The host computer can be a personal computer, workstation, video game console, or other computing or display device, set top box, "network-computer", etc. Besides a microprocessor, the host computer preferably includes random access memory (RAM), read only memory (ROM), input/output (I/O) circuitry, and other components of computers well-known to those skilled in the art. The host computer can implement a host application program with which a user interacts using control device **10** and/or other controls and peripherals. The host application program can be responsive to signals from control device **10** such as the motion of the arm or knob, or button presses. In force feedback embodiments, the host application program can output force feedback commands to the local microprocessor **202**, using, for example, a force feedback API of the host computer, such as I-Force from Immersion Corporation. In a host computer embodiment or other similar embodiment, microprocessor **202** can be provided with software instructions to wait for commands or requests from the host computer, parse/decode the command or request, and handle/control input and output signals according to the command or request.

For example, in one force feedback embodiment, a host computer can provide low-level force commands over bus **220**, which microprocessor **202** directly transmits to the actuators. In a different force feedback local control embodiment, the host computer provides high level supervisory commands to microprocessor **202** over bus **220**, and microprocessor **202** decodes/parses the commands and manages low level force control loops to sensors and actuators in accordance with the high level commands and independently of the host computer. In the local control embodiment, the microprocessor **202** can independently process sensor signals to determine appropriate output actuator signals by following the instructions of a "force process" that may be stored in local memory **206** and includes calculation instructions, formulas, force magnitudes (force profiles), and/or other data. The force process can command distinct force sensations, such as vibrations, textures, jolts, or even simulated interactions between displayed objects. Such operation of local microprocessor in force feedback applications is described in greater detail in U.S. Pat. No. 5,734,373, previously incorporated herein by reference.

In an alternate embodiment, no local microprocessor **202** is included in interface device **10**, and a remote microprocessor in apparatus **218** controls and processes all signals to and from the components of interface device **10**. Or, hard-wired digital logic in device **10** can perform any input/output functions to the device **10**.

While this invention has been described in terms of several preferred embodiments, there are alterations, modifications, and permutations thereof which fall within the scope of this invention. It should also be noted that the embodiments described above can be combined in various ways in a particular implementation. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to limit the present invention. It is therefore intended that the following appended claims include such alterations, modifications, and permutations as fall within the true spirit and scope of the present invention.

What is claimed is:

1. An apparatus comprising:

a manipulandum movable in at least two rotary degrees of freedom, wherein said at least two rotary degrees of freedom comprise a first and a second rotary degree of freedom, wherein an axis of rotation of said first rotary degree of freedom is substantially perpendicular to an axis of rotation of said second rotary degree of freedom;

a sensor operable to detect a position of said manipulandum and a deviation of said manipulandum from said position and to output a first sensor signal associated with said deviation of said manipulandum from said position;

a first actuator operable to provide tactile feedback to said manipulandum in a first of said at least two degrees of freedom, the tactile feedback associated with said first sensor signal;

a second actuator operable to provide tactile feedback to said manipulandum in a second of said at least two degrees of freedom, the tactile feedback associated with said first sensor signal; and

a first processor operable to control said first actuator and said second actuator and to receive said first sensor signal from said sensor.

2. An apparatus as recited in claim **1** wherein said manipulandum comprises a roller.

3. An apparatus as recited in claim **2** wherein said roller communicates an electrical signal output to said first processor.

4. An apparatus as recited in claim **2** wherein said roller is moveable in two degrees of freedom.

5. An apparatus as recited in claim **4** wherein said two degrees of freedom comprise a rotary degree of freedom and a translatory degree of freedom.

6. An apparatus as recited in claim **1** further comprising a local display screen.

7. An apparatus as recited in claim **1** further comprising a microphone.

8. An apparatus as recited in claim **1** wherein said first processor is included in a video game console.

9. An apparatus as recited in claim **1** wherein said first processor is included in a computer.

10. An apparatus as recited in claim **1** wherein said first processor is included in a Web-access device.

11. An apparatus as recited in claim **1** wherein said first processor is included in an electronic device.

12. An apparatus as recited in claim **1** further comprising a second processor, separate from said first processor and operable to communicate with said first processor.

13. An apparatus as recited in claim **6** wherein said local display screen further comprises a touch-sensitive surface.

14. An apparatus as recited in claim **1** wherein said sensor is operable to detect an amount of said deviation of said manipulandum from said position and to output a second sensor signal associated with said amount of said deviation of said manipulandum from said position, said first processor operable to receive said second signal.

15. An apparatus as recited in claim **1** wherein said first processor is operable to associate a value with said position of said manipulandum in a position control mapping mode and to control a rate of change of said value in a rate control mapping mode.

16. An apparatus as recited in claim **15** wherein said first processor is operable to control said tactile feedback to said manipulandum in said rate control mapping mode.

17. An apparatus as recited in claim **15** wherein said first actuator is operable to output a force detent during a displacement of said manipulandum in said position control mapping mode.

18. An apparatus as recited in claim **15** wherein said rate of change associates with a displacement of said manipulandum with respect to said position of said manipulandum.