[0074] The touch screen **82** provides haptic feedback to the user similarly to the touchpad **16** described in previous embodiments. One or more actuators **86** can be coupled to the underside of the touch screen **82** to provide haptic feedback such as pulses, vibrations, and textures; for example, an actuator **86** can be positioned near each corner of the screen **82**, as shown in FIG. **8***a*. Other configurations of actuators can also be used. The user can experience the haptic feedback through a finger or a held object such as a stylus **87** that is contacting the screen **82**.

[0075] As shown in FIG. **8***b*, the touch screen **82** is preferably coupled to the housing **88** of the device **80** by one or more spring or compliant elements **90**, such as helical springs, leaf springs, flexures, or compliant material (foam, rubber, etc.) The compliant element allows the touch screen **82** to move approximately along the z-axis, thereby providing haptic feedback similarly to the touchpad embodiments described above. Actuators **86** can be piezo-electric actuators, voice coil actuators, or any of the other types of actuators described above for the touchpad embodiments. As shown in FIG. **8***b*, the actuators **86** are directly coupled to the touch screen **82** similarly to the touchpad embodiment of FIG. **3**; alternatively, an inertial mass can be moved to provide inertial feedback in the z-axis of the touch screen, similarly to the touchpad embodiment of FIG. **6**. Other features described above for the touchpad are equally applicable to the touch screen embodiment **80**.

[0076] In the embodiments of touch input devices (touchpad and touch screen) described herein, it is also advantageous that contact of the user is detected by the touch input device. Since haptic feedback need only be output when the user is contacting the touch device, this detection allows haptic feedback to be stopped (actuators "turned off") when no objects are contacting the touch input device. This feature can conserve battery power for portable devices. If a local touch device microprocessor (or similar circuitry) is being used in the computer, such a microprocessor can turn off actuator output when no user contact is sensed, thus alleviating the host processor of additional computational burden.

[0077] While the subject matter has been described in terms of several preferred embodiments, it is contemplated that alterations, permutations, and equivalents thereof will become apparent to those skilled in the art upon a reading of the specification and study of the drawings. For example, many different types of actuators can be used to output tactile sensations to the user. Furthermore, many of the features described in one embodiment can be used interchangeably with other embodiments. Furthermore, certain terminology has been used for the purposes of descriptive clarity, and not to be limiting.

What is claimed is:

1. A haptic feedback device, comprising:

a touch screen operative to display a graphical image and to output a position signal indicative of a selected location on the touch screen in two dimensions; and

at least a first actuator configured to impart a first force directly to the touch screen to thereby provide a haptic effect in response to the selection, the first force based on information output by a computer device

wherein at least the first force is output substantially parallel to a plane of the touch screen.

2. The haptic feedback device of claim 1, further comprising a housing, wherein the first actuator is a linear actuator configured to provide an output force in a linear degree of freedom, wherein the first actuator is rigidly coupled to the housing.

3. The haptic feedback device of claim 1, wherein the first actuator is a rotary actuator configured to provide an output force in a rotary degree of freedom, the output force being converted to the linear force on the touch screen.

4. The haptic feedback device of claim 1, wherein the first actuator is an inertial actuator that provides an inertial force on the touch screen.

5. A haptic feedback device, comprising:

a touch screen operative to display a graphical image and to output a position signal indicative of a selected location on the touch screen in two dimensions; and

at least a first actuator configured to impart a first force directly to the touch screen to thereby provide a haptic effect in response to the selection, the first force based on information output by a computer device,

wherein the touch screen is operative to allow the user to draw or write on the touch screen resulting in a graphical display at locations where the user has pressed a tip of an object.

6. The haptic feedback device of claim 5, wherein the object is a stylus or a finger.

7. A haptic feedback device, comprising:

a touch screen operative to display a graphical image and to output a position signal indicative of a selected location on the touch screen in two dimensions; and

at least a first actuator configured to impart a first force directly to the touch screen to thereby provide a haptic effect in response to the selection, the first force based on information output by a computer device,

wherein the first actuator is capable of outputting a continuous vibration or a pulse tactile sensation on the touch screen.

8. A haptic feedback device, comprising:

a touch screen operative to display a graphical image and to output a position signal indicative of a selected location on the touch screen in two dimensions; and

at least a first actuator configured to impart a first force directly to the touch screen to thereby provide a haptic effect in response to the selection, the first force based on information output by a computer device

wherein the touch screen includes a first region and a second region.

9. The haptic feedback device of claim 6, wherein the first region provides the position signal and the second region provides a second signal.

10. The haptic feedback device of claim 6, wherein the second signal is used in a rate control function of a value.

11. The haptic feedback device of claim 6, wherein the second signal is used in conjunction with a button press.

12. The haptic feedback device of claim 6, wherein the first region is capable of outputting a haptic sensation that is different from a haptic sensation output at the second region.

13. The haptic feedback device of claim 6, wherein the computer device is configured to send a control signal to the