

for each virtual control knob. Alternatively or additionally, one or more slider bars can be controlled at the same time as the virtual control knob, i.e., one hand operates the virtual control knob, while at least one finger and maybe more than one finger of the opposite hand operates at least one slider and maybe more than one slider bar, e.g., slider bar for each finger.

[0096] It should also be noted that although the embodiment is described using a virtual control knob, in another embodiment, the UI element can be a virtual scroll wheel. As an example, the virtual scroll wheel can mimic an actual scroll wheel such as those described in U.S. Patent Publication Nos: 2003/0076303A1, 2003/0076301A1, 2003/0095096A1, which are all herein incorporated by reference. For example, when the user places their finger on the surface of the virtual scroll wheel and makes a swirling, rotational or tangential gesture motion, a scrolling action can be performed with respect to a list of items displayed in a window.

[0097] FIG. 7 is a diagram of a touch-based method 200 in accordance with one embodiment of the present invention. The method generally begins at block 202 where a user input that occurs over a multipoint sensing device is detected. The user input includes one or more touch inputs, with each touch input having a unique identifier. Following block 202, the touch-based method 200 proceeds to block 204 where the user input is classified as a tracking or selection input when the user input includes a single unique identifier (one touch input), or is classified as a gesture input when the user input includes at least two unique identifiers (more than one touch input). If the user input is classified as a tracking input, the touch-based method 200 proceeds to block 206 where tracking is performed corresponding to the user input.

[0098] If the user input is classified as a gesture input, the touch-based method 200 proceeds to block 208 where one or more gesture control actions are performed corresponding the user input. The gesture control actions are based at least in part on changes that occur with or between the at least two unique identifiers.

[0099] FIG. 8 is a diagram of a touch-based method 250 in accordance with one embodiment of the present invention. The touch-based method 250 generally begins at block 252 where an initial image is captured during an input stroke on a touch sensitive surface. Following block 252, the touch-based method 250 proceeds to block 254 where the touch mode is determined based on the initial image. For example, if the initial image includes a single unique identifier then the touch mode may correspond to a tracking or selection mode. On the other hand, if the image includes more than one unique identifier, then the touch mode may correspond to a gesture mode. Following block 254, the touch-based method 250 proceeds to block 256 where a next image is captured during the input stroke on the touch sensitive surface. Images are typically captured sequentially during the stroke and thus there may be a plurality of images associated with the stroke. Following block 256, touch-based method 250 proceeds to block 258 where a determination is made as to whether the touch mode changed between capture of the initial image and capture of the next image. If the touch mode changed, the touch-based method 250 proceeds to block 260 where the next image is set as the initial image and thereafter the touch mode is again determined at block 254 based on the new initial image. If the touch mode stayed the same, the touch-based method 250 proceeds to block 262 where the initial and next images are compared and one or more control signals are generated based on the comparison.

[0100] FIG. 9 is a diagram of a touch-based method 300 in accordance with one embodiment of the present invention. The touch-based method 300 begins at block 302 where a GUI object is output. For example, a processor may instruct a display to display a particular GUI object. Following block 302, the touch-based method 300 proceeds to block 304 where a gesture input is received over the GUI object. For instance, a user may set or move their fingers in a gestural way on the surface of the touch screen and while over the displayed GUI object. The gestural input may include one or more single gestures that occur consecutively or multiple gestures that occur simultaneously. Each of the gestures generally has a particular sequence, motion, or orientation associated therewith. For example, a gesture may include spreading fingers apart or closing fingers together, rotating the fingers, translating the fingers, and/or the like.

[0101] Following block 304 the touch-based method 300 proceeds to block 306 where the GUI object is modified based on and in unison with the gesture input. By modified, it is meant that the GUI object changes according to the particular gesture or gestures being performed. By in unison, it is meant that the changes occur approximately while the gesture or gestures are being performed. In most cases, there is a one to one relationship between the gesture(s) and the changes occurring at the GUI object and they occur substantially simultaneously. In essence, the GUI object follows the motion of the fingers. For example, spreading of the fingers may simultaneously enlarge the object, closing of the fingers may simultaneously reduce the GUI object, rotating the fingers may simultaneously rotate the object, translating the fingers may allow simultaneous panning or scrolling of the GUI object.

[0102] In one embodiment, block 306 may include determining which GUI object is associated with the gesture being performed, and thereafter locking the displayed object to the fingers disposed over it such that the GUI object changes in accordance with the gestural input. By locking or associating the fingers to the GUI object, the GUI object can continuously adjust itself in accordance to what the fingers are doing on the touch screen. Often the determination and locking occurs at set down, i.e., when the finger is positioned on the touch screen.

[0103] FIG. 10 is a diagram of a zoom gesture method 350, in accordance with one embodiment of the present invention. The zoom gesture may be performed on a multipoint touch screen. The zoom gesture method 350 generally begins at block 352 where the presence of at least a first finger and a second finger are detected on a touch sensitive surface at the same time. The presence of at least two fingers is configured to indicate that the touch is a gestural touch rather than a tracking touch based on one finger. In some cases, the presence of only two fingers indicates that the touch is a gestural touch. In other cases, any number of more than two fingers indicates that the touch is a gestural touch. In fact, the gestural touch may be configured to operate whether two, three, four or more fingers are touching, and even if the numbers change during the gesture, i.e., only need a minimum of two fingers at any time during the gesture.

[0104] Following block 352, the zoom gesture method 350 proceeds to block 354 where the distance between at least the two fingers is compared. The distance may be from finger to finger or from each finger to some other reference point as for example the centroid. If the distance between the two fingers increases (spread apart), a zoom-in signal is generated as