0038] Furthermore, the use of a system according to the invention for carrying out, guiding and supervising exercises is provided. Such exercises can for example belong to the field of physical education, post traumatic and/or post-operative rehabilitation, rhetoric training, art performance training and the like. i.e. all fields in which a real time feedback related to physical exercises and movements is beneficial and/or required.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] In the following description, detailed embodiments of a feedback device and a feedback method according to the invention are described with reference to the Figures, in which

Fig. 1 diagrammatically shows a feedback device according to the invention: and
Fig. 2 diagrammatically shows a process of overlaying a mirror image with a display image in the device of Fig. 1.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0040] Fig. 1 shows a mirror display feedback system 10 according to the invention, comprising a mirror display 11 which consists of a wall-mounted mirror that provides the possibility to show a computer graphic on its surface. Moreover, the system comprises a camera 13, which may be stereo camera, which records the movements of a patient 12 standing in front of the mirror. The patient carries position sensors 14. A processing unit, not shown, creates an animation providing a template posture and/or movement animation 15, which is then displayed as a rendered template animation on the mirror display 11.

[0041] When the system is in use, the patient 13 sees himself in the mirror display 11 just as in any traditional mirror. Additionally, a template posture and/or movement animation 15 is overlaid in the mirror display 11, which is comparable to the patient's mirror image in size and orientation. While executing a therapy exercise, the patient 13 sees himself in the mirror, and the overlaid ren-

dered figure performs the template posture and/or movement.

[0042] Thus the patient can directly see any discrepancies between his movements and the template posture and/or movement. As he sees himself in the mirror, and not a rendered representation, the intuitive realization of his deficiencies in exercise execution is much easier.

[0043] In Fig. 1 there is a discrepancy between the posture of the patient's left hand 16 and the respective template posture. The patient can immediately perceive this discrepancy by comparing the computer generated animation and his own mirror image. Moreover, the CPU connected with the mirror display device detects said discrepancy and creates feedback information, which consist of a dotted line 17 in Fig.

[0044] In Fig. 2 the process to overlay a mirror image with a display image in mirror display feedback system 2 according to the invention is shown. The location of the eyes (21, only one eye is symbolically shown for reasons of clarity) is determined, e.g. by means of a stereo camera (not shown), coupled to an image processing module (not shown). The X,Y-pixel coordinates of the eye (21) are calculated by orthogonal projection onto the mirror plane (22). Other options to determine the position in space include ultrasound triangulation, or use of passive or active sensors.

[0045] From the X,Y-coordinates the proper pixel location for the eyes can be derived. The location of the extremities (23, only one hand is symbolically shown for reasons of clarity) are determined, e.g. by means of a stereo camera (not shown), coupled to an image processing module (not shown). The X,Y-pivel coordinates of the extremities (23) are calculated by orthogonal projection onto the mirror plane (22), followed by scaling in the x and y direction by a factor of 0.5. As a result, a screen pixel switched on at the location 21' in the mirror plane 22 will be overlaid onto the virtual image 21" of the eyes. Likewise, a pixel switched on at the location 23' in the mirror plane 22 will be overlaid onto the virtual image of the hand 23".

[0046] By this means, the patient may consistently compare the mirrored image of his body posture with the predetermined body posture which is displayed on the mirror screen, and which indicates predetermined movements and/or postures the patient is expected to carry out in order to do rehabilitation exercises.

EXAMPLES

[0047] In the following, the present invention is demonstrated by means of examples, which by no means should be understood to limit the scope of the invention.

[0048] The user approaches the system in order to carry out an exercise for his rehabilitation. In one embodiment he is wearing colour markers on selected body positions such as wrists, elbows etc. The patient disposes himself in front of the mirror display such that he can see himself fully in the mirror. If this is the case, a stereo-camera mounted in the frame of the mirror is able to see the patient fully. A colour-tracking algorithm finds the markers in the camera images of the left and right camera of the stereo camera pair. Using calibration information of the camera system it is then possible to compute the position of the markers worn by the patient in a 3D coordinate system. This procedure is standard for stereo camera systems and can e.g. be performed by the 'Bumblebee' stereo camera manufactured by Point Grey (www.pointgrey.com), which contains a software development kit for computing 3D positions of image features. Once the 3D coordinates of the marker points are known it is a standard geometric calculation to derive the expected points of appearance of the mirror images of the markers on the surface of the mirror display. These points are subsequently used for generating a picture of a rendered figure on the mirror display in such a way that the position of the points indicated by the markers of rendered figure and mirror image coincide. This means that, while the patient is at rest at the beginning of the exercise, a rendered figure is generated that has the same size and body posture as the patient. The user sees the rendered figure perfectly overlaying his mirror image. When the exercise starts, the rendered figure is animated according to a stored template movement. The patient tries to move according to the template. He can easily see any discrepancies as his limbs and those of the rendered figure do not move synchronously. Additional feedback can be displayed on the mirror display, e.g. by colouring the background part of the display where the discrepancy of patient and template posture and/or movement is most severe.

[0049] While the invention has been illustrated and described in detail in the drawings and the foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive: the invention is not limited to the disclosed embodiments.

[0050] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

[0051] The particular combinations of elements and features in the above detailed embodiments are exemplary only; the interchanging and substitution of these teachings with other teachings in this and other patents/applications incorporated by reference are also expressly contemplated. As those skilled in the art will recognize, variations, modifications, and other implementations of what is described herein can occur to those of

ordinary skill in the art without departing from the spirit and the scope of the invention as claimed. Accordingly, the foregoing description is by way of example only and is not intended as limiting. The invention's scope is defined in the following claims.
Furthermore, reference signs used in the description and claims do not limit the scope of the invention as claimed.

Claims

1. A feedback device (10) for guiding and supervising physical exercises, comprising

   a) a computer device having a CPU and a memory,
   b) a mirror display device (11) comprising a conventional display device having a reflective surface, and
   c) position-sensing means (13, 14) for detecting a body posture and/or body movements of a person disposed before the mirror display device,
   wherein the computer device is configured to generate an animation for display on the mirror display device which represents a template posture and/or movement, and the computer device is configured to use the detected body posture and/or body movements of the person to display the template posture and/or movement on the mirror display device such that the template posture and/or body movement is overlaid over the mirror image of the person in the reflective surface.

2. A feedback device according to claim 1, **characterized in that**, further, the device comprises means for controlling a transmission and/or a reflectance of the reflective surface.

3. A feedback device according to claim 2, **characterized in that** said means for controlling the transmission and/or reflectance of the reflective surface comprises a polarizing film, disposed on the mirror display device, that adjusts the whole, or a portion, of its surface so as to be either transmissive, reflective, or semi-reflective.

4. A feedback device according to claim 1, **characterized in that** the position-sensing means for the person comprises either

   a) body-worn sensors or markers (14), and/or
   b) a camera system (13).

5. A feedback device according to claim 4. **characterized in that** said camera system comprises a stereo camera.

6. A feedback method for guiding and supervising physical exercises, said method comprising the steps of

   a) disposing a person before a feedback device comprising: a CPU and a memory, a mirror display device comprising a conventional display device having a reflective surface, and a position-sensing means for the person,
   b) detecting a body posture and/or body movements of the person, and
   c) generating and displaying a computer-generated animation on the mirror display device, which represents a template posture and/or movement, such that the template posture and/or movement is overlaid over the mirror image of the person in the reflective surface using the detected body posture and/or movements of the person.

7. A feedback method according to claim 6, **characterized in that** the method further comprises

   a) detecting any deviations between the template posture and/or movement and the person's body posture and/or body movements.

8. A feedback method according to claim 7, **characterized in that** the method further comprises

   b) generating feedback information according to said deviation.

9. A feedback method according to claim 6, **characterized in that** it comprises the execution of algorithms selected from the group consisting of:

   a) an algorithm to detect 3D positions of the person and his limbs when disposed before the mirror display device,
   b) an algorithm to compute coordinates of the mirror image of the person and/or his limbs on the surface of the mirror display,
   c) an algorithm for creating a computer-generated image of a figure the limbs of which appear at the same points on the surface of the mirror display as in the mirror image, as computed by the algorithm mentioned in point b),
   d) an algorithm to animate the computer-generated image according to the template posture and/or movement, and/or
   e) an algorithm to generate feedback information according to the deviation of the person's posture and/or movement from the template posture and/or movement.

10. The use of a feedback device according to any one of claims 1 to 5 for carrying out, guiding and super-

vising physical exercises and movements.

Patentansprüche

1. Rückmeldungsvorrichtung (10) zum Anleiten und Überwachen von Körperübungen, die Folgendes umfasst:

   a) einen Computer mit einer Zentraleinheit und einem Speicher,
   b) eine Spiegelanzeigevorrichtung (11), die eine konventionelle Anzeigevorrichtung mit einer reflektierenden Oberfläche umfasst, und
   c) Positionserfassungsmittel (13, 14) zur Erkennung der Körperhaltung und/oder Körperbewegungen einer Person, die sich vor der Spiegelanzeigevorrichtung befindet,
   wobei der Computer so konfiguriert ist, dass er eine Animation zur Anzeige auf der Spiegelanzeigevorrichtung generiert, die eine Schablone der Körperhaltung und/oder Körperbewegung der Person darstellt, und wobei der Computer so konfiguriert ist, dass er die erkannte Körperhaltung und/oder Körperbewegung der Person verwendet, um die Schablone der Haltung und/oder Bewegung auf der Spiegelanzeigevorrichtung derart anzuzeigen, dass die Schablone der Haltung und/oder Körperbewegung auf der reflektierenden Oberfläche über das Spiegelbild der Person gelegt wird.

2. Rückmeldungsvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Vorrichtung des Weiteren Mittel zur Steuerung der Transmission und/oder Reflexion der reflektierenden Oberfläche umfasst.

3. Rückmeldungsvorrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** die genannten Mittel zur Steuerung der Transmission und/oder Reflexion der reflektierenden Oberfläche eine Polarisationsfolie umfassen, die auf der Spiegelanzeigevorrichtung aufgebracht ist und die Oberfläche im Ganzen oder in Teilen so anpasst, dass sie durchlässig, reflektierend oder halb-reflektierend ist.

4. Rückmeldungsvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Positionserfassungsmittel für die Person entweder

   a) am Körper getragene Sensoren oder Markierungen (14) und/oder
   b) ein Kamerasystem (13) umfassen.

5. Rückmeldungsvorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** das genannte Kamerasystem eine Stereokamera umfasst.

6. Rückmeldungsverfahren zum Anleiten und Überwachen von Körperübungen, wobei das genannte Verfahren die folgenden Schritte umfasst:

   a) Aufstellen einer Person vor einer Rückmeldungsvorrichtung, die Folgendes umfasst: eine Zentraleinheit und einen Speicher, eine Spiegelanzeigevorrichtung mit einer konventionellen Anzeigevorrichtung mit einer reflektierenden Oberfläche und Positionserfassungsmittel für die Person,
   b) Erkennen der Körperhaltung und/oder Körperbewegungen der Person und
   c) Generieren und Anzeigen einer computergenerierten Animation auf der Spiegelanzeigevorrichtung, die eine Schablone der Haltung und/oder Bewegung darstellt, so dass die Schablone der Haltung und/oder Bewegung unter Verwendung der erkannten Körperhaltung und/oder Körperbewegungen der Person in der reflektierenden Oberfläche über das Spiegelbild der Person gelegt wird.

7. Rückmeldungsverfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** das Verfahren ferner Folgendes umfasst:

   a) Erkennen von Abweichungen zwischen der Schablone der Haltung und/oder Bewegung und der Körperhaltung und/oder Körperbewegungen der Person.

8. Rückmeldungsvorrichtung nach Anspruch 7, **dadurch gekennzeichnet, dass** das Verfahren ferner Folgendes umfasst:

   b) Erzeugen von Rückmeldungen gemäß der genannten Abweichung.

9. Rückmeldungsverfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** es die Ausführung von Algorithmen umfasst, die aus der folgenden Gruppe ausgewählt werden:

   a) einem Algorithmus zur Erkennung von 3D-Positionen der Person und ihrer Gliedmaßen, wenn sie sich vor der Spiegelanzeigevorrichtung befindet,
   b) einem Algorithmus zur Berechnung der Koordinaten des Spiegelbildes der Person und/oder ihrer Gliedmaßen auf der Oberfläche der Spiegelanzeige,
   c) einem Algorithmus zur Generierung eines computergenerierten Bildes einer Figur, deren Gliedmaßen an den gleichen Punkten auf der Oberfläche der Spiegelanzeige erscheinen wie das Spiegelbild, nach Berechnung durch den unter Punkt b) erwähnten Algorithmus,

d) einem Algorithmus zur Animation des computergenerierten Bildes gemäß der Schablone der Haltung und/oder Bewegung und/oder
e) einem Algorithmus zur Erzeugung von Rückmeldungen gemäß der Abweichung der Haltung und/oder Bewegung der Person von der Schablone der Haltung und/oder Bewegung.

10. Verwendung einer Rückmeldungsvorrichtung nach einem der Ansprüche 1 bis 5 zur Ausführung, Anleitung und Überwachung von Körperübungen und Bewegungen.

Revendications

1. Dispositif de rétroaction (10) pour guider et superviser des exercices physiques, comprenant :

a) un dispositif ordinateur comportant une unité centrale de traitement et une mémoire,
b) un dispositif d'affichage à miroir (11) comprenant un dispositif d'affichage classique comportant une surface réfléchissante, et
c) des moyens de détection de position (13, 14) pour détecter une position du corps et/ou des mouvements du corps d'une personne disposée devant le dispositif d'affichage à miroir,
dans lequel le dispositif ordinateur est configuré pour générer une animation pour l'affichage sur le dispositif d'affichage à miroir qui représente une position et/ou un mouvement modèle, et le dispositif ordinateur est configuré pour utiliser la position détectée du corps et/ou les mouvement détectés du corps de la personne pour afficher la position et/ou le mouvement modèle sur le dispositif d'affichage à miroir de sorte que la position et/ou le mouvement modèle du corps soit superposé sur l'image en miroir de la personne dans la surface réfléchissante.

2. Dispositif de rétroaction selon la revendication 1, **caractérisé en ce que**, en outre, le dispositif comprend des moyens pour commander une transmission et/ou un facteur de réflexion de la surface réfléchissante.

3. Dispositif de rétroaction selon la revendication 2, **caractérisé en ce que** lesdits moyens pour commander la transmission et/ou le facteur de réflexion de la surface réfléchissante comprennent un film polarisant, disposé sur le dispositif d'affichage à miroir, qui règle la totalité, ou une partie, de sa surface afin d'être transmissive, réfléchissante, ou semi-réfléchissante.

4. Dispositif de rétroaction selon la revendication 1, **caractérisé en ce que** les moyens de détection de position pour la personne comprennent :

a) des capteurs ou marqueurs (14) portés sur le corps, et/ou
b) un système caméra (13).

5. Dispositif de rétroaction selon la revendication 4, **caractérisé en ce que** ledit système caméra comprend une caméra stéréo.

6. Procédé de rétroaction pour guider et superviser des exercices physiques, ledit procédé comprenant les étapes de :

a) la disposition d'une personne devant un dispositif de rétroaction comprenant : une unité centrale de traitement et une mémoire, un dispositif d'affichage à miroir comprenant un dispositif d'affichage classique comportant une surface réfléchissante, et des moyens de détection de position pour la personne,
b) la détection d'une position du corps et/ou de mouvements du corps de la personne, et
c) la génération et l'affichage d'une animation générée par ordinateur sur le dispositif d'affichage à miroir, qui représente une position et/ou un mouvement modèle, de sorte que la position et/ou le mouvement modèle soit superposé sur l'image en miroir de la personne dans la surface réfléchissante en utilisant la position détectée et/ou les mouvements détectés du corps de la personne.

7. Procédé de rétroaction selon la revendication 6, **caractérisé en ce que** le procédé comprend en outre :

a) la détection de quelconques écarts entre la position et/ou le mouvement modèle et la position du corps et/ou les mouvements du corps de la personne.

8. Procédé de rétroaction selon la revendication 7, **caractérisé en ce que** le procédé comprend en outre :

b) la génération d'informations de rétroaction selon ledit écart.

9. Procédé de rétroaction selon la revendication 6, **caractérisé en ce qu'**il comprend l'exécution d'algorithmes sélectionnés parmi le groupe constitué de :

a) un algorithme pour détecter des positions 3D de la personne et ses membres lorsqu'elle est disposée devant le dispositif d'affichage à miroir,
b) un algorithme pour calculer des coordonnées de l'image en miroir de la personne et/ou ses membres sur la surface de l'affichage à miroir,

c) un algorithme pour créer une image générée par ordinateur d'une silhouette dont les membres apparaissent aux mêmes points sur la surface de l'affichage à miroir que dans l'image en miroir, telle qu'elle est calculée par l'algorithme mentionné dans le point b),
d) un algorithme pour animer l'image générée par ordinateur selon la position et/ou le mouvement modèle, et/ou
e) un algorithme pour générer des informations de rétroaction selon l'écart de la position et/ou du mouvement de la personne par rapport à la position et/ou au mouvement modèle.

10. Utilisation d'un dispositif de rétroaction selon une quelconque des revendications 1 à 5 pour réaliser, guider et superviser des exercices physiques et des mouvements.

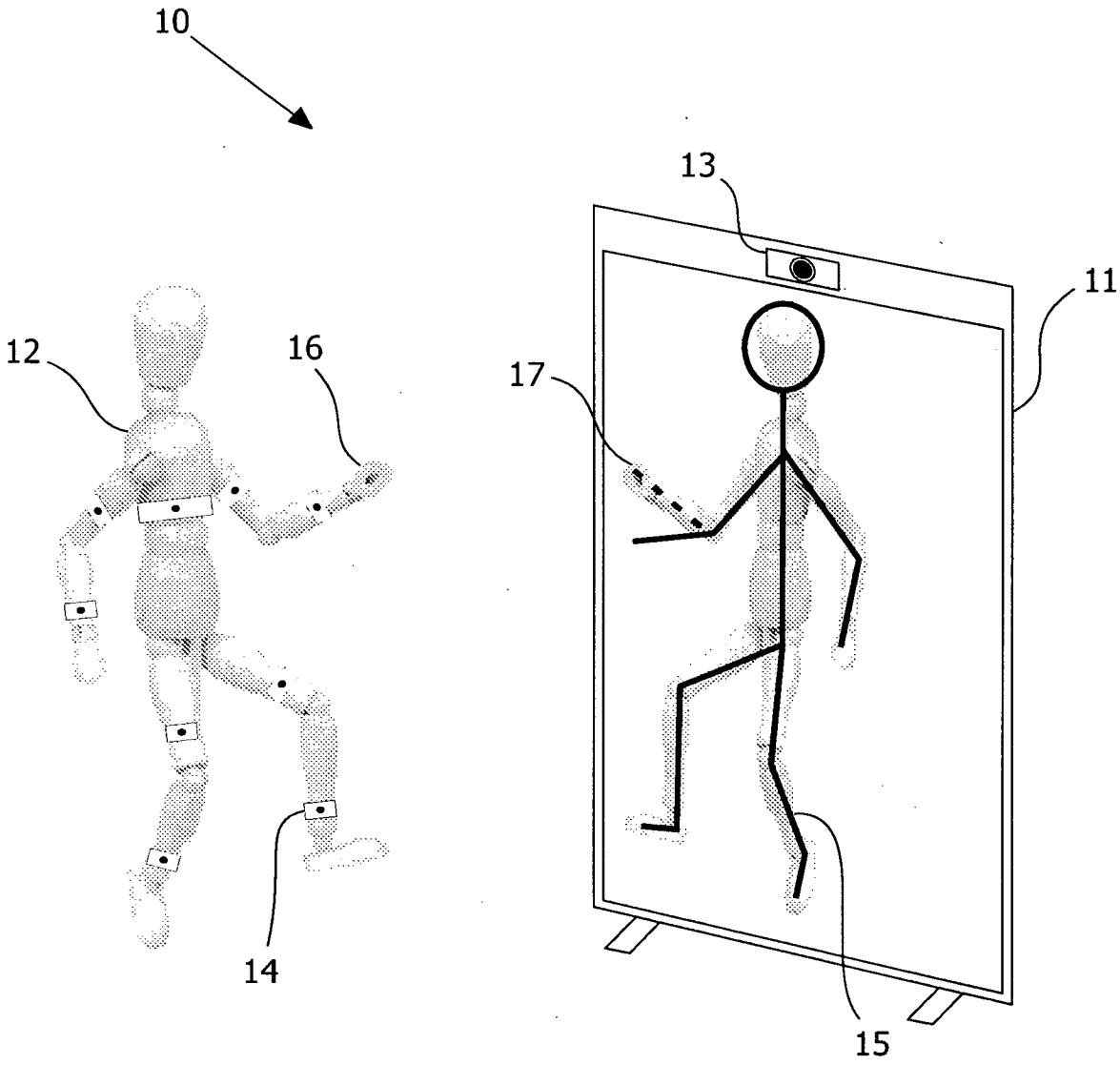

FIG.1

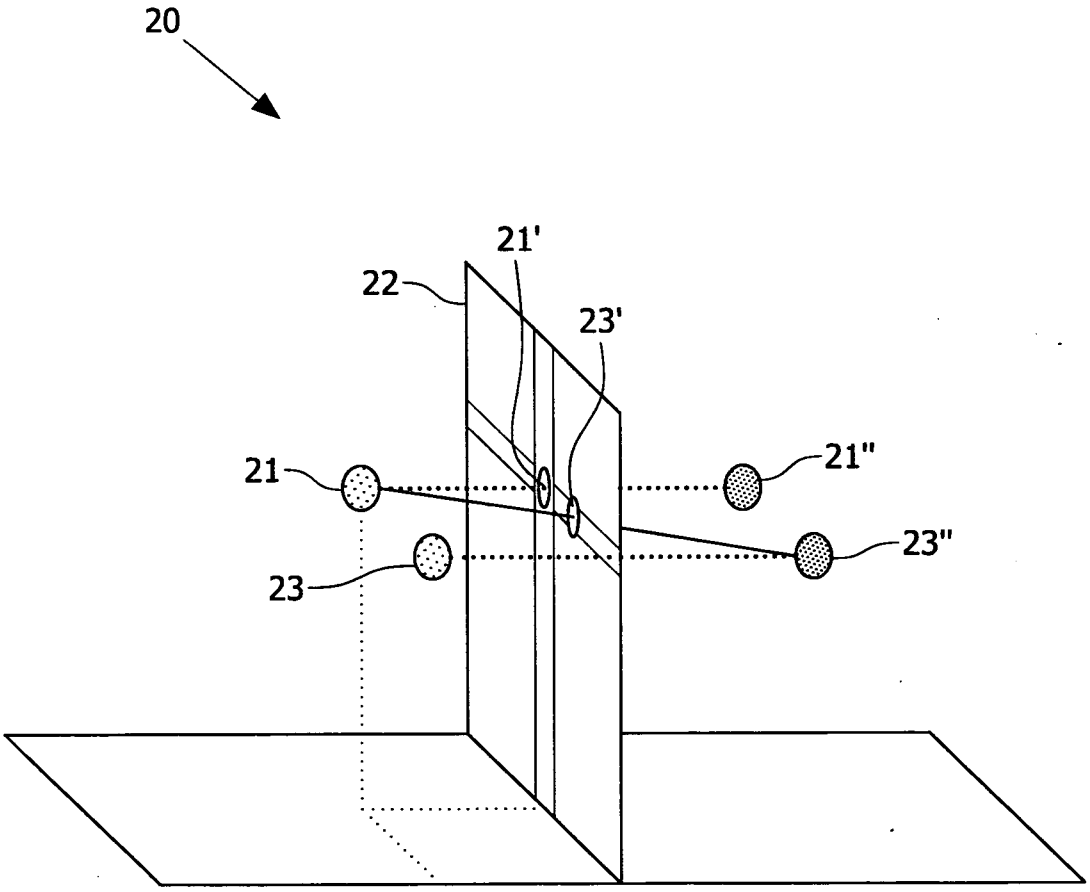

FIG. 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 3353282 A **[0003]**
- US 6834436 B **[0005]**
- US 6231527 B **[0007]**

专利名称(译)	用于指导和监督体育锻炼的反馈装置		
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摘要(译)

本发明涉及一种用于引导和监督体育锻炼的反馈装置（10），特别是人（12）的家庭康复锻炼，包括具有CPU和存储器的计算机装置，包括传统的镜子显示装置（11）具有反射表面的显示装置和位于装置之前的人的位置检测装置（13,14）。此外，本发明涉及一种用于引导和监督体育锻炼，特别是家庭康复锻炼的反馈方法。

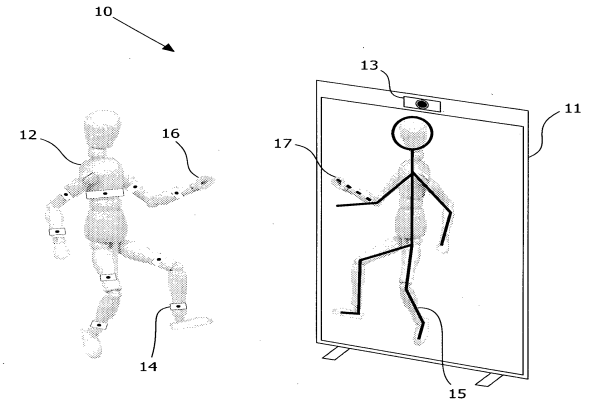

FIG.1