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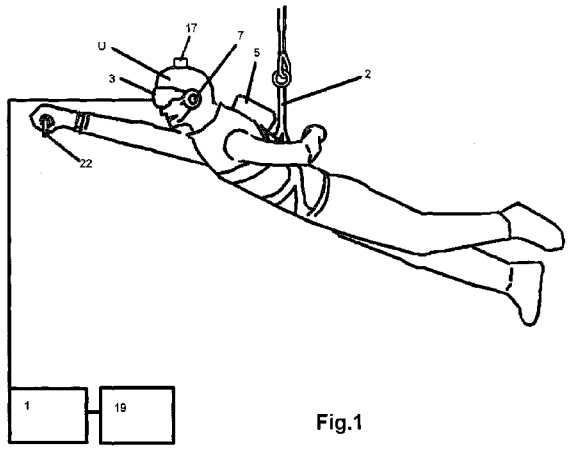

Fig.1

(57) Abstract: Methods and apparatus for providing user somatosensory experience for thrill seeking jumping like activities (for purposes such as but not limited to training, game, or entertainment) are provided. The method involves: providing means for changing elevation of user rapidly enough for user to feel the difference of gravity feeling or "G force" with feelings of user under stationary situation, wherein the facing direction relative to the direction of movement and / or pose of the user can be changed, and the speed of elevation change provided by the means can be controlled / adjusted; while the user using the elevation changing means, using a computer -implemented virtual reality system to present to the user a virtual reality environment. The view point and / or direction changes in the virtual reality environment are consistent with the position changes and / or self motion of the user in the elevation changing means; so that the user experiences the virtual reality environment under a "variable gravity" condition or "G-Force" provided by the elevation changing means in a synchronized way, such "variable gravity" condition enhancing experience of the virtual reality environment. It is also possible for users to interact with the system by means such as game controller or gesture and etc., so that the output of the elevation means could be affected / changed by user input. And apparatus for providing user somatosensory experience for thrill seeking jumping like activities are provided.

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METHODS AND APPARATUS FOR PROVIDING USER SOMATOSENSORY EXPERIENCE FOR THRILL SEEKING JUMPING LIKE ACTIVITIES

Cross Reference to Related Applications

The present application claims priority from US Provisional Patents Application Serial No. 61/210,107 filed March 14, 2009, the full disclosures of which is hereby incorporated by reference herein.

Technical Field

The present invention generally relates to simulates or enhance user experiences in "thrill seeking jumping like activities" --free fall or speed controlled descend /ascend -- such as sky-diving, bungee jumping, ski-jumping, jet pack, "turbo drop" and etc. In such activities user's (or rider's) elevation can be changed rapidly, and more particularly by using VR(virtual reality) and/or MR (Mixed reality) systems to provide visual sensation and/or "scene substitution" that is synchronized with the movement of user in the activities, thus providing an integrated somatosensory experience for user.

Background Art

Bungee jumping and sky diving are 2 examples of many popular ways to generate thrilling experiences (for the passenger/rider/jumper) by jumping off from plane or high places. Other thrill seeking jumping activities including ski-jumping, jet pack, and reverse bungee, X-Bikes, snow-mobile jumping, "turbo drop" ride etc. The thrill mainly comes from the combination of the rapid changing elevation hence the G-force feeling and the unusual scene viewed by user.

It is a well known technique that by rapidly changing elevation (ascending /descending), it is possible to create "G"force (gravity) feelings for the rider that is different with stationary situation. From Newton's 2nd law F=Ma we know that the force equals to Mass times acceleration rate,

and this principle can be used to adjust "gravity force" passenger feels. In stationary when we are supported by ground and acceleration we have is 0, we feel the normal "gravity force" of 1G. And if we are moving with the same "acceleration" downwards as the "gravitational acceleration" which equals to 9.8m/sec2, (on earth) we will feel zero gravity force, usually called "0 G". "Turbo drop" like amusement park rides is using this principle/technique to create entertainment for riders.

US Patent 5628690 "Amusement ride with at least one longitudinal guide with a passenger vehicle capable of changes in height " describe the "Turbo drop" design in detail. However the method described is just one way or "fashion" of changing user elevations. Other methods such as using a hoist system to raise and low passenger and controlling the speed/elevation, or using a bungee cord and free fall (or speed control/ braked by another means) can all achieve the purpose of rapid changing elevation, thus fulfill the need for generate different G force feelings. So possible ways to changing user elevation are very flexible, such as but not limited to: Bungee, Reverse Bungee, "Human Slingshot machine" (U.S. Patent US5421783), hoist system, elevator like system, turbo-drop, crane like system, trampoline, air cushion, air bed Air-spring like jumping/cushion system, or even slide way system or the like, etc.

Also the related technologies for implementation of such design are quite mature. As demonstrated by U.S. Patent US5421783 (A) (Human slingshot machine) and WO9219325, US4264311 (A) there are known ways to simulate parachuting, or improve bungee jumping. Or using a rig/crane and suspension system to assist SPORTS JUMPING FROM GREAT HEIGHTS [WO9219325 (A1)]. It is also well known that in means such as a hoist system , elevator or the similar the acceleration speed can be dynamically controlled , for many purposes for example for the comfort of passenger or to dampen the "swing" of the load , as described in patent FR2809243.

It is known in the prior art to provide users with virtual reality systems. The ability for these systems has increased and they are

providing greater image quality, lower prices, and enhanced abilities to integrate real world materials with the virtual reality materials to provide a more realistic experience. Presently, virtual reality systems focus on engaging the visual and audio senses of a user. It is also easy to synchronize the movement of "view point" in virtual reality environment with actual movement of user because the both the view point in virtual environment and the actual position (i.e. elevation) of user can be controlled (for example, by computer program).

To create sensations by changing elevation of user(rider) is also known method in many amusement park machine design and in flight simulator design. However they have their limitations such as expose to out door weather, scenes are limited to local area (for the amusement park machines), very limited continues "Zero-G" time span due to limited moving range (for flight simulator). And also significantly limiting user's activity in theses situations – user are basically fixed on the seats and the seats are usually fixed directions (relative to the vehicle) and not changing during the ride.

Objectives

It is an objective of this invention is to provide an amusement /training /game ride that: 1) capable of quickly changing the elevation of a passenger(rider) so that rider can feel different "G force"(gravity) than he/she perceived in stationary situations 2) provide virtual reality/mixed reality image(scenes) display to rider during the process, the image displayed to rider synchronize (on force feed back or "G-Force feelings") with the movement of the rider so that the visual sensation of the rider correspond to the G force feeling and other movements he/she feels.

It is another objective of the present invention to provide an to provide a safe yet exciting amusement/training/game ride experience which allows passengers to "free fall" or experience similar "G Force changes" in a controlled descend/ascend for a short duration (for example several seconds), while provide flexibility in "scenes" or "surrounding

environment" selection by providing a simulated visual environment for virtual reality/mixed reality space, enable rider to feel like "jumping" at "impossible" places, and also minimizing the space requirements and costs of constructing the ride.

Additional objectives, advantages, and novel features of the present invention will be set forth in part in the description which follows, and in part will become readily apparent to those skilled in the art from the following detailed description, wherein the preferred embodiments of the invention are shown and described simply by way of illustration of the best mode contemplated for carrying out the invention.

Summary of the Invention

A first embodiment of the invention is directed to a method of providing a user with an free fall or controllable descend/ascend somatosensory experience, which is similar to the G force feeling and visual sense in "thrill seeking jumping like" activities such as but not limited to: bungee jumping/sky diving/parachuting/jet pack flying/ski jumping/X bike jumping /ATV or snow mobile jumping. The method in this embodiment includes equipping the user with means for rapid changing user's elevation, using a computer-implemented virtual reality/mixed reality/augmented reality system to present to the user a virtual reality environment modeling "virtual" environment (such as extraterrestrial). The virtual reality(VR) /mixed reality (MR) system provides user a visual experiences of "virtual" environment under a "acceleration" or "G Force" feeling provided by the simulation environment -- elevation changing means plus other possible mechanisms such as direction changing means -- , in which the rapid changing "G force" --such as controlled descend/ascend or free fall--enhancing the experience of the virtual reality environment.

In a related embodiment the computer-implemented virtual reality system includes a virtual reality display on at least one surface in the simulation environment.

In a further related embodiment the surface is at least one wall of the simulation environment (which surrounds user).

In another related embodiment using the computer-implemented virtual reality system includes having the user don (i) a head-mounted display system, such display system including at least one sensor to identify at least one position of the user's head, wherein the display system and the sensors form a part of the computer-implemented virtual reality system.

In yet another related embodiment using a computer-implemented virtual reality system includes having the user don (i) a head-mounted display system, such display system including at least one motion-tracking sensor for tracking the user's head movement, wherein the display system and the sensors form a part of the computer-implemented virtual reality system.

In another related embodiment using a computer-implemented virtual reality system includes using the virtual reality system to model an experience of "thrill seeking jumping like" experience.

In another related embodiment the user's elevation/descending or ascending speed (could be dynamically accelerating or decelerating) in the simulated environment is controlled or adjusted, so that the G force user feels is at a desired level/value that coordinates/corresponding to/synchronized with the image provided to the user by the VR system. For example in the initial "free fall" stage of sky diving the "G Force" sky divers feels is close to 0, but later air drag balanced out gravity so "G Force" sky divers feel back to standard 1G. At the moment parachute is deployed, with additional deceleration the sky diver will feel more than 1G. The situation is similar to bungee jumpers: when the jumper just left the supporting platform, he or she feels 0 G, but later air drag kicks in so the G force feeling is increasing from 0 towards 1G, and when the bungee cord start to extend and provide deceleration, jumper will feel more than 1G. All these dynamically changing G force feelings can be simulated by controlling the ascending / descend rate of the rider in the means to

quickly changing elevation, for example a hoist system. And the bungee jumping can be simulated even without bungee cord, in which case a non-elastic cord controls the descending speed of user from the very beginning, so user do not have a real "free fall" period since at all times the descending speed is under control. In this configuration it is also possible to simulate bungee jumping "in slow motion" which means the descending acceleration is controlled to less than 9.8 m/s2, so that user will not feel complete "weightlessness" of 0G, but rather just for example "1/3" weight of 0.3G. In this manner user can experience longer but less "harsh" ride, like a "slow motion". Since the "G Force" can be controlled it is also possible for this system to "briefly" simulates gravitational forces on other celestial body like moon or mars. For example it is possible this system simulates movements like "jumping" on moon or other planet where the gravity is different with earth.

In another related embodiment a motion and position associated with the user is monitored and the virtual reality environment is adjusted in a manner responsive to the position.

In a related embodiment the method includes blocking a light source transmitting light into the simulated environment (for example in the some situation of mixed reality/augmented reality.)

In another embodiment of "Turbo Drop" like elevation changing means, after one or more passengers are loaded onto the vehicle, the vehicle is raised vertically by lifting means to a point near the top of the tower, where it is released. The vehicle then free falls (or acceleration/speed controlled ascend/ then descend) until it reaches a slow down phase (section), where it is gradually slowed and eventually stopped. Both in the upward and downward direction, the vehicle is directed by vertical guide means attached to the tower. In a "reverse turbo drop" situation the acceleration of passenger vehicle starting from the ground, so it first throw passenger upward, then free fall. The user will have "double length" time of 0-G or "weightlessness" feelings. During the entire process user wear an HMD or using "CAVE" like surrounding visual display to

enjoy the visual effects that is in synchronize with the motion and G force he/she is feeling.

In a related embodiment the user's orientation/heading direction (direction facing) is adjustable/can be changed. For example the supporting means of a rider's weight (such as a belt) fits around the waist of the rider, and permits the rider to rotate with respect to the belt about a vertical axis, and also permits the rider to rotate about a horizontal axis defined by supporting swivels on opposite sides of the belt. Similar to that described in US5221241 (TRAINING APPARATUS FOR GYMNASTICS). When using a passenger vehicle, it is also desirable that the direction/orientation of that vehicle can be changed, for example like the design in US5421783 (A) (Human slingshot machine). It is also possible that under some situations the seat on which user is bond to can turn to different directions such as lean forward or backward to let user experience variable G-Forces from different direction (which is consistent with the virtual reality simulation at the same time).

In a (further) another related embodiment the where a group of 2 or more people could "jump" or "ride" together, they can be sharing the same "elevation changing means" such as a hoist system, or separated systems. In the later case the descending speed of the multiple separated systems maybe coordinated so that people in the group can have similar descending rates when they close to each other.

For landing or "rebounding", the area rider lands can be made of resilient materials or apparatus such as , but not limited to trampoline, air cushion, air bed Air-spring like jumping/cushion system. This can also served as a safety measure.

Another embodiment of the present invention is directed to a virtual reality apparatus that provides a user with an "thrill seeking jumping like" somatosensory experience. The apparatus includes a means to change passenger(rider)'s elevation rapidly (so that rider can sense the different "G Froce" than stationary) and a computer-implemented virtual reality /Mixed reality/ Augmented reality system that presents to the user a virtual

reality environment while user is using ("riding") the elevation changing means, the virtual reality environment modeling an "thrill seeking jumping like activity" setting, and desirable inhibiting visual perception by the user of items outside of the virtual reality environment.

In a related embodiment the computer implemented virtual reality system includes a head-mounted display system, such display system including at least one sensor to identify at least one of position and motion of the user's head, wherein the display system and the sensor form a part of the computer-implemented virtual reality system, the head-mounted display system integrated with an elevation changing means [apparatus] for the user, (operative in the visual environment, if needed in Mixed reality).

In related embodiment the elevation changing means apparatus includes an suspension/support system for rider, desirable with mechanism to control descending/ascending rate/accelerating rate and desirably with shock-absorbing and anti-swing mechanisms.

In an related embodiment the elevation changing means or "hoist system" includes, but not limited to the following type:

A Hoist that use cable – a resilient link/connection-- to support the weight / provide lift for user.

A "Turbo Drop" like system that using a "rigid" link/connection such as a track (rail) or cylinder to support the weight / provide lift to the users.

A "bungee" setting in which a resilient cord (bungee cord) is used to support user.

An elevator like setting in which the very wide range of ascending and descending speed can be achieved and be controlled safely.

A "crane" like setting which user can 2-D or 3-D move by the hoist system and crane system.

Human slingshot like system.

A Jet pack like system.

A trampoline, air bed Air-spring like jumping/cushion system.

A slideway system or the like,

And etc.

Thus, the way user connects to (or attaching to or supporting by) the elevation changing means is varied according to situation and can be flexible. Normally the connecting method is desirably the way that is appropriate to the specific activity being simulated. For example for "Bungee" then use the way normal bungee jumper connects to the bungee cord. For "sky diving" it can be connected like "parachute connection", like those describe in US4264311 (A) "Dynamic parachute four-line release simulator". However, for amusement purpose it is ok to use other connection method to create fun (such as allowing more freedom, allowing flipping etc.) as long as it is safe.

It is desirable that the HMD have shock absorber elements like cushions /soft resilient pads and linkage(s) with the head and ear to prevent injuries / hurt in motion /acceleration/deceleration and etc. Or some kind of weight relief means for the HMD can be used.

In yet another related embodiment the design allows to move user not only vertically, but horizontally as well, so as to allow user to achieve 2 Dimensional or 3-D "flying" experience. For example this can be achieve by introducing to the simulated environment at least one "carriage" carries the "hoist winch", and can moves along a horizontal "rig" that is placed above the simulation activity area, like a crane design. The "carriage" advances over the simulation activity area with the rider. An other crane like design that a boom secured by guy cables and a ground anchor can also be used, like those described in patent WO 9219325.

It is desirable that the simulation environment may includes a surrounding accommodating visual environment ("SAVE") that shrouds, from the user's perception, items outside of the virtual reality environment

It is desirable that the surrounding accommodating visual environment includes a system of solid color walls such as green, blue, or black non-reflective surfaces, for the requirement of Mixed reality.

In another related embodiment the means that changing passenger elevation includes a speed/acceleration control mechanism that controls

the "G" force that can be felt by the user.

In another related embodiment we can simulate "ski-jumping" by using 2 dimensional movement like a crane design mention earlier, The "carriage" advances over the simulation activity area with the "ski-jumper".

In another related embodiment including means to blow artificial wind to the user (such as fans).

In another related embodiment the apparatus includes an audio component for transmitting an audible signal to the user.

In another related embodiment the apparatus includes a tactile component for transmitting a tactile signal to the user.

In another embodiment the one or more game control means or manipulator(s) is(are) provided to one or more users for them to play games with this system. Any suitable game control means can be used. User can play game with computer, and/ or against each other, either locally or via network.

In some embodiment additional "props" or equipment appropriate to the simulation or game can be use to increase realistic feeling and enhance user experience. For example in a "Jet pack" simulation or game, mockups for Jet pack or real jet packs can be use, and the equipment can even provide some "vector thrusting" to change user movements to create additional fun.

In a related embodiment the trampoline , air cushion, air bed Air-spring like jumping/cushion system can be used to enhance user experience and provide additional safety.

Detailed Description of drawings

Fig 1 shows an user with head mounted display/VR goggle and related system that can be attached to an hoist system.

The apparatus for providing "thrill seeking jumping" experience comprises means 1 (Fig. 1) for providing 3-D/streo images, may include

forming a virtual space in which objects appear and move in a predetermined and random manner. One or more computers with storage and accelerator(s) of three-dimensional graphics is usually used as the means 1 of such image provider.

A means 3 for displaying the virtual space to the user U is connected to the means 1. A headpiece, put on the head of the user and comprising two screens for transmitting imagery to the user and headphones for transmitting sound, is used in the variant being described as the means 3 for displaying the virtual space.

As an option design, backpack 5 can be provided for user to carry on. It can be used as placing related equipments such as communication, control, image processing unit and etc.

This figure shows user can be connected to a hoist system like those shown in other drawings via cable and connector 2. The way / method of connection can be many kind.

Optionally a means 3 could be made to be "flip-able" or adjustable so that you can take it on or off to provide additional safety and functionality.

The apparatus also comprises means 17 (which not necessarily mounted on user's helmet) for determining the magnitude and direction of movement of the user U relative to the environment (pool, etc), the means being connected to the unit 19 for calculating and converting the virtual space that is provided by means 1. A plurality of means 17 for tracking user motion /position (especially the head and hand movement and position) maybe used. And methods such as but not limited to Inertial Tracking -- accelerometers or of angular rate sensors for motion tracking -- are used in the variant being described as the means 17.

The output of the sensor 17 of signals of movement of the user relative to the environment is connected to a unit 19 for conversion of the virtual space in accordance with the real physical hand, head and body movements of the user in the real space, and provide adjustments/feed back to means 1, taking into account interaction with the objects in the virtual space. With this in view, a number of sensors 17 determining the

position of the hands, head, body of the user respectively, are mounted on the user U.

Also optionally a means 3 can be as simple as a 3-D/ stereoscopic glasses, while the image provided by means 1 is displayed on a external screen 10 that is visible for user U, as shown in Fig.4.

Optionally user U can have one or more controller/manipulator 22 in hand for the purpose of control the display/communication/game play/training etc.

FIG. 2 shows one embodiment of the system in which user U wearing VR/MR/AR display means 3 (HMD), attached to the hoist system consists of cable 202, which is connected and controlled by hoist winch 203. Optionally the hoist winch can be sitting on a carriage 205 that moves along (lateral) rig 206 that supports all the weight.

When user U jump off platform 201 the hoist winch 203 begin to control the descend speed of user. Alternatively user can also start from ground and hoist winch 203 lifts the user and then decelerating, so that user can feel "weightlessness" even when traveling upwards.

It is also desirable that video camera/stereoscopic cameras being mounted on the front of HMD/goggle so that a source of real word images (what the user should see without the goggle) is also available to user. Means 1 (in Fig1) can mix these signals with virtual world signals (by the help of means 17 and 19 in Fig 1) so that user can feel combined feeling of real world scenario and the virtual world. This is useful in for example when user "jumping" with friends in the real world, so that he/she can have visual of the friend jumping together, while still immersed in virtual world being simulated.

Air cushion, air bed like jumping/cushion system can be used (shown in the bottom) to enhance user experience and provide additional safety.

Fig 3 shows an example of using props / mockups and/or addition related equipments in the simulation. User wearing VR/MR/AR display means 3, is attached to a elevation changing means, with cable 202 connects to and controlled by hoist winch 303. The hoist winch can be

located on a carriage 305 that moves along a crane arm 306 that belongs to crane 301 or the like.

User also don a "mockup" Jet pack which optionally be able to provide some "vector thrust" by using jets like mechanism (312). However since the cable 202 supports the weight of user and hoist winch 303 and carriage 305, crane arm 306 can provide full 3-D movement for user, there isn't much need for the thrust so there wont be a lot of fuel consumption. So even a real jet pack can be used for practice purposes.

To add more fun and safety, a trampoline is provide in the takeoff-landing area, and can be used in many occasions such as in games.

Fig 4 shows an example of using elevator like elevation changing means (401 represents the floor of the elevator car) combined with "CAVE" like virtual reality system (10 represents the external screen that surrounds the user). The seat S can change direction for example forwards and backwards so that user when sitting on the seats (which could have safety belt) can feel the "virable G" feelings in various directions which are consistent with the movement in the virtual environment. Alternatively, the screen might also rotate together with the seats around a same axis.

Detailed Description of Specific Embodiments

Some related concepts /definitions:

"Somatosensory experience" of a user is experience by the user as perceived through the user's sensory organs and other sensory receptors throughout the user's body.

A "virtual reality system" is a computer-based system that presents to the user a virtual reality environment.

It is desirable that the virtual reality environment is presented under conditions wherein the user is inhibited from experiencing visual perceptions that are deemed inconsistent with the virtual reality environment. If the user is able to see visual references that is in the "real world" rather than in the virtual world, such as outside light sources, edges of supporting structure, those perception might increase the user's feeling

of being still in the actual location and not the virtual world being simulated, so as to interfere with the user's experience of being immersed within a virtual environment.

So it is desirable the virtual reality environment inhibits visual perception by the user of items outside of the simulated ("virtual") environment, by for example presenting visual experience of the environment via a head mounted display that blocks viewing the ambient environment. Alternatively, the visual experience may be presented on one or more displays mounted on one or more surfaces at a distance from the user, under conditions where viewing the ambient environment is inhibited by shrouding anything that may be viewed in a location away from the displays in a sea of blackness, using, for example, black walls that are non-reflective.

An "thrill seeking jumping" setting modeled in a virtual reality environment is a setting that do not reflect the current scene, but rather , some other interesting scenes such as grand canyon, Niagara falls, empire state building, or even places not on earth, and such setting may be fictional. (The gravitational force experienced by a user in many such extra-terrestrial environments will generally differnt than the gravitational force the user feels on earth's surface.) A setting on the moon surface is "thrill seeking jumping" for purposes of this definition.

Various embodiments of the present invention for simulating "thrill seeking jumping like" experiences may be used for activities such as training, recreational or entertainment activities.

In accordance with an embodiment of the present invention depicted in Fig 1, a user is provided with a suspension apparatus (that could provide elevation changing) in combination with head mounted display 3. The head mounted display 3 may be in the form of goggles. The head mounted display is used to provide the user with a virtual reality experience. The head mounted display provides the user with three-dimensional visual imagery and other content that stimulates different senses in the somatosensory system. The content provided by

the virtual reality system generally simulates an "thrill seeking jumping like" experience.

Often the virtual reality environment models a setting with respect to which a user is able to interact so that user input modifies the presentation of the setting to the user. The interaction may be provided in various forms such as via sensing head motion, user orientation, or via a game controller or sensing gesture of the user.

The user may be equipped with a backpack to carry communication, image processing or data transmission systems as an alternative or in addition to image providing units that located separately (for example on ground). Communication can be performed in either wired or wireless manner, or both.

In some embodiments video camera(s) might be mounted on the helmet (or HMD) to move together with user's head, to provide real time images of objects and people in their surrounding --such as partner/friends rides together-- for usage such as merging with the background in real time. In those embodiments a computer system such as system 19 (as shown in Fig 1) can switch or alter the view of user 1 in the head mounted display 3 such that the user can obtain the appropriate sensations that simulates user 1 physically working on or with systems physically in his or her environment while maintaining the sensation of being in the virtual environment. Such technology is generally referred as "mixed reality"

backup cables, safety parachutes, airbags and etc. safety device may be included.

User may be provided with a manipulator to control the display, to access their communication systems, or control any other feature in the event that the user is training or participating in a game.

Virtual reality is limited when the only visual stimulation is provided or displayed to a user. The human body uses three different senses to resolve motion and acceleration cues like those simulated in virtual reality. Visual stimulation is adequate to perceive the motion of an external object such as a bouncing ball, but is insufficient to fully demonstrate

self-motion.

Reliance on purely the visual scene, therefore, necessarily invites conflict between the visual system and the two remaining centers for motion sensation that remain dormant and, therefore, does not reinforce the visual sensations. Accordingly, the user still may not feel completely immersed in an "virtual world" being simulated without engagement of additional non-visual senses such as touch to resolve force or acceleration.

Organizations such as NASA have engaged in the use of air plane to rapid changing elevation of passenger to simulate 0 gravity force. When the force feelings provided by an elevation changing system which includes support/hoist/safety means and speed control means, are confirmed by the surrounding visual cues provided by the VR/MR system , the immersive sensation of the "virtual world" being simulated may be achieved. Accordingly, some embodiments of the invention provide simulations that will engage the user's tactile and hearing sense in a manner consistent with the visual display and surrounding visual cues provided by the VR/MR system.

In some embodiments using Mixed reality and AR (augmented reality), the MR/AR system may require a clean "background" for visual signal mixing. Basically it requires a solid color (such as green) background in the field of view (FOV) of the camera against the foreground "people" or "user's hand/feet " that is captured by the same camera. Mixed reality image processing engine later can substitute the "green background" with other images such as the images of the virtual world being simulated. In such cases, the jumping hoisting structure or the elevation changing means may need to be surround by curve shaped surfaces with either light absorbing materials or painted into solid color so that during the elevation changing process the camera on user's HMD may not pickup apparent surfaces, edges, etc and thus provide "clean background" for mixed reality technology usage.

In some embodiments the external display may be provided in such a format that surrounds the user so that the user feels as though he or she is

in the environment being simulated. To achieve this sensation the external screen may be displayed on the sidewalls and the bottom surface of the simulation environment and /or the simulation environment may have a spherical shape, with no apparent edges in the user's field of view. The simulation environment may be structured to provide a display as in a cave automatic virtual environment, also known as "CAVE", wherein the visual display is provided on multiple walls of the simulation environment so that the user is surrounded by the virtual environment and has a more realistic sensation of being immersed in the environment depicted by the virtual environment.

Claims

1. A method of providing user somatosensory experience for "thrill seeking jumping like activities", the method comprising:

Providing means for changing elevation of user that rapid enough for user to feel the difference of gravity feeling or "G force" with feelings of user under stationary situation, wherein the speed of elevation change provide by the means can be controlled/adjusted and the facing direction relative to the direction of movement and /or pose of the user can be changed,

While the user using the elevation changing means, using a computer -implemented virtual reality system to present to the user a virtual reality environment. The view point and/or direction changes in the virtual reality environment are consistent with the position changes and/or self motion of the user in the elevation changing means,

So that the user experiences the virtual reality environment under a "variable gravity" condition or "G-Force" provided by the elevation changing means (in a synchronized way), such "variable gravity" condition enhancing experience of the virtual reality environment.

2. A method according to claim 1, wherein using the computer-implemented virtual reality / mixed reality system including modeling an virtual environment in which user can perform "thrill seeking jumping like" activities such as but not limited to: bungee jumping, sky diving, parachuting, jet pack flying, ski jumping, X bike, ATV or snow mobile jumping, flying with special(or fictional) equipments or riding fictional animals and etc. The virtual environment could have a setting that is on earth or extraterrestrial.

3. A method according to claim 1, wherein the computer-implemented virtual reality system includes a virtual reality display on at least one surface in the visual environment.

4. A method according to claim 3, wherein the surface is at least one wall of the simulating environment (that surrounds user).

5. A method according to claim 1, wherein using the computer-implemented virtual reality system includes having the user don (i) a head-mounted display system, such display system including at least one sensor to identify at least one position of the user's head, wherein the display system and the sensors form a part of the computer-implemented virtual reality system.

6. A method according to claim 1, wherein using the computer-implemented virtual reality system includes having the user don (i) a head-mounted display system, such display system including at least one motion-tracking sensor for tracking the user's head movement, wherein the display system and the sensors form a part of the computer-implemented virtual reality system

7. A method according to claim 1, wherein using a means for changing elevation of user includes using a resilient link/connection-- to support the weight / provide lift for user, such as but not limited to using hoist (which use cable) or bungee cord, crane like systems and etc.

8. A method according to claim 1, wherein using a means for changing elevation of user includes using rigid link/connection such as a track (rail) or cylinder to support the weight / provide lift to the users such as but not limited to "Turbo Drop" like system, elevator like system or slide way like system.

9. A method according to claim 1, wherein a motion and position associated with the user is monitored and the virtual reality environment is adjusted in a manner responsive to the position.

10. A method according to claim 1, wherein one or more control means or manipulator(s) which is(are) provided to one or more users for them to interact/play games with this system. User's input via the controllers or by other pre-defined methods such as gesture or pose could affect/change the output of the elevation changing means.

11. A virtual reality apparatus for providing a user with an "thrill seeking jumping like activities" somatosensory experience, the apparatus comprising:

an elevation changing means for user than can move user rapid enough to feel the difference of gravity feeling or "G force" (compared with feelings of user under stationary situation). In such means the speed of elevation change provide can be controlled/adjusted and the facing direction relative to the direction of movement and /or pose of the user can be changed;

a computer-implemented virtual reality system that presents to the user a virtual reality environment while user is using the elevation changing means. The visual display of the virtual reality environment moves together with user when user's elevation changed. The view point and/or direction changes in the virtual reality environment are consistent with the position changes and/or self motion of the user in the elevation changing means, enhancing user experience.

12. An apparatus according to claim 11, wherein the computer-implemented virtual reality / mixed reality system modeling an virtual environment in which user can perform "thrill seeking jumping like" activities such as but not limited to: bungee jumping/sky diving/parachuting/jet pack flying/ski jumping/X bike jumping /ATV or snow mobile jumping/flying with special(or fictional) equipments or riding fictional animals, and etc, the virtual environment could have a setting that is on earth or extraterrestrial.

13. An apparatus according to claim 11, wherein the computer implemented virtual reality system includes: a head-mounted display system, such display system including at least one sensor to identify at least one of position and motion of the user's head, wherein the display system and the sensor form a part of the computer-implemented virtual reality system, the head-mounted display system integrated with the elevation changing means for use by the user.

14. An apparatus according to claim 11, wherein the computer implemented virtual reality system includes: an external display providing a visual display of the virtual reality environment. This external display could provide visual display on at least one wall of the environment

surrounding user

15. An apparatus according to claim 11, wherein a motion and position associated with the user is monitored and the virtual reality environment is adjusted in a manner responsive to the position.

16. An apparatus according to claim 11 including one or more control means or manipulator(s) which is(are) provided to one or more users for them to interact/play games with this system. User's input via the controllers or by other pre-defined methods such as gesture or pose could affect/change the output of the elevation changing means.

17. An apparatus according to claim 11 includes means to blow artificial wind to the user (such as fans).

18. An apparatus according to claim 11 includes a tactile component for transmitting a tactile signal to the user.

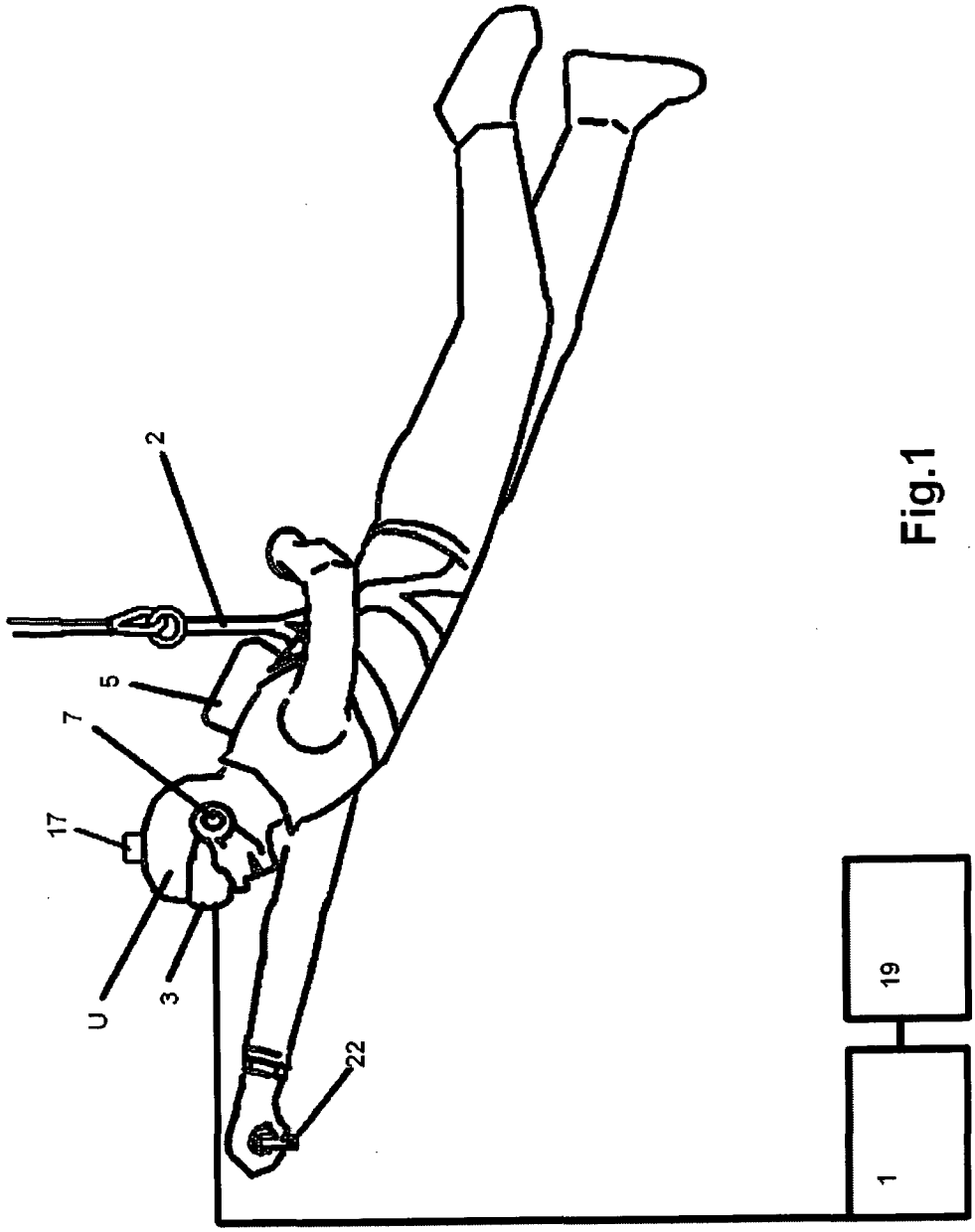

Fig.1

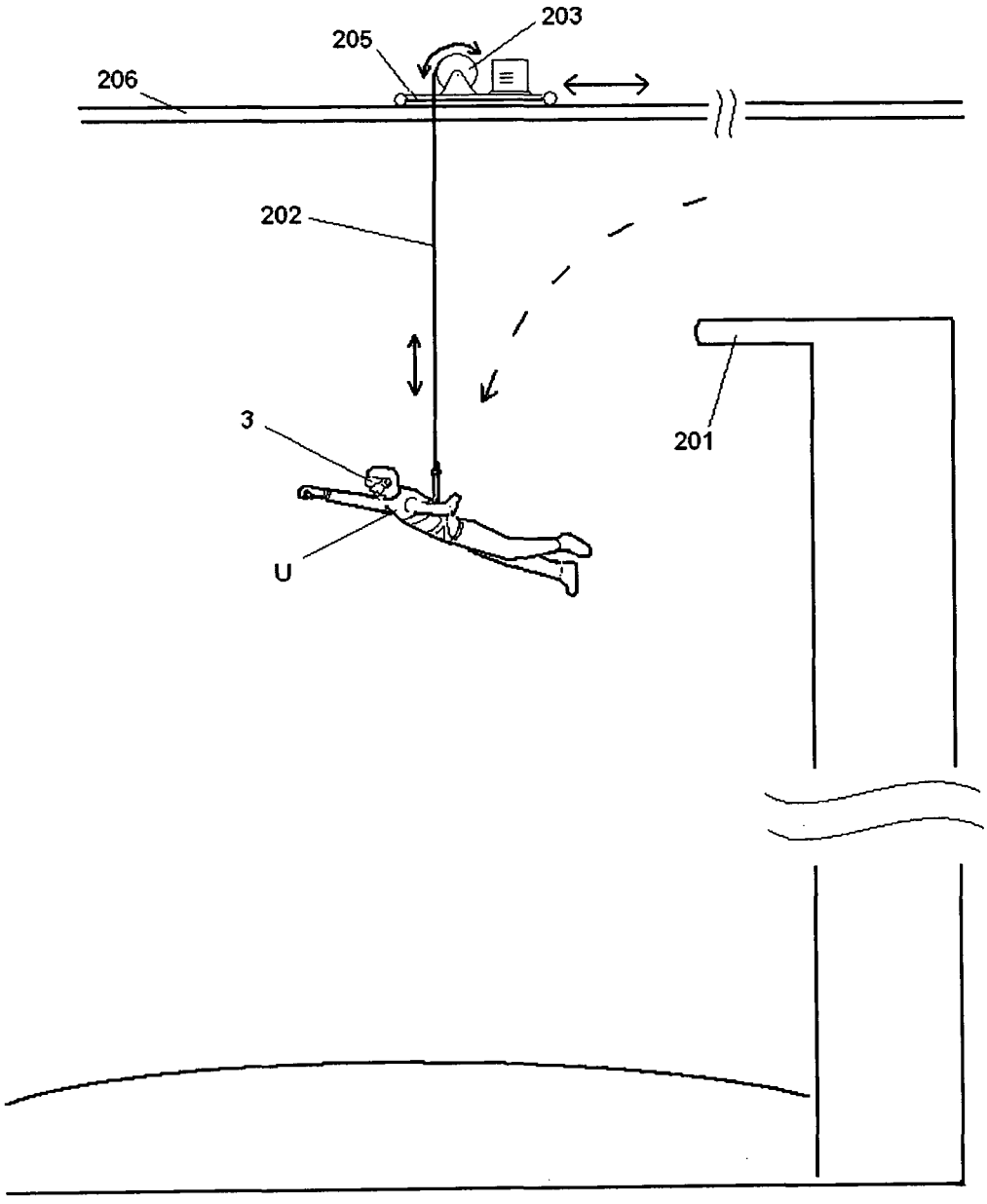

Fig.2

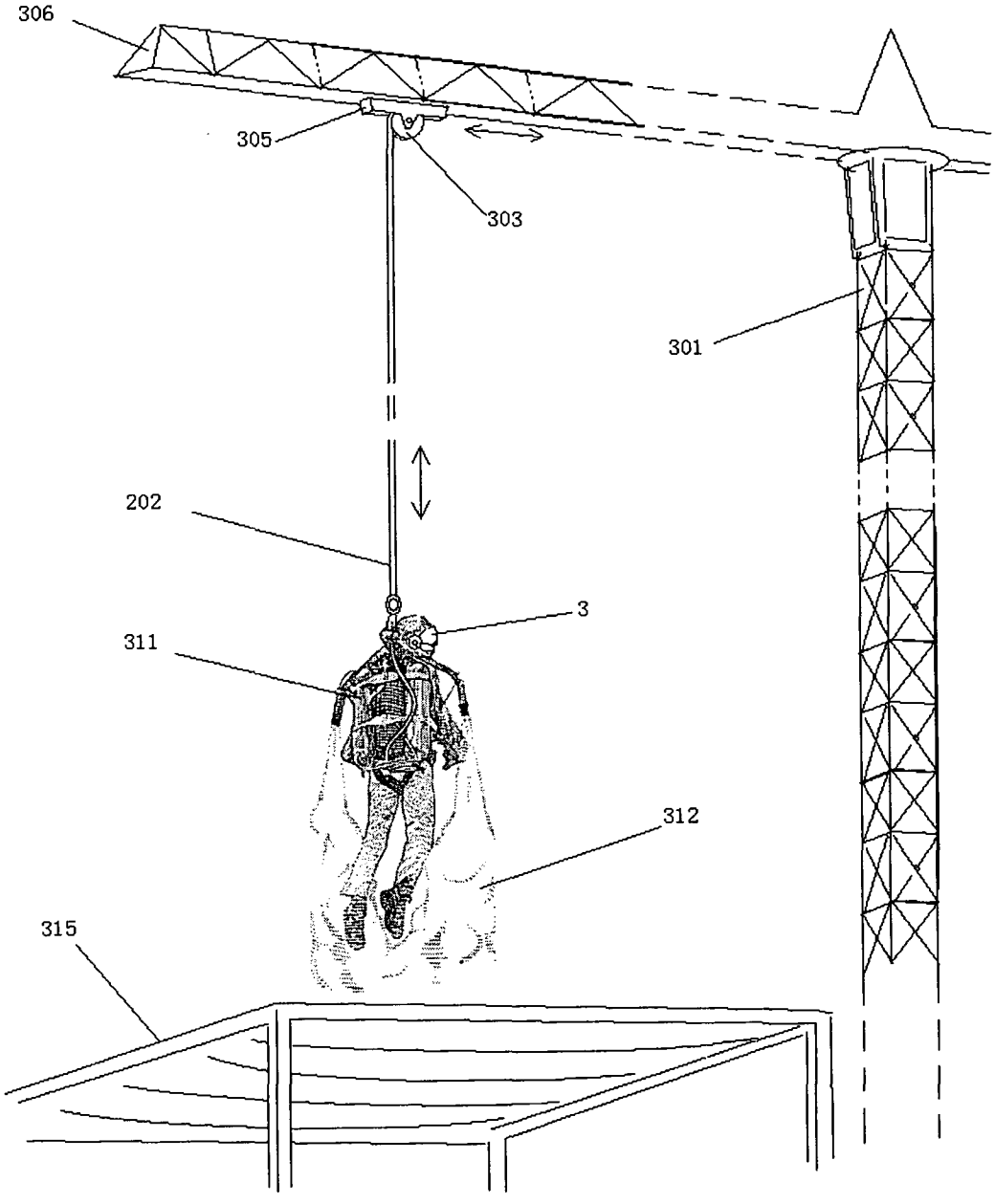

Fig. 3

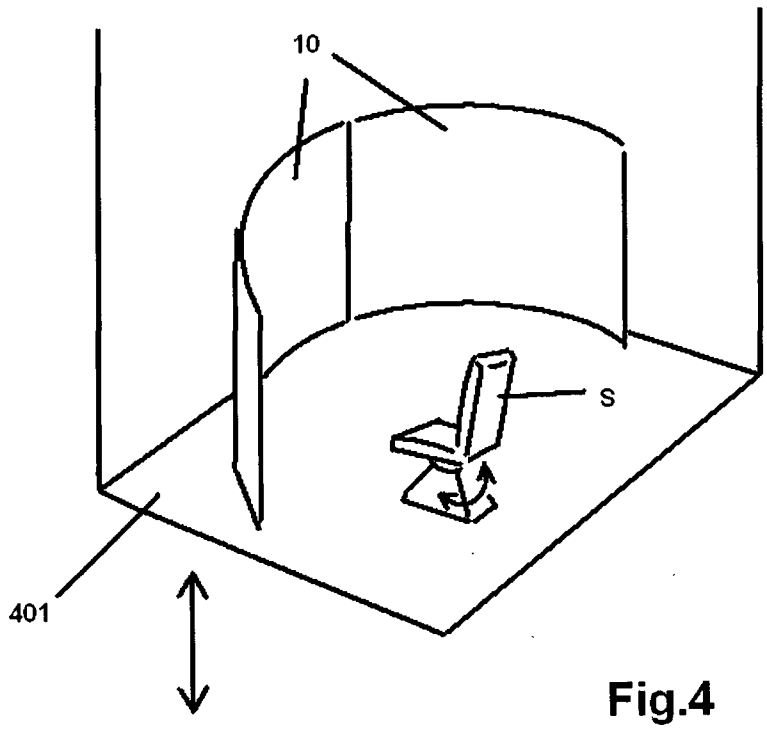

Fig.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2010/000308

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC: B64G 7/00, G09B 9, A63B 5/00, A63B 69/00, A63B 71/00

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

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

CPRS, CNKI, EPODOC, WPI: +jump+, bungee, jet, +gravity+, +weight+, +gravitation+, G, virtual reality, jump+, gravit+, simulat+, train+, exercis+, XIAO-I, XIAO Q, XIAO W QUAN

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO2009029657 A2(XIAO, Quan) 05 Mar. 2009 (05. 03. 2009) claims 1-5, 8, 11, 15, 27, desc. Paragraphs 008,009, 0040, 0041, 0049 and figs. 1-3	1-18
Y	WO 02076829 A1(LEE Sung Taee et al.) 03 Oct. 2002 (03. 10. 2002) figs. 3-11	1-18
D, Y	WO 9219325 A1(SCHWEIZER Jochen) 12 Nov. 1992 (12. 11. 1992) abstract and fig. 1	1-18
A	WO 2008055974 A1(VIRTUNAUT SPRL et al.) 15 May 2008 (15. 05. 2008) the whole document	1-18
A	CN 2607179 Y (TENG, Guilong) 24 Mar. 2004 (24. 03. 2004) the whole document	1-18

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

* Special categories of cited documents:

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"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	Date of mailing of the international search report
10 May 2010 (10. 05. 2010)	**17 Jun. 2010 (17.06.2010)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer LU, Shijie Telephone No. (86-10)62084988

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2010/000308

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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		WO2009029657 A3	14. 05. 2009
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CN 2607179 Y	24. 03. 2004	None	

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

B64G 7/00 (2006.01)i

A63B 5/00 (2006.01)i

G09B 9/00 (2006.01)i