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(71) Applicant (for all designated States except US): **COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION** [AU/AU]; Limestone Avenue, Campbell, Australian Capital Territory 2612 (AU).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **BERKOVSKY, Shlomo** [IL/AU]; 6 Denmark Close, Taroona, Tasmania 7053 (AU). **BHANDARI, Dipak** [AU/AU]; 40A Clarence St, Bellerive, Tasmania 7018 (AU). **GIUGNI, Stephen** [AU/AU]; 92 Woodcutters Rd, Tollmans Hill, Tasmania 7007 (AU).

(74) Agent: **GRIFFITH HACK**; Level 29, Northpoint, 100 Miller Street, North Sydney, New South Wales 2060 (AU).

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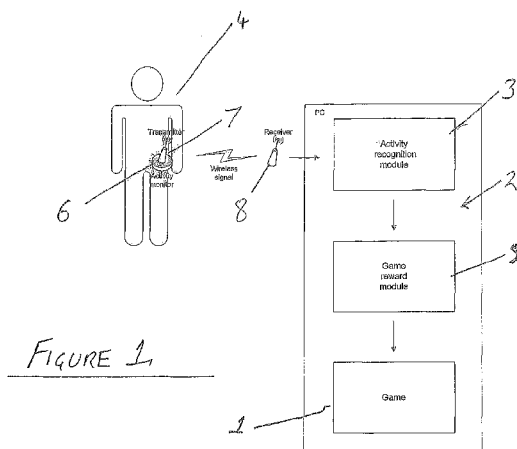


FIGURE 1

(57) Abstract: The present invention relates to a method and apparatus for motivating physical activity when playing computer games. Generic physical activity of a user is monitored (eg jumping, running) to determine a physical activity value. The physical activity value is converted into a value for a game commodity, such as speed, movement, life, of a character in the computer. This motivates the user to be physically active in association with playing the computer game.

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A GAMING METHOD AND APPARATUS FOR MOTIVATING PHYSICAL
ACTIVITY

5 FIELD OF THE INVENTION

 The present invention relates to a method and apparatus for motivating physical activity when playing a computer game, and, particularly, but not exclusively, to
10 a method and apparatus for utilizing user physical activity in control of a computer game.

BACKGROUND OF THE INVENTION

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 Computer games are very well known to encourage sedentary activity. Such games are often addictive and self reinforcing. As obesity is a worldwide problem (for example in the US it is reckoned that over 60% of adults
20 and over 20% of children are overweight, while international statistics published by World Health estimate over 1.6 billion overweight individuals), then computer games which encourage sedentary activity are an issue.

25 Computer games are known which require physical activity to play the game. These include the Nintendo[®] Wii[®] suite of games. In these games, the Wii[®] control needs to be moved in a physically robust manner, sometimes simulating play of a "real" game (eg tennis, golf).

30 Proposals have also been made for interfacing exercise apparatus (such as exercise bikes) with computer games in order to control aspects of the game eg level of difficulty of the game (see US 5362069 and US 5001632, for

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required to play the game and directly interfaces with the game. Another example of such an arrangement is disclosed in US 2008/0262786, where physical activity of a user directly affects a race game, where a user avatar makes
5 variable progress in the game depending upon the physical activity of the user during the day. Further, accumulated physical activity "points" can be used to control a Sudoku type game, by adding a new feature to the game which provides "hints" on how to progress in the game in
10 exchange for physical activity points that have been accumulated. A new feature (the feature of hints) is introduced into the Sudoku game to enable use of the physical activity points.

While the types of games discussed above are
15 laudable, in that they do require some physical activity to play the games, there are still many games where limited or no physical activity is required to play the game, or which do not lend themselves to interfacing with any direct interface device to encourage physical activity
20 while playing the game. This may create a negative perception of games in society.

SUMMARY OF THE INVENTION

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In accordance with a first aspect, the present invention provides a method of controlling a computer game, the game having a game commodity which is required to play the game, the method comprising the steps of
30 determining a physical activity value for a user of the game and converting the physical activity value into a value of the game commodity.

In an embodiment, the physical activity value is

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determined based on physical activity carried out by the user. In an embodiment, the more physical the user carries out the higher the physical activity value and the higher the value of the game commodity which can be converted from the physical activity value. It is an advantage of at least an embodiment of the invention therefore, that physical activity of the user can be converted into a value for the game commodity to facilitate play of the game, thereby "rewarding" the user for undertaking physical activity.

There is therefore motivation for the user to undertake physical activity in order to assist them in playing of the game. The commodity may be any game commodity. For example, in a game which requires ammunition (eg, in a computer war game ammunition may be required in the form of virtual bullets), the physical activity value may be converted into ammunition (eg to increase the available number of bullets available to the user). Other commodities may include speed, power (eg power of a character in a game), time (eg time left to play the game), number of "lives" (eg number of lives of a character or piece in the game), or any other game commodity.

In an embodiment, the physical activity is an adjunct to the game. That is, it is a feature which may be added to the game but it is not essential for play of the game. The game may be played without any user physical activity or the generation of any physical activity value. In an embodiment, the game may be an existing game (eg Neverball™, a racing game, a computer war game or any other computer game) which is adapted to have a physical activity value converted into a value of the game

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Commodity. It is envisaged that any existing computer game having game commodities (which is virtually all of them) can be adapted to implement the method of the present invention. It is an advantage of at least an embodiment of the invention, therefore, that existing, sedentary computer games, can be adapted to implement the method of the present invention and motivate physical activity in their play. It is a further advantage of at least an embodiment of the invention, that it is not necessary to change features of the existing game in order to adapt it to implement the method of this invention. It can stay the same. The game may be essentially unaffected, other than that physical activity can be "traded" for game commodities.

In an embodiment, the game may have a plurality of commodities, and the physical activity value may be converted into a value for one of the game commodities or values for more than one of the game commodities. For example, a game may have a time commodity and a speed commodity, and the physical activity value may be converted into a value for the speed commodity and a value for the time commodity.

In an embodiment, the physical activity value conversion is implemented in dependence on a user parameter. In an embodiment, the user parameter may be user selection of a particular one of a plurality of available game commodities. The user may set a user preference for conversion of the physical activity into a particular game commodity, for example. In an embodiment, the user parameter may be user selection of a particular magnitude of the conversion of the physical activity to the game commodity value. The user may set the ratio of the conversion from the physical activity value to the

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commodity value, for example. In an embodiment, the user parameter may be physical performance of the user. This may be automatically detected and the conversion may be adjusted in dependence upon the physical capabilities of the user. For example, if the user is very physically capable, the ratio of the conversion may be set so that the user must work physically harder in order to gain commodity value. Which game commodity the physical value is converted into may also depend on physical performance of the user. In an embodiment, the physical performance may be detected over a period of time eg assessing previous physical performance of the user when playing the game. This may lead to an increase in the physical performance of the user (the user gets fitter). In an embodiment, the user parameter may be a user demographic eg, age, gender or any other demographic. The conversion may depend on the age of the user, for example.

In an embodiment, the method includes the step of varying the difficulty of the game. The difficulty of the game may be varied depending upon the physical activity value. The game may be made more difficult, for example, if the physical activity value is low, and difficulty may be decreased if the physical activity value is increased. In an embodiment, the difficulty of the game may depend on any user parameter, such as the user parameters discussed in the previous paragraph.

In an embodiment, the method includes the step of accumulating physical activity value. The accumulated physical activity value may be utilized to convert to a value of the game commodity at any time. In an embodiment, the accumulated physical activity value may be used in another computer game. There may be a plurality of computer games available to the player, for example,

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and the accumulated physical activity value may be used for any one of them. The user may therefore accumulate their physical activity value by performing physical activity over a period of time, and use it with any
5 available game where it can be converted into a value of a game commodity.

In an embodiment, play of the computer game is interrupted in order for a user to undertake physical activity and therefore increase their physical activity
10 value. In an alternative embodiment, game play is not interrupted while the user undertakes physical activity.

In an embodiment, the step of determining physical activity value comprises the step of monitoring the physical activity undertaken by the user and determining
15 the value based on the amount of physical activity carried out. The amount of physical activity may be based on length of physical activity, intensity of physical activity, or any other parameter of the physical activity.

In an embodiment, the physical activity of the user
20 may be any physical activity. In an embodiment, no exercise device is required. Instead the physical activity of the user is monitored by a detecting device, which may, in an embodiment, be an accelerometer, for example. The user may jog on the spot, may run, jump or
25 undertake any other physical activity that can be detected by the device. Physical activity is therefore generic and not exercise specific. In embodiments, the physical activity of the user may be monitored using physiological parameter measurement devices eg heart rate monitors, ECG,
30 and other physiological monitoring devices.

In accordance with a second aspect, the present invention provides a control apparatus for controlling a computer game, the computer game having a game commodity

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which is required to play the game, the control apparatus comprising a physical activity monitor arranged to determine a physical activity value for a user of the game, and a commodity converter for converting the
5 physical activity value into a value of the game commodity.

In an embodiment, the computer game may be any computer game. In an embodiment the computer game may be an existing, known computer game, adapted for use with the
10 gaming apparatus.

In accordance with a third aspect, the present invention provides a computer gaming apparatus, comprising a computer game module arranged for play of a computer game, the computer game having a game commodity which is
15 required to play the game, and a game control module, the game control module comprising a physical activity monitor arranged to determine a physical activity value for a user of the game, and a commodity converter for converting the physical activity value into a value of the game
20 commodity.

In accordance with a fourth aspect, the present invention provides a method of adapting a computer game to facilitate motivation of physical activity, the computer game having a game commodity which is required to play the
25 game, the method comprising the step of adapting the computer game so that a measured value of physical activity of a user is convertible into a value for the game commodity.

In an embodiment, existing computer games may be
30 adapted so that physical activity of the user can be converted into a value for the game commodity. In at least an embodiment, this has the advantage that typical, sedentary computer games can be adapted in order to

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motivate physical activity of the user.

In accordance with a fifth aspect, the present invention provides a computer program for controlling a computer to implement a control apparatus in accordance
5 with the second aspect of the invention.

In accordance with a sixth aspect, the present invention provides a computer readable medium providing a computer program in accordance with the fifth aspect of the invention.

10 In accordance with a seventh aspect, the present invention provides a data signal comprising a computer program in accordance with the fifth aspect of the invention.

In accordance with an eighth aspect, the present
15 invention provides a computer program comprising instructions for controlling a computer to implement a computer gaming apparatus in accordance with the third aspect of the invention.

In accordance with a ninth aspect, the present
20 invention provides computer readable medium, providing a computer program in accordance with the eighth aspect of the invention.

In accordance with a tenth aspect, the present invention provides a data signal, comprising a computer
25 program in accordance with the eighth aspect of the invention.

In accordance with an eleventh aspect, the present invention provides a method of designing a computer game, comprising the steps of determining one or more suitable
30 game commodities, and providing an interface so that physical activity of the user can be converted into a value for one or more of the game commodities.

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BRIEF DESCRIPTION OF THE DRAWINGS

Features and advantages of the present invention will become apparent from the following description of
5 embodiments thereof, by way of example only, with reference to the accompanying drawings, in which;

Figure 1 is a schematic diagram of a control apparatus and gaming apparatus in accordance with an embodiment of the present invention;

10 Figure 2 is a schematic diagram of computer hardware which may be utilized in implementation of an embodiment of the present invention;

Figure 3a is a picture of a physical activity sensor which may be utilized with an embodiment of the present
15 invention;

Figure 3b is a representation of a video display of an example computer game being controlled in accordance with an embodiment of the present invention; and

Figure 4 is a flow diagram illustrating a process in
20 accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

25 Figure 1 is schematic diagram of components of a control apparatus and gaming apparatus in accordance with an embodiment of the present invention.

In this embodiment, a computer game 1 is controlled by a control apparatus generally designated by reference
30 numeral 2. The computer game 1 has a game commodity which is required to play the game. The game commodity may be any computer game commodity, such as speed, power,

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ammunition (for a virtual war game), or any other commodity.

The control apparatus 2 comprises a physical activity monitor module 3 which is arranged to determine a physical activity value for user 4. The control apparatus also
5 comprises a commodity converter module 5, (in this embodiment termed a "game reward module") which is arranged to convert the physical activity value determined by the monitor module 3, into a value for the commodity of
10 the game 1.

Physical activity of a user 4 can therefore be "traded" for a game commodity, such as speed, time, power or any other commodity. This motivates the user 4 to undertake physical activity in order to facilitate play of
15 the game 1.

In this embodiment, the control apparatus 2 also includes a physical activity sensor 6. The physical activity sensor 6 in this embodiment is an accelerometer which can monitor any motion of the user. It will be
20 described in more detail later. The transmitter 7 is provided to transmit physical activity data on the user's physical activity to a receiver 8 which inputs the physical activity data into the physical activity monitor module 3.

25 The control apparatus 2 in this embodiment comprises appropriate software configured to run on appropriate hardware. The game 1 also comprises appropriate software running on appropriate hardware.

Figure 2 is a schematic diagram of example hardware
30 which may be utilized for implementation of the control apparatus and gaming apparatus of the present invention.

The illustrated computing system 11 may be in the form of a specifically arranged gaming console (such as a

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Wii[®] console, or other brand console) or may be a general purpose computer, such as a PC or laptop.

Whether console or general purpose computer, the illustrated computing system comprises a computer 11 which includes a processor 12 and memory 13. The processor 12 is arranged to process programmed instructions and data in a known manner. In this embodiment, the software for implementation of the physical activity monitor 3, commodity converter 5 and game 1 are stored in the memory 13. Memory 13 is arranged to store programmed instructions and data also in a known manner. Processor 2 may constitute one or more processing means, such as integrated circuit processors. The memory 3 may comprise any known memory architecture and may include hard disk, IC memory (ROM, PROM, RAM, etc), floppy disks and other types of additional memory such as CD ROM, and any other type of memory.

A BUS 14 is provided for communication between the processor 12 and memory 13 and also communication with external components. In this case the external components include a user interface 15. The user interface 15 includes a visual display unit 16 for displaying information to a user. The VDU 16 may display information in graphical format or any other format depending upon the programmed instructions being processed by processor 12. In this embodiment, the VDU 16 may be controlled to display game information, (graphical game displays, for example).

The user interface 15 also includes user input means 17 which in this example include a keyboard 18 (which in this example may be a standard QWERTY keyboard) and a mouse 19. The mouse 19 may be used to manipulate a graphical user interface (GUI) if a GUI is provided by

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software running on the computer. In this embodiment, a joystick 20 is also provided for manipulation of game pieces (eg a game "character"). Other interface components may be included, and the invention is not
5 limited to the interface components shown in Figure 2. It will be appreciated that any convenient interface component may be added, eg a steering wheel (good for car race games, for example), a Wii[®] type control, or any other interface device.

10 The physical activity sensor and transmitter 6, 7 and receiver 8 input the physical activity data onto the bus 14 of the computer 11.

A network connection 21 is also provided for connecting to a network which may include a communication
15 network and other computers/computing systems.

The computing system of Figure 2 may be implemented by any known type of computing hardware such as, for example, a game console, a PC, by a number of networked PCs if required to implement a system of this embodiment,
20 by a "mainframe architecture" including a remote computer and user workstations connected to the remote computer, by a client-server architecture, including a client computer accessing a server computer over a network, or by any other computing architecture. This embodiment of the
25 present invention is implemented by appropriate software providing instructions for operation of the computing system hardware to implement the system of the embodiment and implement the method of the embodiment.

The computing system need not be connected to a
30 network if this is not required by the software or computer architecture.

In computer games the core part of the gaming process consists of the user's interactions with the virtual game

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environment. These interactions are typically indirect and occur by means of a game character: the user U controls the game character C , which actually interacts with the game environment G . For example, consider the well known Pac-Man™ game. In this game, U controls the Pac-Man™ character C to follow the rules and achieve the goal of G : navigate through the maze, avoid ghosts, and collect coloured dots and bonus items.

Since no direct interaction occurs between U and G , C virtually represents U in the context of G . More formally, C is modeled by a set of quantifiable features reflecting the state of the character within the game and their respective values. We denote this by $C=\{f_i:v_i\}$. For example, consider the Pac-Man™ character model

{dots-collected:6, remaining-time:40, maximal-speed:14}.

In most games v_i can be modified in three ways (1) directly by G , eg, reduction of the remaining time, (2) by U directly controlling C , eg speed and direction of the motion, and (3) by U controlling the interactions of C with G , eg collection of the dots. These modifications typically occur concurrently, such that U has to process multiple input data originated by G and by the interactions of C and G , and control C accordingly.

To maintain a sustained engagement of U , G is divided into several tasks of gradually increasing difficulty, which U has to accomplish. Formally, accomplishing a task means reaching the required values v_i of certain features f_i while satisfying the constraints of other features, eg to have the Pac-Man™ character collect 50 dots within 3 minutes. The ability to accomplish the task is one of the main criteria for the enjoyment of playing, and engagement of U with G .

In embodiments of the present invention, the game is

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controlled to leverage the existing engagement of U with G to seamlessly motivate U to perform physical activity. In an embodiment this motivation may be achieved by modifying the following components of G and aspects of interaction

5 between U and G :

1. Game difficulty. G becomes more difficult, such that the tasks of U are harder, ie v_i , needed to accomplish the tasks are harder to reach.
2. Physical activity effect. In addition to directly
10 controlling C and the interactions of C with G , U can directly affect the v_i of certain f_i of C .
3. Physical activity interface. To affect the v_i of certain f_i U is provided with an external interface (physical activity sensor 1) capturing the physical
15 activity of U and transferring these data to C .
4. Game control. Since performing physical activity and controlling C concurrently may be over-complicated, in embodiments U is given more control over the flow of G .

20 These modifications are intended to motivate the user to perform some physical activity as follows. The game becomes more difficult and does not allow the user to accomplish the tasks easily. The difficulty is introduced gradually to keep the tasks challenging while
25 accomplishable. The user is made aware of the fact that the features of the game character can be controlled and reinforced if the user performs a certain amount of physical activity. The combination of the difficulty of the tasks, engagement with the game, and enjoyment of
30 accomplishing the tasks necessitates the user to reinforce the game character. As a result, the user is seamlessly motivated to interrupt the sedentary playing and perform physical activity. When performed, this activity is

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'captured by the physical activity monitor and transferred to the game. The received data regarding the amount, duration, and intensity of the physical activity are processed and reinforce the game character. Since the user is provided with immediate feedback and the character reinforcement is instantaneously visualized by the game interface, the user remains in control of the amount of the physical activity. Hence, at any point of time, the user can resume the sedentary playing having had the game character reinforced.

Applied to the Pac-ManTM game, the game becomes more difficult by decreasing the maximal speed of the Pac-ManTM character. To be able to accomplish the tasks, the user can reinforce the Pac-ManTM, ie, increase its maximal speed by performing some physical activity. The user is equipped with a pedometer that counts the user's steps and transfers their number to the game. This number is received by the game and the maximal speed of the Pac-ManTM increases accordingly, ie, the speed depends on the number counted by the pedometer. It may be difficult to control the Pac-ManTM while jumping, stepping, or walking around. To combine the two, the user can slow down or eventually interrupt the flow of the game at any point of time.

In this embodiment, a physical activity value of the user (the number of user's steps) is converted into a game commodity (maximum speed of the Pac-ManTM).

In this embodiment, the physical activity is not necessary to play the game. The game can be played as normal, in the usual sedentary fashion. The physical activity motivator is an adjunct to the game. There is motivation for the user to undertake physical activity, if he wishes to facilitate play of the game.

Further, current games, such as Pac-ManTM are easily

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adaptable in accordance with the present invention.

Appropriate adjustment of the game difficulty and calibration of the physical activity interface is minor in comparison with the effort of designing and developing a new game. Any existing game that has a commodity that can be varied can be adapted to implement embodiments of the present invention. Further, new games may be designed which utilize a control apparatus and method in accordance with the present invention.

10 The components of the control apparatus of Figure 1 will now be described in more detail.

Activity Sensor

The purpose of the activity sensor 6 (in this embodiment being a hardware component) is to capture the user's activity and transmit it to the other components, 1,2 run by the computer 10 executing the game. It consists of three main components:

- i. Sensor 6. Miniature sensing device physically attached to the user, which detects the user's motion and converts it to a raw data signal. Can be implemented using a variety of state-of-the-art physical (accelerometer - measures the acceleration, pedometer - counts steps, or gyrometer - measures the inclination) or physiological (heart rate monitor, ECG reader, or respiration rate monitor) technologies. To increase the accuracy and reliability, activity sensor can combine several types of sensing devices and technologies.
- 30 ii. Transmitter 7. Transmits the activity data captured by the monitor to the receiver.
- iii. Receiver 8. Receives the activity data captured by the monitor from the transmitter..

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The dimensions of the monitor and the transmitter are such that it is wearable and lightweight, and at the same time does not interfere with the user's normal motion. The transmission of the data between the transmitter and receiver can be done using any of the existing communication technologies. Wireless transmission of the data is preferable, as the user will not be connected to the computer and will not be limited physically in his motion.

10 In this embodiment, the sensor is implemented using accelerometer based sensing technology. The user 4 is equipped with a 3D accelerometer. The sensor 6 is clipped on an elastic belt (not shown), which is attached to the user's waist. The sensor includes a built in transmitter 7
15 that sends the wireless signal to the receiver 8 connected to the USB port of the connector 10 hosting the other components (many wireless technologies, such as WiFi or RFID tags can be used). The sensor 6 continuously captures the user's acceleration signals over the 3 physical
20 dimensions and transmits 500 updates in a second. Because of the high frequency of the acceleration signals, the activity recognition monitor 3 can easily reconstruct an accurate 3D acceleration of the user as a function of time.

25 In this embodiment, there is no particular exercise device which is required to be operated by the user. A physical interface is not required to operate the game. Instead, the physical sensor can capture generic physical activity of the user. The user can run, jump, and make
30 any movement, and is not restricted by any particular exercise device.

Activity recognition monitor

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The purpose of the activity recognition monitor 3 (in this embodiment being a software module) is to process the activity data received from the activity sensor 6 and convert them into a meaningful representation of the user's activity. The implementation of this module 3 depends on the technology used by the activity sensor 6 and the type of activity that is recognized. For example, if the activity sensor 6 is based on the physical technology and real activity is recognized, activity recognition module 3 will process the physical signals and estimate the real physical activity, i.e., the number of steps or jumps performed by the user. However, if the activity sensor 6 is based on the physiological technology and the activity is approximated by the energy omitted by the user, activity recognition module 3 will process the amount of energy emitted by the user and estimate the amount of the performed physical activity.

In this embodiment, the activity sensor 6 is implemented using accelerometer based technology, the activity recognition module 3 processes the 3D acceleration signal and converts it into user's physical activity. The activity considered in this embodiment refers to the number of jumps. For this, the raw acceleration signal is processed as follows:

- i. Combined magnitude of the 3D signal is estimated. The magnitudes of the individual signals over the 3 physical dimensions are summed to provide a approximate overall acceleration.
- ii. Noises and false activity bursts are filtered out. The raw acceleration signal can be noisy, as certain sharp movements can lead to false positive recognitions. At this stage abnormal and false activity burst are identified and filtered out.

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'iii.' Time based normalization is performed. Instances of certain physical activities require a minimal delay between any two instances. This delay is used for time normalization to avoid numerous recognition of the same activity.

Note that many state of the art signal processing mechanisms can be applied to the activity recognition module.

10 Commodity Converter

The purpose of the commodity converter (in this embodiment being implemented in software as game reward module 5) is to convert the real physical activity recognized by the activity recognition module 3 into virtual rewards in the game. The implementation of this module depends on the game in hand and the features that the reward can refer to. The only requirement for the game is that the user is represented by quantifiable features (e.g., points, energy, or position) that will be improved by performing physical activity.

An example of application of a control apparatus and method in accordance with the embodiment of Figures 1 and 2, to a computer game will now be given with reference to Figures 3 and 4.

25 In this embodiment, the control apparatus and method is applied to the game Neverball™.

Neverball™ (<http://icculus.org/neverball/>) is an open source GNU General Public Licence game developed in C programming language. In Neverball, the user navigates a ball through a maze surface to avoid obstacles and collect coins. Control over the ball is achieved by inclining the surface. The game requires the user to navigate the ball to the target point of the maze and collect the required

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number of coins, while accomplishing these in a limited amount of time. See Figure 3(b) which shows a screen 30 of Neverball™ interface. It can be seen that the screen 30 also displays value of game commodities such as number of coins (31), time available (32) and number of balls left (33).

The Neverball™ game consists of multiple levels with gradually increasing degree of difficulty in terms of the maze structure, the obstacles, the number of coins to collect and the time allocated. In this embodiment, to implement control of the Neverball™ game in accordance with the present invention, the normal sedentary version of the game was modified as follows:

- i. The amount of time allocated to complete the game levels is shortened and this time decreases when the user controls the ball in the maze. The remaining time is visualized, such that the user can decide when to interrupt the sedentary playing and perform physical activity (reference numeral 32, Figure 3(b)).
- ii. When the remaining time is perceived to be insufficient, the user pauses the game, interrupts the sedentary playing, and performs physical activity, such as jumping, stepping, or other mild indoor lower body exercising.
- iii. The user's activity is captured by the activity sensor 6,7, instantaneously transmitted to and processed by the activity recognition module 3, and then passed to the game reward module 5.
- iv. The game reward module 5 converts the captured physical activity into virtual game reward. In this case, physical activity increases the remaining time that the user can use to complete the levels.

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v. When the remaining time is perceived to be sufficient, the user unpauses the game and resumes the sedentary playing.

The flowchart of Figure 4 shows some of the steps in a method of this embodiment. At step 100, the Neverball game is played in its standard mode.

When the user considers that more time is necessary, he interrupts gameplay (step 101). The user then performs physical activity which is monitored by the sensor 6 and physical activity monitor 3 (step 102). At step 103, the physical activity valued determined at 102 is converted into a game commodity, in this example being the amount of time that the user has left to play this phase of the game. Gameplay is then returned to.

It should be noted that the paradigm of "active games" (the idea of the present invention of using physical activity as an adjunct to a computer game, to trade physical activity for game commodities) can be applied in a similar manner to a wide variety of computer games, as long as the user (precisely, his game character) is represented in the game by some quantifiable features, which can be updated as a result of performing physical activity. For example, in car racing games the user can increase the maximal speed of the car by performing physical activity; in shooter games he can get extra ammunition; and in strategy games he can get new features or enhance the existing features of the game character. The paradigm of active games is applicable also to role-playing and multi-player games, where group activity will provide group rewards to the users.

In fact, the paradigm of active games is applicable to any computer game that has a commodity that can be exchanged for a determined physical activity value.

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In embodiments of the present invention, the commodity converter may be arranged to carry out the conversion based on user parameters.

For example, where the game has a number of commodities, the user may be able to select which commodity they want the physical activity value converted into. The user interfaces with the commodity converter and specifies the appropriate commodity (by way of the user interface 17). In embodiments, the user may specify the value to be converted into more than one commodity, or shared between commodities.

In the Neverball implementation, for example, the user may be able to specify the preference that the commodity is time or that the commodity is the number of balls available ("lives").

In embodiments, the user may be able to select their preference for the magnitude of the conversion. For example, where the commodity is time, as in the Neverball implementation, the user may be able to specify how much physical activity is converted into how much time. In the embodiment described in relation to Figure 3, the physical activity equivalent to one jump of the user is converted into one second of time. Where there is a user selection option, the user may be able to change the value of this conversion e.g. one jump equals two seconds. The implementation of user preferences has the potential to increase the enjoyment of the game and tailor it to the user's physical capabilities.

In an embodiment, the user parameter may be the physical performance of the user. For example, the user's physical performance may be determined over a period of time and the conversion adjusted accordingly. For example, if the user is fit, the conversion may be made

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more difficult (ie the user gets less commodity per amount of physical activity). As the user exercise, it is likely that they will be capable of carrying out more physical activity as they get better at exercise. The commodity converter may monitor the amount of physical activity a user is doing over a period of time (days, weeks) and adjust the commodity conversion accordingly. For example, it may decrease the value of the conversion. In Neverball, where the commodity is time, as the user gets fitter the amount of time that is received for a unit value of physical activity may get shorter, so that the user has to undertake more physical activity. Users are indirectly required to perform more physical activity, to facilitate improvements in fitness and enjoyment of the game.

In an embodiment, the user parameter may be time and more activity may be required to get the same amount of commodity as the user continues to play the game (to motivate them to increase their physical performance, for example). The amount of physical activity required may gradually increase over time, so that new players (ie players just starting to play games requiring physical activity) will be required to perform less activity than experienced players in order to get a commodity reward.

In an embodiment, user physical activity may be monitored for a certain period of time and then the conversion ratio to commodity adjusted. Gaming practices may be monitored and appropriate conversions provided. For example in role playing games, stamina may be increased for a fight and magic skills for a magician, or in shooters games functionalities may be added to the favourite weapon.

In embodiments, the user parameter may be a user

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demographic. For example it may be age, gender, or any other demographic.

The commodity conversion can dynamically change as a function of information available about the user (e.g. age, fitness level and personal preferences) and his past interaction with the game (e.g. role in the game, preferred game tactics and previous captured activity). For example, the user may be able to configure his physical level and the expected amount of physical activity, to keep the flow of the game and not to spoil the enjoyment of playing.

In the above example implementation of Neverball, the user interrupts game play in order to carry out physical activity. The invention is not limited to this. In other embodiments, the user may carry out physical activity to be converted to game commodities, during play of the game.

In an embodiment, a user may be able to accumulate physical activity "points" for example. The activity recognition module's memory may store activity points gained by the user from physical activity over a period of time. The user may be enabled to control the system to exchange these points for a game commodity, when they wish to.

In a further embodiment, physical activity points may be accumulated when the player is not playing the game, during any time of the day, for example. In these embodiments, a memory may be associated with the physical activity sensor 6, to store physical activity data for subsequent downloading. When downloaded, the activity recognition module 3 determines the physical activity value that has been accumulated and this may be converted by the game reward module 5 into one or more game commodities.

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Conversion of a physical activity value into a game commodity may occur automatically, or in some embodiments, it may be under control of the player (via the interface 17 of Figure 2).

5 In embodiments, where physical activity points can be accumulated, they may be used to convert to game commodities of different games that have been adapted for use with embodiments of the present invention. For example, there may be an entire suite of games that is
10 arranged to interface with a control apparatus in accordance with the present invention. The user may undertake physical activity over a period of time, download their physical activity data at any time to play any one of the suite of games.

15 In the above Neverball implementation of the embodiment, the difficulty of the game is increased to motivate the user to use physical activity to gain game commodities. The invention is not limited to this. The difficulty of the usual (sedentary) computer game may
20 remain unchanged. The user may still be motivated to use physical activity to get game commodities, particularly as the levels of difficulty of the game increase.

Embodiments of this invention may be particularly useful in combatting obesity, which is encouraged by
25 sedentary occupations such as computer games. Embodiments may also increase entertainment value, encourage rehabilitation from injury, or other applications and advantages.

It will be appreciated that the term "computer games"
30 encompasses any game played on a computing device. A computing device may be a PC, laptop, networked computing device, mobile computing device (such as a PDA, mobile telephone or other mobile device), or any other computing

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'device'.

In the above embodiment, the physical activity monitor is generic and does not require an exercise device, merely a sensor to sense the physical activity of the user. The invention is not limited to this, however, and in some embodiments, an exercise device may be utilized as the sensor eg an exercise bicycle, running machine, or any other exercise device.

Where methods and apparatus of the present invention may implemented by software applications, or partly implemented by software, then they may take the form of program code stored or available from computer readable media, such as CD-ROMS, floppy disks, hard disks, or any other machine-readable media. The program code comprises instructions, which, when loaded on a machine such as a computer, the machine then becomes an apparatus for carrying-out the invention. The computer readable medium may include transmission media, such as cabling, fibre optics or any other form of transmission media. The program code could be provided as a data signal (for example by downloading from a server).

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

Variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are,

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'therefore, to be considered in all respects as illustrated
and not restrictive.

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CLAIMS:

1. A method of controlling a computer game, the game having a game commodity which is required to play the game, the method comprising the steps of determining a physical activity value for a user of the game and
5 converting the physical activity value into a value of the game commodity.
2. A method in accordance with Claim 1, wherein the
10 step of determining the physical activity value comprises the step of monitoring physical activity carried out by the user.
3. A method in accordance with Claim 2, wherein the
15 step of determining the physical activity comprises the step of the user undertaking physical activity when play of the game is interrupted.
4. A method in accordance with Claim 2 or Claim 3,
20 wherein the monitored user physical activity is any generic physical activity.
5. A method in accordance with any one of the preceding claims, wherein the step of converting the physical
25 activity value is carried out as an adjunct to the game and is not necessary for normal play of the game.
6. A method in accordance with any one of the preceding claims, wherein the computer game is an existing game
30 which has been adapted so that a game commodity value can be converted from a physical activity value.
7. A method in accordance with any one of the preceding

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claims, wherein the game has a plurality of commodities, and the physical activity value may be converted into a value for one or more of the game commodities.

5 8. A method in accordance with any one of the preceding claims, comprising the further step of implementing the physical activity value conversion in dependence on a user parameter.

10 9. A method in accordance with Claim 8, wherein the user parameter is a user preference for the conversion of a physical activity value into one or more of a plurality of commodities.

15 10. A method in accordance with Claim 8 or Claim 9, wherein the user parameter comprises a user preference for a particular magnitude of conversion of the physical activity to the game commodity value.

20 11. A method in accordance with Claim 8, 9 or 10, wherein the user parameter is physical performance of the user.

25 12. A method in accordance with Claim 11, comprising the step of monitoring the physical performance of the user over time and determining the magnitude of conversion of the physical activity to the game commodity value based on the user's physical performance over time.

30 13. A method in accordance with any one of Claims 8 to 12, wherein the user parameter is a user demographic.

14. A method in accordance with any one of the preceding claims, comprising the further step of varying the

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'difficulty of the game in dependence on the physical activity value.

15 15. A method in accordance with any one of the preceding claims, comprising the further step of accumulating the physical activity value, and utilizing the physical activity value for conversion to a value of a game commodity at a later time.

10 16. A control apparatus for controlling a computer game, the computer game having a game commodity which is required to play the game, the control apparatus comprising a physical activity monitor arranged to determine a physical activity value for a user of the
15 game, and a commodity converter for converting the physical activity value into a value of the game commodity.

20 17. A control apparatus in accordance with Claim 16, wherein the physical activity monitor is arranged to monitor physical activity of the user and determine the physical activity value based on the physical activity of the user.

25 18. A control apparatus in accordance with Claim 17, the physical activity monitor being arranged to monitor physical activity of the user when game play is interrupted.

30 19. A control apparatus in accordance with Claim 17 or Claim 18, wherein the physical activity monitor is arranged to monitor generic physical activity of the user.

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20. A control apparatus in accordance with any one of the Claims 16 to 19, wherein the commodity converter operates as an adjunct to play of the game, and is not necessary for normal play of the game.

5

21. A control apparatus in accordance with any one of the Claims 16 to 20, wherein the computer game is an existing game which has been adapted so that the commodity converter can convert the physical activity value into a value for the game commodity.

10

22. A control apparatus in accordance with any one of the Claims 16 to 21, wherein the computer game has a plurality of game commodities, and the commodity converter is arranged to convert the physical activity value to a value for one or more of the plurality of game commodities.

15

23. A control apparatus in accordance with any one of the Claims 16 to 22, wherein the commodity converter is arranged to implement the physical activity value conversion in accordance with a user parameter.

20

24. A control apparatus in accordance with Claim 23, wherein the user parameter is a user preference for the conversion of a physical activity value into one or more of a plurality of commodities.

25

25. A control apparatus in accordance with Claim 23 or Claim 24, wherein the user parameter comprises a user preference for a particular magnitude of conversion of the physical activity to the game commodity value.

30

26. A control apparatus in accordance with Claim 23, 24

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or 25, wherein the user parameter is physical performance of the user.

27. A control apparatus in accordance with Claim 26,
5 wherein the physical activity monitor is arranged to monitor the physical performance of the user over time and the commodity converter is arranged to determine the magnitude of conversion of the physical activity to the game commodity value based on the user's physical
10 performance over time.

28. A control apparatus in accordance with any one of Claims 23 to 27, wherein the user parameter is a user demographic.

15

29. A control apparatus in accordance with any one of Claims 16 to 28, further comprising an accumulator for storing a physical activity value for conversion into a game commodity at a later time.

20

30. A control apparatus in accordance with Claim 29, wherein the physical activity monitor is arranged to monitor physical activity over a period of time when the game is not being played, for use in playing the game at
25 other times.

31. A control apparatus in accordance with any one of the Claims 16 to 30, wherein the physical activity monitor comprises a physical activity sensor which is portable and
30 is arranged to be carried by the user.

32. A control apparatus in accordance with Claim 31, wherein the physical activity sensor is an accelerometer.

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33. A computer gaming apparatus comprising a computer game module arranged for play of a computer game, the computer game having a game commodity which is required to play the game, and a game control module, the game control module comprising the game control apparatus in accordance with any one of Claims 16 to 32.

34. A method of adapting a computer game to facilitate motivation of physical activity, the computer game having a game commodity which is required to play the game, the method comprising the step of adapting the computer game to implement a control method in accordance with any one of the Claims 1 to 15.

15

35. A method of designing a computer game, comprising the steps of determining one or more suitable game commodities, and providing an interface so that physical activity of the user can be converted into a value for one or more of the game commodities.

20

36. A method in accordance with Claim 34, comprising the step of adapting an existing computer game.

37. A method in accordance with Claim 34, comprising the step of designing a new computer game.

25

38. A computer program for controlling a computer to implement the control apparatus of any one of Claims 16 to 32.

30

39. A computer readable medium providing a program in accordance with Claim 38.

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40. A data signal comprising a computer program in accordance with Claim 38.

5 41. A computer program for controlling a computer to implement a gaming apparatus in accordance with Claim 33.

42. A computer readable medium providing a computer program in accordance with Claim 39.

10

43. A data signal, comprising a computer program in accordance with Claim 40.

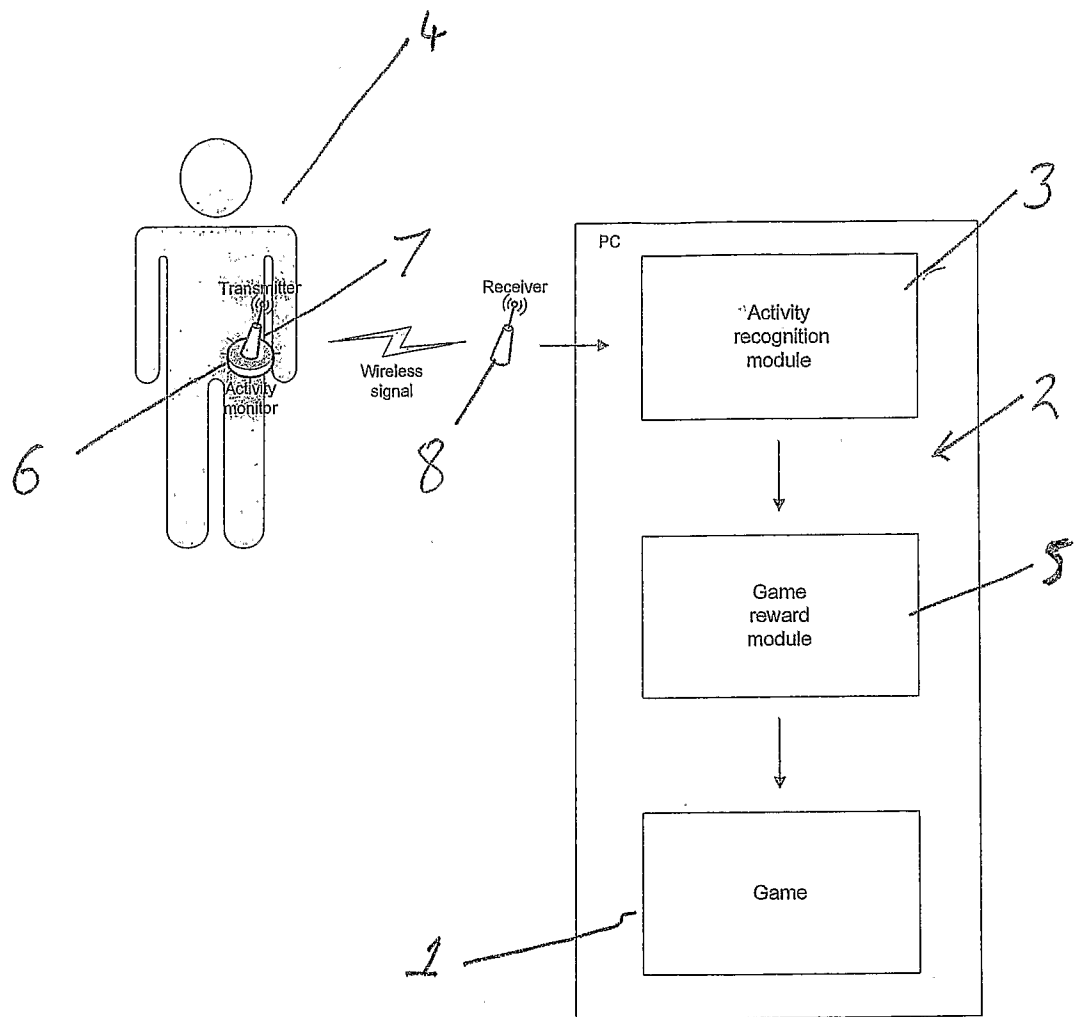


FIGURE 1

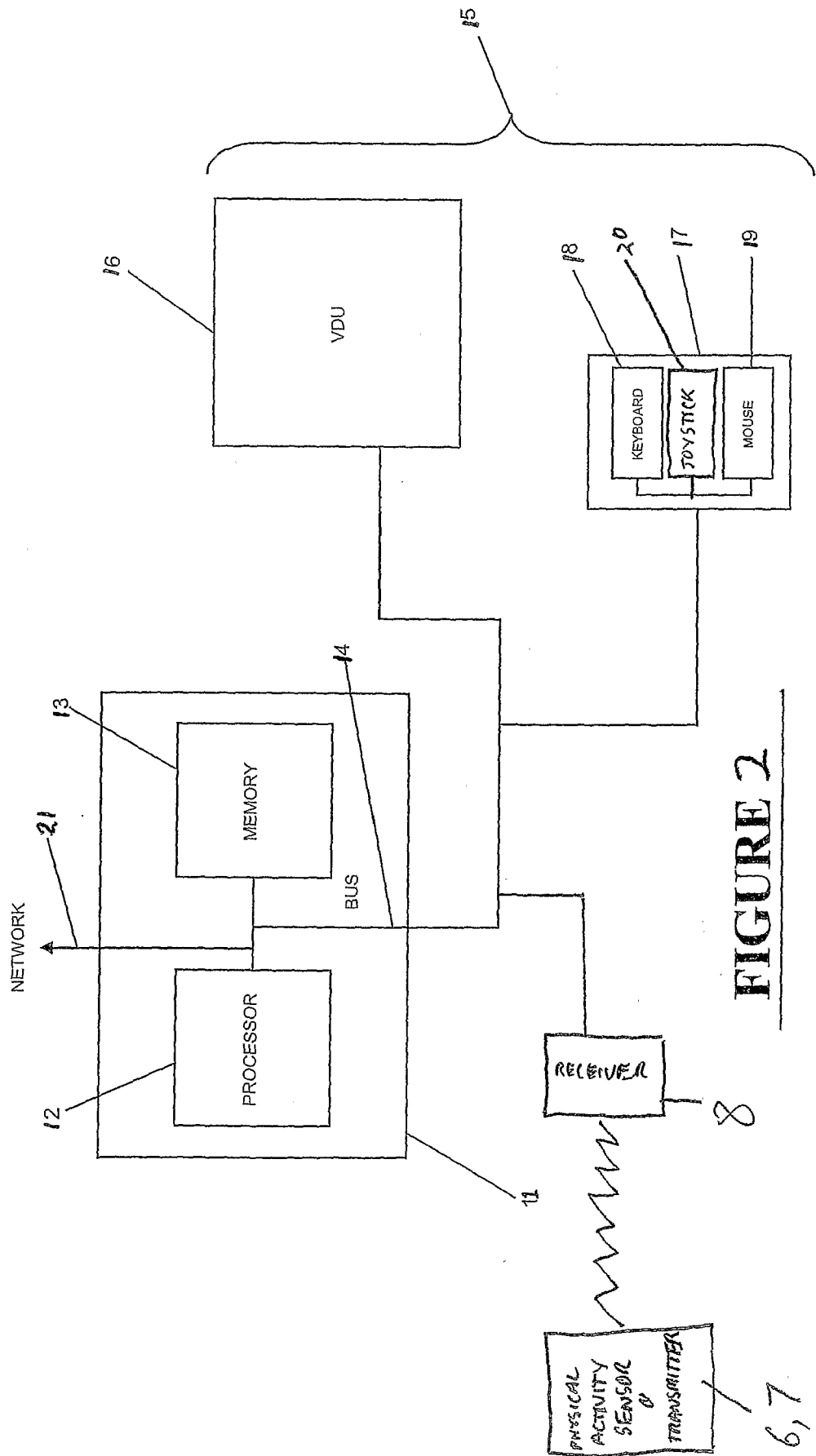


FIGURE 2

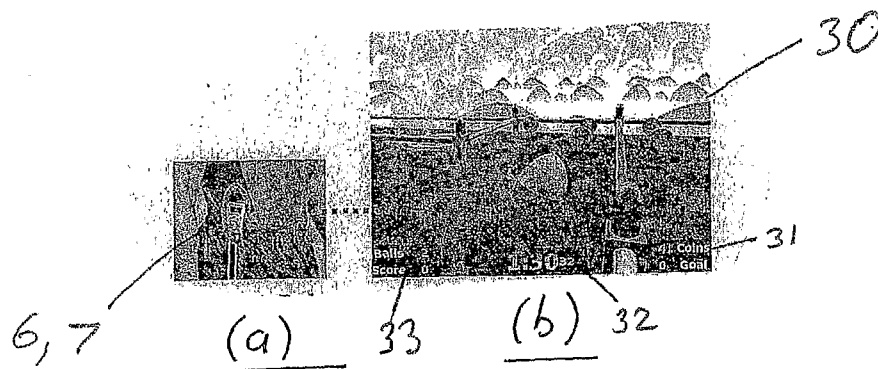


FIGURE 3

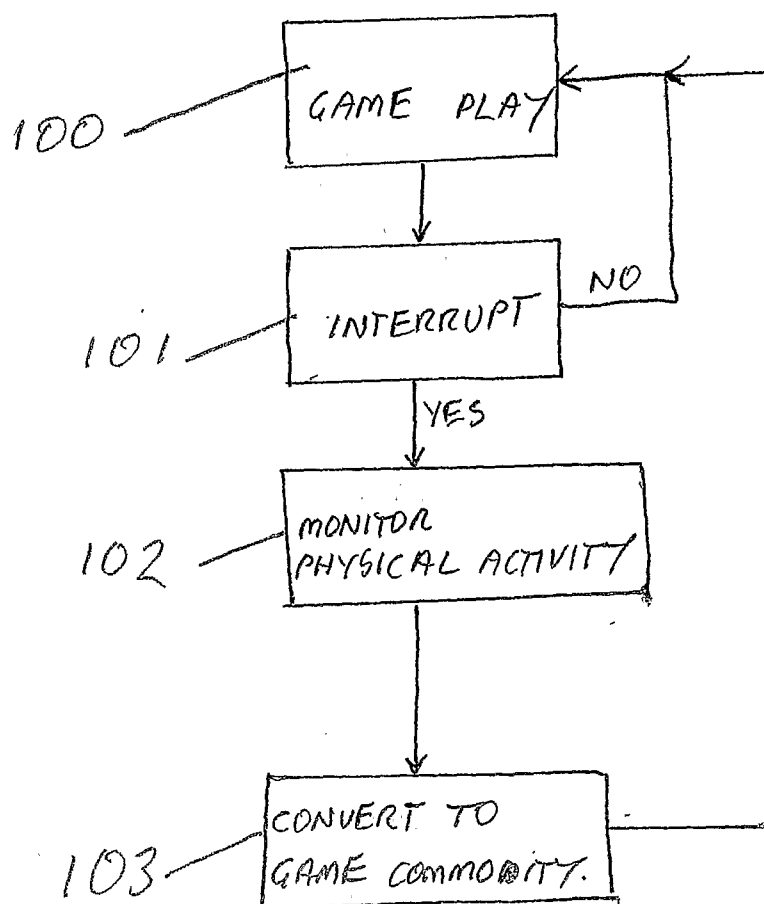


FIGURE 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2010/000045

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

A63F 13/00 (2006.01)

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)

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)

Internet, USPTO, EPODOC, WPI using keywords such as: physical, activity, exertion, exercise, game, video, computer, Internet, console, convert, trade, earn, reward, incentive, points, credits, resources

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BERKOVSKY et al., "Designing Games to Motivate Physical Activity", In Proceedings of Persuasive 2009, the 4th International Conference on Persuasive Technology, Claremont, California, USA, 26 – 29 April 2009 See whole document, in particular: Sections 1, 3, 4 and 5	1 – 7, 14 – 22, 29 – 43
X	US 2005/0227811 A1 (SHUM et al.) 13 October 2005 See whole document, in particular: Abstract; Paras 0005, 0026, 0054	1 – 5, 7, 15 – 20, 22, 29 – 43
X	US 5001632 A (HALL-TIPPING) 19 March 1991 See whole document, in particular: Abstract; Columns 4, Lines 36 – 54	1, 2, 4, 6 – 14, 16, 17, 19, 21 – 28, 31, 33 – 43



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

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"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

15 February 2010

Date of mailing of the international search report

15 FEB 2010

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaustalia.gov.au
Facsimile No. +61 2 6283 7999

Authorized officer

JONTY GOLDIN

AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)

Telephone No : +61 3 9935 9618

INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5989157 A (WALTON) 23 November 1999 See whole document	
A	EP 0890338 B1 (FEDERAL PATENT CORP.) 13 January 1999 See whole document.	
A	KAZAKOS et al., "NEAT-o-Games: Novel Mobile Gaming Versus Modern Sedentary Lifestyle", Mobile HCI, Amsterdam, the Netherlands, 2 – 5 September 2008 See whole document	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2010/000045

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
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		EP	1556148	EP	1744822	EP	1848520
		EP	2039403	JP	2008168155	US	6585622
		US	2004087366	US	2005037844	WO	2004041379
		WO	2005102483	WO	2006086487		
US	5001632	CA	2071993	EP	0506863	WO	9109374
US	5989157	NONE					
EP	0890338	CA	2208932	HK	1017246	JP	11047445
		US	5672107	US	5860860		
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.							
END OF ANNEX							