In an advanced version, each actuator is independently controllable to provide independent haptic sensations to each of the fingers. These sensations may also be provided in addition to the haptic sensations provided to the palm through the housing of the mouse and in addition to any kinesthetic force feedback that is provided to the user.

[0146] Another version of a finger sensing mouse is shown in **FIGS. 20A and 20B** in this version, a finger receiving extension **1110** is attached to the button **620***a* The finger receiving extension **1110** includes a ring **1215** and a link **1120** connecting the ring **1115** to the button **620***a,* as can be seen in **FIG. 20B** which shows the view from the perspective of B-B in **FIG. 20A**. With this version, the user inserts his or her finger into the ring **1115**. Accordingly, the user is able to manipulate the button **620***a* in both directions, rather than just depression of the button **620***a.* Accordingly, the user can actively open a closed graphical hand **170**.: Optionally, an actuator **1070**, such as the actuator shown in **FIG. 19B**, may be provided to apply forces to the finger in both directions. Alternatively, the button may be removed and replaced with a linear or curved rod **1125** that extends through the housing of the mouse **600** and is engaged by a sensor **1060** and/or an actuator **1070**, as shown in **FIG. 21**. In another version, as shown in **FIG. 22**, the finger receiving extension **110** may comprise a ring **1115** mounted to an articulated linkage **1130** which is mounted on the mouse **600**, for example by being mounted on the housing of the mouse **600**. The linkage **1130** may include any number of revolute joints **1135**, such as three as shown. An encoder or other type sensor may detect the angular position of the revolute joints **1135** to determine the position of the ring **115** and thereby determine the position of the finger of the user. In another version, each revolute joint **1115** is provided with a rotary actuator, such as a motor, to provide force feedback to the finger. Alternatively to the configuration shown in **FIG. 22**, a five-bar linkage, with the housing of the mouse **600** being one of the bars, may be used to provide position sensing and actuation of the finger. In one version, a revolute joint **1140** is provided to detect rotation of the ring **1115** about axes that lie in the plane of the cross-section of **FIG. 22**. Additionally or alternatively, a linkage may be provided that is allows the ring **1115** to move perpendicularly to the plane of the cross-section of **FIG. 22**, and the ring **115** may be sensed and/or forced in that movement.

[0147] This version allows for the detection of spreading of the fingers and crossing of the fingers. The finger receiving extensions of **FIGS. 20 through 22** may be provided any number of fingers of the user, including all five fingers of the hand of the user. In another version, the linkage **1130** may bee connected to a grounded member instead of to the mouse **600**. In another version, the linkage **1130** may be connected to the user, for example by being connected to the wrist or hand of the user as described in U.S. Pat. No. 6,110,130 which is incorporated herein by reference in its entirety.

[0148] Another version of a finger sensing button **620***a* is shown in **FIGS. 23A and 23B**. This version comprises an articulated button **1150**. The articulated button **1150** comprises a first portion **1160** is articulatable relative to a second button portion **1170**. The first button portion **1160** may be adapts to contact a first finger portion **1165** and the second button portion, **1170** may be adapted to contact a second finger portion **1170**. In this way, the position of the finger tip may be detected and the relative positions of the first and second portions of the fingers can be detected. A more complex version includes three articulated button portions. Optionally one or more actuators may be provided to apply a force to the finger through one or more of the portions.

[0149] **FIG. 24** shows a mouse **600**, capable of sensed movement in three dimensions. Movement in two dimensions may be provided by a mechanism a mechanical interface **830** similar to that shown in **FIG. 17**. However, instead of being connected directly to the mouse **600**, the mechanical interface **830** is connected to a z-axis translation member **1200**. The z-axis translation member **1200** in the version shown comprises telescoping rods **1210**, **1220**. The top rod **1210** is connected to the mouse **600**. Thus, the mouse **600** may be moved in three dimensions. A linear potentiometer or encoder or the like may be positioned to detect the displacement of the telescoping rods **1210**, **1220** in order to generate a signal that may be used by the computer to control the graphical image **115** in a third dimension. Also, a linear motor, or the like, may be provided to apply force feedback to the mouse **600** in a third linear dimension. In addition, rotation of the mouse **600** about the z-axis can be sensed by measuring the rotation between the telescoping rods **1210**, **1220** and by non-rotatably connecting the base **1230** of the mouse **600** to the top rod **1210**. If desired, an articulation **1250** may be provided to allow the mouse **600** to rotate about the x axis, and an articulation **1260** may be provided to allow the mouse **600** to rotate about the y axis. These articulations may also include a rotation sensor to control the display of the graphical image **115** and/or a rotary actuator to provide force feedback in these additional degrees of freedom. In one version, the mouse **600** is capable of up to six degrees of freedom of movement, is sensed in up to six degrees of freedom, is forced in up to six degrees of freedom, and includes from one to five finger sensing buttons **620**. Alternatively, a three dimensional linkage system such as those described in U.S. Pat. Nos. 5,701,140 and 5,625,576, which are incorporated herein by reference in their entireties, may be used. In these version, a mouse **600** with one or more finger sensing buttons **620** may be mounted on the linkage.

[0150] Graphical image controlling mouse alternatives are shown in **FIGS. 25A through 25G**. In the version of **FIG. 25A**, an orients on ball **1300** is provided at the distal end of the mouse **600** instead of or in addition to the finger sensing buttons **620**. **FIG. 25B** shows a frontal view of the mouse **600** of **FIG. 25A** with a user grasping the orientation ball **1300** with his or her thumb and first two fingers. By rotating the orientation ball about the longitudinal axis of the mouse **600**, for example, the user can control the orientation, of the graphical image **115** about an axis. A retainer **1310** may be rotatable so as to not interfere with the motion of the fingers. In another version, the orientation ball **1300** is rotatable about three orthogonal axes, in a manner similar to a track ball, to control the orientation of the graphical image **115** in about three orthogonal axes. Alternatively, as shown in **FIG. 25C**, an additional orientation of the graphical image **115** can be controlled by rotating the mouse **600**. The rotation can be detected by providing two longitudinally spaced mouse balls **665**, **665'**. By comparing the position signals from the two bails **665**, **665'**, the-orientation of the mouse **600** can be determined. This orientation can then be used by the computer **150** to update the display of the graphical image **115**, such as a graphical hand **170**, accordingly.