US 20100167820A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2010/0167820 A1**

(43) **Pub. Date: Jul. 1, 2010**

BARAKAT et al.

(54) **HUMAN INTERFACE DEVICE**

(76) Inventors: **HOUSSAM BARAKAT**, Toledo, OH (US); **Bradford R. Lilly**, Toledo, OH (US); **Krishna Shenai**, Toledo, OH (US)

Correspondence Address:
MACMILLAN SOBANSKI & TODD, LLC
ONE MARITIME PLAZA FIFTH FLOOR, 720 WATER STREET
TOLEDO, OH 43604-1619 (US)

(21) Appl. No.: **12/649,277**

(22) Filed: **Dec. 29, 2009**

Related U.S. Application Data

(60) Provisional application No. 61/141,052, filed on Dec. 29, 2008.

Publication Classification

(51) **Int. Cl.**
A63F 9/24 (2006.01)

(52) **U.S. Cl.** **463/37**; 463/40

(57) **ABSTRACT**

A human interface device with an inherent built-in feedback mechanism for use by a user to remotely interface with a computer-simulated environment is disclosed herein. The human interface device comprises at least one sensor configured to sense a condition within the action of the computer-simulated environment and also operable to generate a communication concerning the sensed condition. At least one micro-controller is positioned within the human interface device and configured to receive the communication concerning the sensed condition from the at least one sensor. The at least one micro-controller is further configured to generate communication in reaction to the communication from the sensor. At least one actuator is configured to receive the communication from the at least one micro-controller and provide a sensory experience in reaction to the communication.

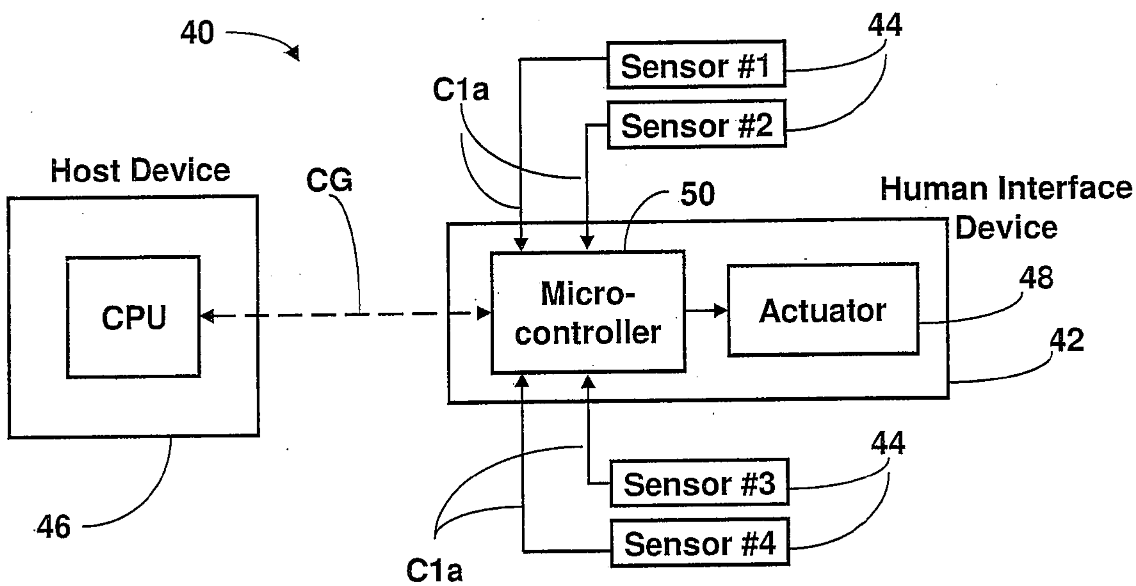
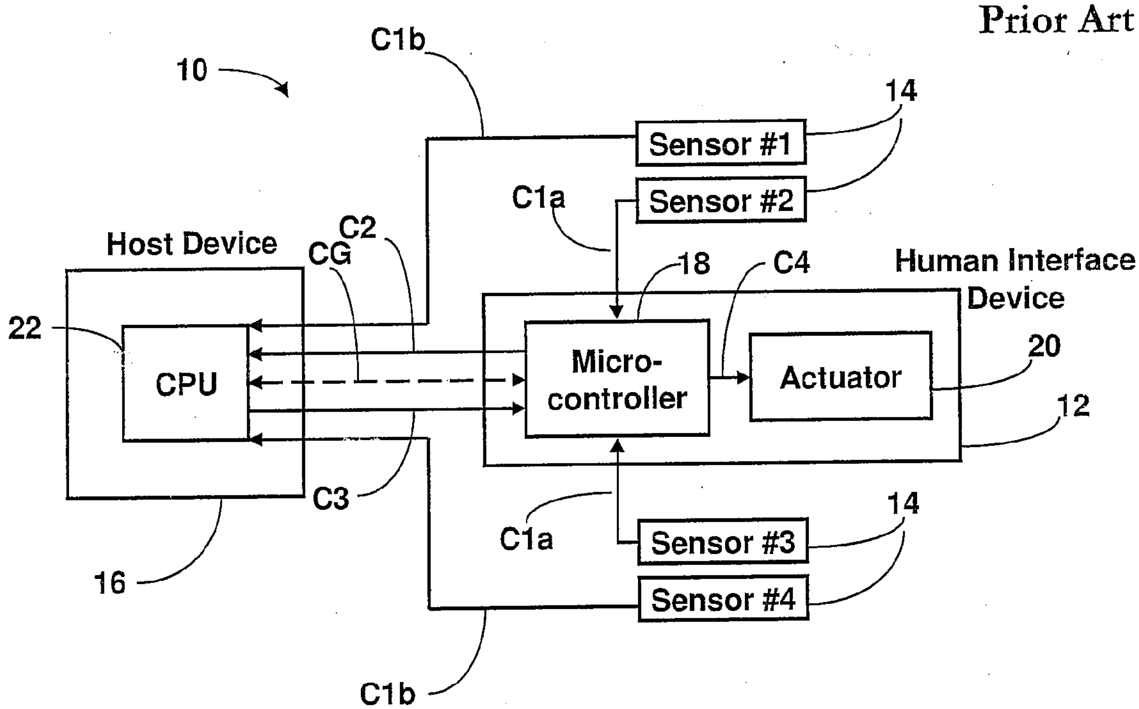


Fig. 1
Prior Art



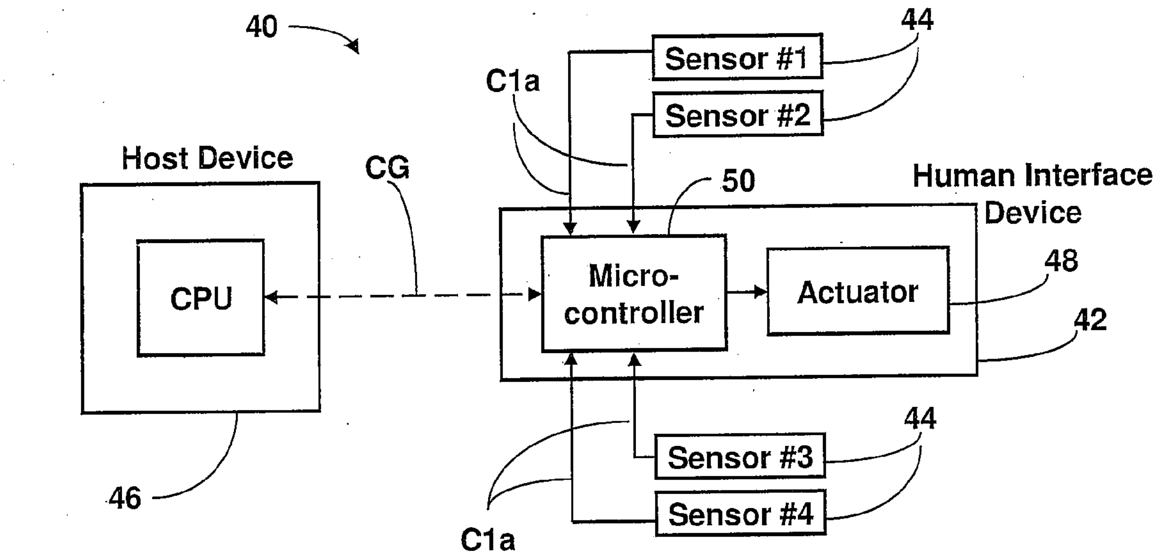


Fig. 2

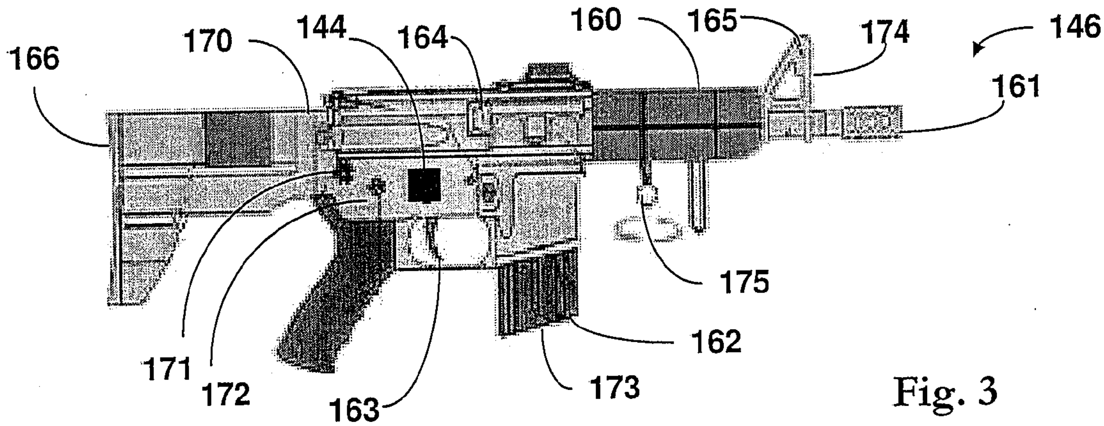


Fig. 3

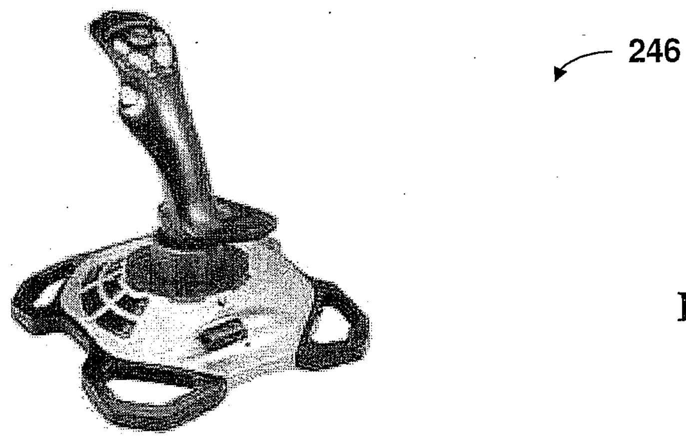


Fig. 4

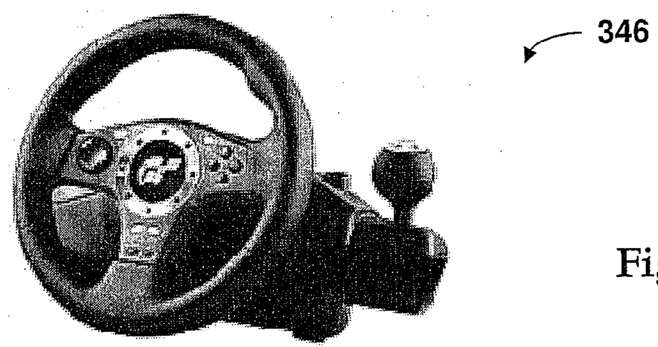


Fig. 5

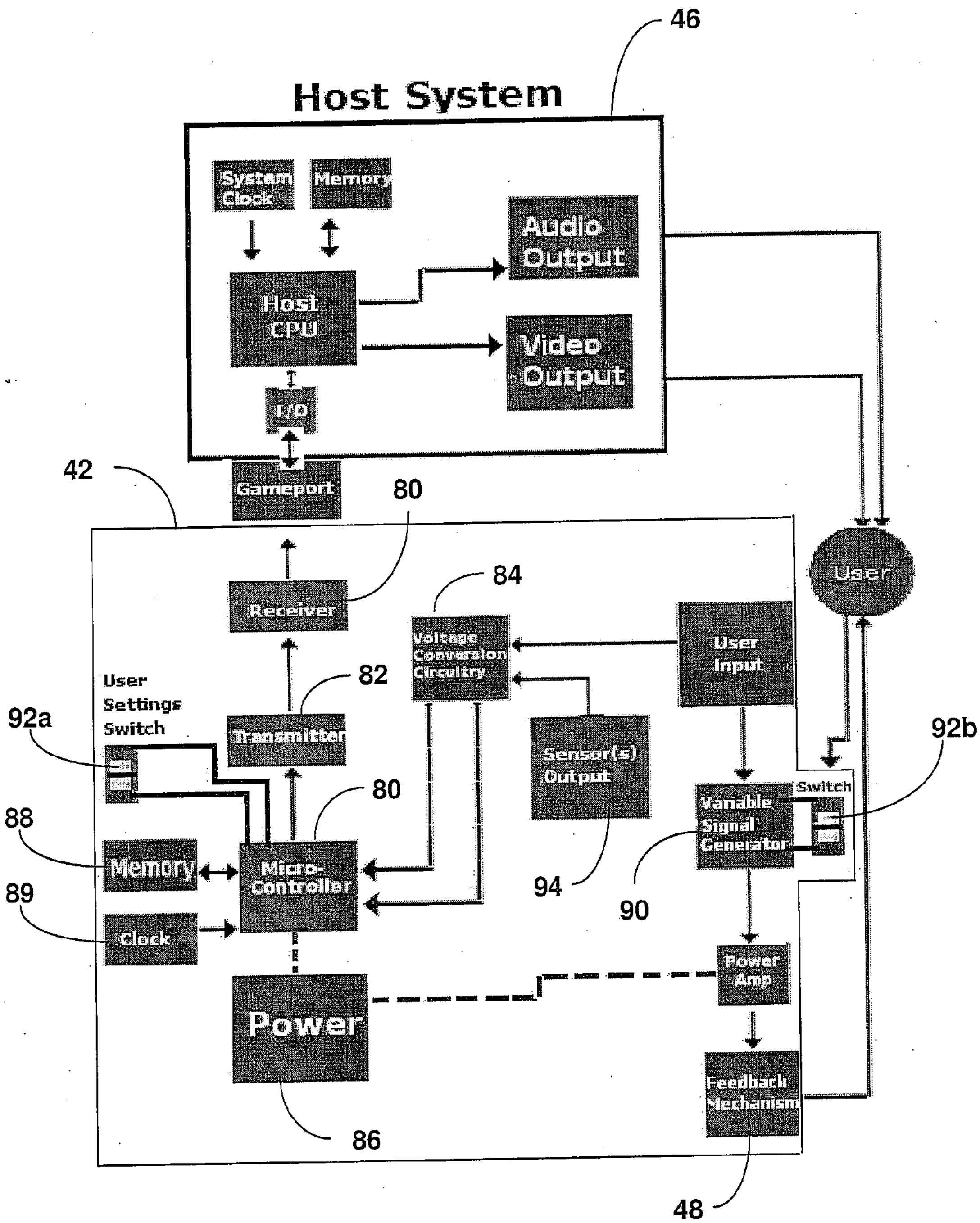

46
Host System
System Clock
Memory
Audio Output
Host CPU
Video Output
I/O
42
Gameport
80
Receiver
84
Voltage Conversion Circuitry
User Input
User
82
User Settings Switch
92a
Transmitter
Sensor(s) Output
92b
Switch
80
Variable Signal Generator
88
Memory
Micro-Controller
94
90
89
Clock
Power Amp
Power
Feedback Mechanism
86
48

Fig. 6

HUMAN INTERFACE DEVICE

BACKGROUND OF THE INVENTION

[0001] This invention relates in general to human interaction with computer-simulated environments. More specifically, this invention relates to multimodal devices having an inherent built-in feedback mechanism that can be used to remotely interface human interaction with computer-simulated environments, such as generated by computer-based gaming and virtual reality systems.

[0002] Gaming and virtual reality systems allow a user or a number of users to interact with a computer-simulated environment. A typical system includes a computer that establishes the computer-simulated environment. The computer-simulated environment can be "virtual reality" or based on a real environment such as, for example, simulations for pilot or combat training. The computer-simulated environment can also be for gaming or based on an imagined environment such as, for example, imaginary interplanetary worlds. Most computer-simulated environments are primarily visual experiences, displayed either on a computer screen or through special or stereoscopic displays, but some computer-simulated environments established by computers include additional sensory experiences, such as sound through speakers or headphones or vibration through user input devices such as controllers. Users can typically interact with such computer-simulated environments through the use of standard input devices such as a keyboard and a mouse, or through multimodal devices such as, for example, controllers, wired gloves, joysticks or steering wheels.

SUMMARY OF THE INVENTION

[0003] According to this invention, there is provided a human interface device with an inherent built-in feedback mechanism for use by a user to remotely interface with a computer-simulated environment. The human interface device comprises at least one sensor configured to sense a condition within the action of the computer-simulated environment and also operable to generate a communication concerning the sensed condition. At least one micro-controller is positioned within the human interface device and configured to receive the communication concerning the sensed condition from the at least one sensor. The at least one micro-controller is further configured to generate communication in reaction to the communication from the sensor. At least one actuator is configured to receive the communication from the at least one micro-controller and provide a sensory experience in reaction to the communication.

[0004] According to this invention, there is also provided a method of providing a sensory experience to a user using the human interface device described above. The method comprises the steps of sensing a condition within the action of the gaming or virtual reality system established by the computer, generating a communication concerning the sensed condition, sending the communication to a human interface device for processing, generating a communication within the human interface device in reaction to the received communication, sending the human interface device communication to at least one actuator; and providing a sensory experience in reaction to the received human interface device communication.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. **1** is a schematic view of the major components of a conventional gaming system.

[0006] FIG. **2** is a schematic view of the major components of a first embodiment of the invention.

[0007] FIG. **3** is a side view, in elevation, of a first embodiment of the human interface device of FIG. **2**.

[0008] FIG. **4** is a side view, in perspective, of a second embodiment of a human interface device.

[0009] FIG. **5** is a side view, in perspective, of a third embodiment of a human interface device.

[0010] FIG. **6** is a schematic view of the components of the human interface device shown in FIG. **2**.

DETAILED DESCRIPTION OF THE INVENTION

[0011] For purposes of this patent application, the terms "gaming system" and "virtual reality system" will be used interchangeably and are defined to include any system, structure(s), or device(s) incorporating a technology which allows a user to interact with a computer-simulated environment.

[0012] Referring now to the drawings, there is illustrated in FIG. **1** a gaming system, indicated generally at **10**, that is conventional in the art. A gaming system is one example of system operable to establish a computer-simulated environment and the invention is not limited to gaming systems. The basic structure and mode of operation of the gaming system **10** are well known in the art, and only those portions of the gaming system **10** that are necessary for a complete understanding of the invention will be described. Some examples of commercially available gaming systems **10** include Wii™ marketed by Nintendo, Playstation® marketed by Sony Corporation, and Xbox® marketed by Microsoft Corporation.

[0013] As shown in FIG. **1**, a typical gaming system **10** includes at least one human interface device (HID) **12**, a plurality of sensors **14**, at least one host device or system or device **16**, and a display (not shown).

[0014] The HID **12** is an input device used to affect the gaming system **10** or govern the movement or actions of an entity within the computer-simulated game/environment. While the HID **12** is typically connected via wires to the host system **16**, the HID **12** can also be operated in a wireless mode. As will be explained in more detail below, the HID **12** can comprise many different physical forms.

[0015] As shown in FIG. **1**, the HID **12** typically includes, among other things, a micro-controller **18** and at least one actuator **20**. As will be explained in more detail below, the micro-controller **18** is configured for processing of information and communication of information to a variety of other devices. The actuator **20** is configured to induce a sensory-based reaction by the user of the HID **12**. Examples of actuators **20** include vibration inducing or motion causing motors, heat causing elements, sound causing elements and motion causing solenoids. As shown in FIG. **1**, the actuator **20** is electrically connected to the micro-controller **18** and configured to respond to signals from the micro-controller **18**.

[0016] The sensors **14** are configured to provide input of the status of game play or game conditions. The sensors **14** can sense a condition within the action of the gaming system in that the sensors **14** can sense some physical condition associated with the user, such as activity of the user, the physical condition of the user, or the physical environment in which the user is participating in the computer-simulated environment. For example, one example of a sensor **12** is an accelerometer, which can measure the magnitude, direction and force of movement of the user. Other types of sensors **14** can be used to provide input regarding user-initiated actions, such as pulling a trigger and movement of a virtual character. Still other sensors **14** can be used to provide input regarding other conditions, such as for example the heart rate of the user, the temperature and humidity of the gaming environment, and the mental consciousness of the user. While the plurality of sensors **14** illustrated in FIG. **1** is shown as being positioned exterior to the HID **12**, it should be understood that the plurality of sensors **14** can be positioned in various locations, including internal to the HID **12**. While the embodiment shown in FIG. **1** illustrates a quantity of four sensors **14**, it should be understood than more or less than four sensors can be used.

[0017] The host system **16** typically includes, among other things, a host central processing unit (CPU) **22** and is configured to control the overall functions of the gaming system. Examples of overall system functions include loading of games software, start up, and shut down. The host CPU **22** typically processes input information from a variety of sources and controls the play of the gaming system.

[0018] In operation, the sensors **14** sense a condition potentially affecting the play of the gaming system **10** and generate a communication concerning the sensed condition. The sensors **14** can communicate with the micro-controller **18** positioned within the HID **12** or the host CPU **22**. The micro-controller **18** can be configured to receive the communications generated by the individual sensors **14**. The communication of the various sensors **14** with the micro-controller **18** is shown in FIG. **1** as communications C**1***a* and the communication of the various sensors **14** with the host CPU **22** is shown as communications C**1***b*. The micro-controller **18** processes the information and communicates the information from the sensors **14** to the host CPU **22** positioned within the host system **16** as shown by communication C**2**. The host CPU **22** processes the sensor information and determines an appropriate action and/or response. The action and/or response is communicated from the host CPU **22** to the micro-controller **18** positioned within the HID **12** by communication C**3**. The micro-controller **18** receives the communication C**3** and determines the appropriate actuator **20** response. The micro-controller **18** then communicates with the appropriate actuator **20** as shown by communication C**4**. The actuator **20** can be configured to receive the communication C**4** and provide a sensory experience in reaction to the communication. For example, the sensory experience can be a feeling of vibration or recoil. The communication C**4** instructs the actuator **20** to initiate and perform an action, such as generate vibrations for a specified period of time. This cycle is repeated as additional communications C**1***a* and C**1***b* are received from the sensors **14**.

[0019] As further shown in FIG. **1**, additional communication of a general nature, indicated as CG, occurs between the host CPU **22** and the micro-controller **18** positioned within the HID **12**. The communication CG can include typical game play instructions.

[0020] Referring now to FIG. **2**, there is illustrated an improved gaming system, indicated generally at **40**, in accordance with a first embodiment of the invention. In the illustrated embodiment as shown in FIG. **2**, the gaming system **40** includes at least one HID **42**, a plurality of sensors **44**, and at least one host device or system **46**.

[0021] As shown in FIG. **2**, the host system **46** can be substantially similar to the host system **16** illustrated in FIG. **1**. Similarly, the plurality of sensors **44** shown in FIG. **2** can be substantially similar to the plurality of sensors **14** illustrated in FIG. **1**.

[0022] The HID **42** shown in FIG. **2** includes, among other things, a micro-controller **50** and at least one actuator **48**. The actuator **48** shown in FIG. **2** can be substantially similar to the actuator **20** illustrated in FIG. **1**. The micro-controller **50** varies from the micro-controller **18** illustrated in FIG. **1** in that it performs the additional processing of the sensor information C**1***a* without communicating the sensor information C**1***a* with the host system **46**. Accordingly, the HID **42** may include different components and different electronic circuitry than the HID **12** illustrated in FIG. **1**.

[0023] Generally, the improved gaming system **40** varies from the traditional gaming system **10** shown in FIG. **1** in several ways. First, the HID **42** does not communicate with the host system **46** as to the processing of the sensor information C**1***a*. Rather, the HID **42** performs the steps of receiving the sensor information C**1***a*, internally processing the sensor information C**1***a*, determining the appropriate actuator response and communicating with the appropriate actuator without communicating the sensor information C**1***a* to the host system **46**. The micro-controller **50** is thus capable of independently determining the response of the actuator **48** that is appropriate or desirable to the condition that is sensed by any of the sensors **44**. Second, while the actuator **48** shown in FIG. **2** can be substantially similar to the actuator **20** shown in FIG. **1**, the actuator **48** is configured to respond solely to sensor information C**1***a* processed by the micro-controller **50**. Accordingly, the actuator **48** does not require communication from the host system **46** for operation.

[0024] Referring now to FIGS. **3**-**5**, the human interface devices **42** can have various physical embodiments. As shown in FIG. **3**, a first physical embodiment of one example of a HID **146** is illustrated. In this embodiment, the HID **146** is in the form of a firearm. The firearm HID **146** is configured to interact with the gaming system or virtual reality system such that the firearm HID **146** simulates the firing of a weapon. Accordingly, in an effort to make the gaming system as realistic as possible, the firearm HID **146** has all of the typical firearm components including a stock **160**, a muzzle **161**, a magazine **162**, a trigger **163**, a receiver **164**, a sight **165** and a butt end **166**. In the illustrated embodiment, the firearm HID **146** also includes a recoil mechanism **170**, a sensor switch **171**, a mode switch **172**, a power supply **173**, a transmitter/receiver **174**, and a motion control **175**. While not illustrated in FIG. **3**, the firearm HID **146** also includes the micro-controller **50** shown in FIG. **2** and associated circuitry.

[0025] As illustrated in FIG. **3** and with reference to FIG. **2**, the recoil mechanism **170** is the same device as the actuator **48** shown in FIG. **2**. The recoil mechanism **170** is configured to provide a realistic "backward kick" or force resulting from the act of firing the firearm HID **146**. In the illustrated embodiment, the recoil mechanism **170** is a solenoid. However, recoil mechanism can be other suitable actuator devices. In operation, as the trigger **163** is pulled, a sensor **144**, illustrated as positioned internal to the firearm HID **146**, senses the motion of the trigger **163** and sends information to the micro-controller **50** as shown in FIG. **2**. The micro-controller receives the sensor information, internally processes the sensor information and communicates with the recoil mechanism **170**, thereby producing the recoil motion. Accordingly, the recoil mechanism **170** produces an immediate, real time action in the firearm HID **146** in response to sensor input without the interaction with the host system **46**. While the actuator shown in FIG. **3** is a recoil mechanism **170**, the actuator can be other suitable devices, and non-limiting examples are provided below.

[0026] The sensor switch **171** is configured to enable or disable communication from the sensor **144** to the micro-controller **50**. In the illustrated embodiment, the sensor switch **171** is an on/off rocker switch which is conventional in the art. However, the sensor switch **171** can be other suitable devices, such as for example, a slide switch, capable of enabling or disabling the communication from the sensor **144** to the micro-controller **50**.

[0027] The mode switch **172** is configured to provide the firearm HID **146** with various modes of game play. The mode switch **172** includes settings for single shot, semi-automatic and full automatic firing rate. In operation, as each mode is selected, the sensor **144** and recoil mechanism **170** react accordingly. In other embodiments, the mode switch **172** can be configured to provide various modes of game play in accordance with the nature of the virtual reality scenario. For example, in a scenario in which the virtual reality game involves fishing, the HID **42** can be configured as a fishing pole and the mode switch **172** could be configured to provide the amount of bait used.

[0028] Referring again to FIGS. **2** and **3**, the power supply **173** is configured to provide sufficient power to the firearm HID **146** such that the firearm HID **146** is independent of the host system **46** for power. As shown in FIG. **3**, the power supply **173** is a rechargeable battery pack. However, the power supply **173** can be other suitable devices sufficient to provide power to the firearm HID **146**. In other embodiments, the power supply **173** can be connected to a conventional electrical outlet (not shown).

[0029] The transmitter/receiver **174** is configured to transmit and receive information to and from the host system **46**. The transmitted and received information can include general communications CG, as shown in FIG. **2**, as well as other necessary information. In the illustrated embodiment, the transmitter/receiver **174** operates on radio frequencies, although other methods of operation are possible.

[0030] The motion control **175** is an input device used to affect the gaming system **46** or govern the movement or actions of an entity within the computer-simulated game. As one example, the motion control **175** can be used to move an entity within the game forward, backward or sideways. In the illustrated embodiment, the motion control **175** is knob having 360° of available motion. However, the motion control **175** can be any mechanism or device suitable to govern the movement or actions of an entity within the computer-simulated game.

[0031] While not illustrated in FIG. **3**, it should be understood that the firearm HID **146** can project images onto the display of the gaming system. The images can include any suitable visual affect, such as for example a cross-hair and bullet tracers.

[0032] As shown in FIG. **4**, a second physical embodiment of a HID **246** is illustrated. In this embodiment, the HID **246** is in the form of a joystick. Non-limiting examples include a joystick **246** that can be used in gaming systems involving the control of helicopters or antique aircraft. The HID **246** illustrated in FIG. **4** includes the sensor, micro-controller, and feedback mechanism and these components operate in the same manner as described above.

[0033] As shown in FIG. **5**, a third physical embodiment of a HID **346** is illustrated. In this embodiment, the HID **346** is in the form of a steering wheel. Non-limiting examples where the steering wheel **346** can be used in gaming systems involving the control of race cars or boats. The HID **346** illustrated in FIG. **5** includes all of the components and operates in the same manner as described above.

[0034] While the illustrated embodiments of the human interface devices include a firearm, joystick, and steering wheel, it should be understood the human interface devices can represent any control mechanism, such as, for example, a fishing pole, a tennis racket, or a surf board suitable to affect the gaming system **10** or govern the movement or actions of an entity within the computer-simulated game.

[0035] One example of suitable internal components and the circuitry within the HID **42** are shown in FIG. **6**. In the illustrated embodiment, the HID **42** includes the micro-controller **50**, feedback mechanism (or actuator) **48**, a receiver **80**, a transmitter **82**, voltage conversion circuitry **84**, a power supply **86**, memory **88**, a time device **89**, a variable signal generator **90**, various user switches, **92***a* and **92***b*, and sensor output **94**.

[0036] The HID **42** is activated through a switch, such as for example user switch **92***a*. Activating the HID **42** enables the micro-controller **50**. The micro-controller **50** awaits a user event, a sensor event or sensor input. All sensor outputs **94** and inputs from user switches **92***a* and **92***b* interact directly with and only with the micro-controller **50**.

[0037] After receiving input, the micro-controller **50** communicates with the host system **46**. The communications from the micro-controller **50** to the host system **46** are transmitted via industry standard communication protocols and devices, such as for example the receiver **80** and the transmitter **82**. The HID **42** does not require custom protocols, additional or special hardware, or custom or special drivers in addition to the standard protocols, hardware and drivers currently residing on the host system **46**.

[0038] The micro-controller **50** can interpret certain sensor outputs **94** and certain inputs from user switches **92***a* and **92***b* as input that require user feedback through the feedback mechanism **48**. In those situations, the micro-controller **50** enables the power supply **86** to supply power to the feedback mechanism **48**. The micro-controller **50** further directs the feedback mechanism **48** to provide a level of feedback as limited according to the user setting **92***a*. As described above, the feedback mechanism **48** can apply the feedback to the user in any desired form. In one embodiment, the user input **92***a* can be channeled to the micro-controller **50**, causing the micro-controller **50** to enable the variable signal generator **90**. The signal generator **90** communicates a signal to a power amplifier which amplifies the signal so that the signal may vary the state of the feedback mechanism **48** accordingly. The user's settings **92***a* and **92***b* have an effect on the type of feedback the user receives. In one embodiment, the user can adjust the variable signal generator **90** through a user switch **92***b* to get a different form of signal wave and, accordingly, a different form of feedback. While the illustrated embodiment shown in FIG. **6** provides one example of suitable internal components and the circuitry within the HID **42**, it should be appreciated that the HID **42** could include different internal components and different circuitry that operate and function in a different manner.

[0039] The improved HID **42** provides many benefits over a traditional HID **12**. First, because the sensor information processing is performed within the HID **42** and communication with the host system **46** is not necessary for processing the sensor information, the HID **42** is compatible with any gaming or virtual reality system without software or hardware changes to the host system **46**. For example, a common HID can be used with different host systems through adaptors. Second, because the HID **42** is independent of the host system **46**, any number of HIDs **42** can be used simultaneously with the host system **46**. Third, the HID **42** is customizable to communicate with various types of sensors and provide various types of sensory feedback. Fourth, the HID can have a wide variety of physical embodiments. Other advantages are also apparent from a reading of the specification and claims and from a study of the Figures.

[0040] It is also noted that a sensor can communicate directly with the feedback mechanism, bypassing the micro-controller. For example, a photo-sensor could trigger the feedback mechanism when the photo-sensor is exposed to light. Alternatively, a pressure sensor button can cause feedback to occur upon being pushed. In such an arrangement, the sensor and feedback mechanism can be connected by circuitry.

[0041] The principle and mode of operation of this invention have been described in its preferred embodiments. However, it should be noted that this invention may be practiced otherwise than as specifically illustrated and described without departing from its scope.

What is claimed is:

1. A human interface device for use by a user to interact with a computer-simulated environment comprising:

at least one sensor configured to sense a condition within the computer-simulated environment and generate a first communication concerning the sensed condition;

at least one micro-controller configured to receive the first communication concerning the sensed condition from the at least one sensor, the at least one micro-controller further configured to generate a second communication in reaction to the first communication from the sensor; and

at least one actuator configured to receive the second communication from the at least one micro-controller and provide a sensory experience in reaction to the second communication, wherein the at least one micro-controller is operable to independently determine the response of the at least one actuator appropriate to the condition sensed by the at least one sensor.

2. The human interface device of claim **1** wherein the at least one actuator is configured to respond solely to sensor information processed by the at least one micro-controller.

3. A gaming system comprising:

a host device having a central processing unit configured to control overall functions of the gaming system; and

a human interface device for use by a user of the gaming system and comprising:

at least one sensor configured to sense a condition within the gaming system and generate a first communication concerning the sensed condition;

at least one micro-controller positioned within the human interface device and configured to receive the first communication concerning the sensed condition from the at least one sensor, the at least one micro-controller further configured to independently process the first communication and generate a second communication in reaction to the first communication from the sensor; and

at least one actuator configured to receive the second communication from the at least one micro-controller and provide a sensory experience in reaction to the second communication.

4. The gaming system of claim **3** wherein the at least one controller does not require communication from the host system for operation.

5. The gaming system of claim **3** wherein the at least one controller does not communicate with the host system as to the processing of the first communication.

6. A method of operating a human interface device to remotely interface with a computer, the method comprising the steps of:

sensing a condition within the action of a virtual reality system;

generating a first communication concerning the sensed condition;

sending the first communication to a human interface device for processing;

generating a second communication solely within the human interface device in reaction to the received communication;

sending the second communication to at least one actuator positioned with the human interface device; and

providing a sensory experience with the at least one actuator in reaction to the received human interface device communication.

* * * * *