unit **55** may additionally comprise a control unit **54** and/or a signal amplification device **56**, as will be discussed in more detail below. The haptic interface unit **55** may further comprise a protective housing or shell within which each of the above-mentioned components are mounted.

[**0055**] Haptic interface device **26** may be any device in operable contact with operator **22**. Operator **22** maneuvers haptic interface device **26** to control and respond to the interactive program processed by the computer system of controller **28**. A suitable haptic interface device **26** may comprise a steering wheel, a joystick, a steering yoke, a crank, a foot pedal, a knob, a mouse, a lever, a seat, a motor bike frame, a jet ski frame, a downhill ski frame, amusement part ride, and any other device in operable contact with operator **22**.

[**0056**] Sensor **32** is in communication with haptic interface device **26** for identifying a detected position within any of the plurality of positions within which the haptic interface device may be moved. Sensor **32** provides a variable input signal to controller **28** based on the detected position. Because haptic interface device **26** may be continually moving, sensor **32** must quickly provide controller **28** with an updated detected position of the haptic interface device **26** in order to allow the controller **28** to update its output signal to provide the operator with tactile sensations as computed by the interactive program. Ideally, sensor **32** provides control unit **54** with a continuous signal that varies in proportion to the movement of the detected position of the haptic interface device **26**.

[**0057**] Suitable sensors may comprise a potentiometer, such as Clarostat 10K ohm potentiometer, an optical encoder, such as a Clarostat Series 6000 optical rotary encoder, or any type of rheostat or variable resistor. For example, sensor **32** may be mounted on a shaft connected to a steering wheel to detect the rotation of the steering wheel. Also, more than one sensor **32** may be required to detect complex movements of haptic interface device **26**. For example, if haptic interface device **26** is a joystick, one sensor **32** may be connected to a component of the joystick to determine a movement in the x-direction, while another sensor **32** may be connected to another component of the joystick to determine a movement in the y-direction. In this example, the x-direction sensor and the y-direction sensor may each send a variable input signal to controller control unit **54**.

[**0058**] Control unit **54** receives the variable input signal from sensor **32** and provides a variable output signal to magnetically-controllable device **24**. As discussed above, there is a continual feedback loop between the control unit **54** of controller **28** and haptic interface device **26**, and hence between host computer **58**, magnetically-controllable device **24** and sensor **32**. The interactive program being processed by host computer **58** uses the variable input signal from sensor **32** as an input to the interactive program. Based upon this input, the host computer **58** further processes the control program to determine the variable output signal to send to magnetically-controllable device **24**. Returning to the previously presented example of operator **22** controlling a computer system, in such a computer system, the control or interactive program within host computer **58** processes an input signal from sensor **32**. From this, the host computer **58** determines a semi-active resistance force required from magnetically-controllable device **24** in order to coordinate what operator **22** is viewing on display **30** with what the operator is feeling through haptic interface device **26** in order to simulate tactile sensations. Host computer **58** sends a signal to display **30** to update the displayed image, and concurrently sends an output signal to magnetically-controllable device **24**. The output signal sent to magnetically-controllable device **24**, for example, may be an electric current having a value in proportion to a resistance force desired to be felt by operator **22**. Thus, in attempting to move haptic interface device **26**, operator **22** feels the change in resistance force applied by magnetically-controllable device **24** through the haptic interface device, thereby providing force feedback sensations.

[**0059**] While, in general, controller **28** receives a variable input signal from sensor **32** and generates a variable output signal to magnetically-controllable device **24**, a number of different components may be involved in the signal transactions. Controller **28** may comprise host computer **58**, and may further include control unit **54** and amplification device **56** to communicate with haptic interface device **26**. Host computer **58** typically includes an input/output **60** for sending/receiving electrical signals, a processor **62** and a memory **64** for respectively processing and storing electrical signals representative of an interactive program, for example. A suitable host computer **58** is, for example, a personal computer such as a IBM, Compaq, Gateway or other suitable computer capable of processing the appropriate information. Input/output **60** may comprise a plurality of serial and/or parallel communication ports, such as RS-232 type ports, and high-speed bi-directional communication channels like the Universal Serial Bus (USB). Processor **62** may comprise an Intel Pentium ® or other suitable microprocessor. Memory **64** may comprise Random Access Memory (RAM) and Read-Only Memory (ROM), as well as other well-known types of memory. As one skilled in the art will appreciate, depending upon the particular application, there is a broad range of personal computers, input/outputs, microprocessors and memories that may be utilized with the present invention.

[**0060**] For example, host computer **58** may send output signal **66** comprising an electric current proportional to a desired resistance force to be applied to haptic interface device **26**. Output signal **66** may be received by control unit **54** for additional processing. Control unit **54** may be a microcomputer having an input/output **68**, a processor **70**, such as a digital signal processor (DSP), for processing electrical signals, a memory **72** for storing electrical signals, and/or firmware **74** that stores and processes electrical signals, where the electrical signals are representative of a local interactive program or inputs from other devices with system **20**. Input/output **68**, microprocessor **70**, and memory **72** may be substantially similar to those described above for host computer **58**, however, the capabilities of control unit **54** may be more limited to reduce cost. Control unit **54** processes output signal **66** from host computer **58** and provides a modified output signal **66'**.

[**0061**] Additionally, control unit **54** may locally process signals or portions of signals directly received from components within system **20**. For example, control unit **54** may receive variable input signal **76** from sensor **32** and search the signal for portions that may be processed locally before passing the input signal on to host computer **58** as modified