KEYSTROKE TACTILITY ARRANGEMENT ON A SMOOTH TOUCH SURFACE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a division of U.S. patent application Ser. No. 11/380,109, filed Apr. 25, 2006, which is related to the following patents and patent applications, which are all herein incorporated by reference: (1) U.S. Pat. No. 6,323,846, titled "Method and Apparatus for Integrating Manual Input," issued on Jul. 1, 2002; (2) U.S. Pat. No. 6,677,932, titled "System and Method for Recognizing Touch Typing Under Limited Tactile Feedback Conditions," issued on Jan. 13, 2004; and (3) U.S. Pat. No. 6,570,557, titled "Multi-Touch System and Method for Emulating Modifier Keys Via Fingertip Chords," issued on May 27, 2003.

BACKGROUND

[0002] Integration of typing, pointing, and gesture capabilities into touch surfaces offers many advantages, such as eliminating need for mouse as a separate pointing device, eliminating wasteful reaches between keyboard and pointing device, and general workflow streamlining. However, pointing and typing have opposite tactile feedback needs. Specifically, pointing and gesturing inputs are best accomplished using a smooth, nearly frictionless touch surface. Conversely, typists are accustomed to relying on sharp key edges for tactile feedback.

[0003] User acceptance of the TouchStream™ integrated typing, pointing and gesture input devices manufactured by FingerWorks demonstrated that learning to type on a smooth, un-textured surface is possible, but takes substantial practice. In many ways, typing on such a surface is almost like learning to type all over again. It is believed that mainstream acceptance of typing on touch surfaces will require shortening of the typing re-acclimation period, which, in turn, requires improved keystroke tactility.

[0004] Traditionally, keystroke tactility on a surface or "membrane" keyboard has been provided by indicating key edges using hydroformed or stamped raised ridges into the surface plastic. However, this technique has several disadvantages for touch surfaces also intended for pointing and gesture. For example, the key-edge ridges impede lateral pointing motions, giving the surface a rough washboard feel. The ridges also disrupt position interpolation from capacitive sensor arrays as the fingertip flesh lifts over the ridge.

[0005] In a more successful attempt to provide surface keyboard users with suitable tactile feedback, keyboards incorporating home row dimples as disclosed in U.S. Pat. No. 6,323,846, referenced above, were produced. These dimples helped users find the home row keys when hands were resting on the surface, while minimizing disruption of a user's motion in pointing or gesturing on the surface. However, these dimples were ineffective feedback for helping users feel for keys away from home row, or detect when they were not striking the centers of these peripheral keys.

[0006] Another somewhat successful prior method for aligning hands on both surface and traditional mechanical keyboards has been to place a single raised Braille-like dot on an "alignment" key or on the "home row" of keys. For example, many mechanical keyboards features such raised dots on the "F" and "J" keys, which are the index finger home positions for a touch typist using QWERTY keyboard. As with the dimples disclosed in the '846 patent, this arrangement is useful to help align a user's hands to home row, but does not help to correct alignment errors while reaching for peripheral keys. Thus, a significant problem arises in attempting to provide feedback of key positions away from the home row.

[0007] Placing alignment dots, such as the single Braille-like dot, at the center of every key would provide feedback for key positions away from the home row. However, such an arrangement would eliminate the distinctiveness of the home row keys, and create more ambiguous feedback for the user. Therefore, what is needed in the art is a way to provide tactility to all or at least a substantial number of keys without creating such a bumpy surface that pointing and gestures are uncomfortable or unsteady.

[0008] This could be accomplished by adapting known prior art Braille displays. In this approach, tiny, individually actuated pins spread across the keyboard could provide dynamic tactility, but at great mechanical cost and complexity. Thus, what is needed to reduce cost and complexity is a way to provide tactility for each key without placing individual electromagnetic actuators under each key.

[0009] An additional issue arises in that multi-touch capacitive sensor arrays, which are often used to form the multi-touch surfaces, are typically built with row and column electrodes spanning the surface, or with row and column drive/sense line accessing electronic buffers at each electrode cell. Thus whatever tactility mechanism is provided, the arrangement must be routable around the row/column electrodes or drive lines of multi-touch sensors without requiring additional circuit board vias or layers.

[0010] Disclosed herein are a variety of techniques for providing tactile feedback in a surface or other keyboard that address one or more of these deficiencies of the prior art.

SUMMARY

[0011] Disclosed herein are four arrangements for providing tactility on a touch surface keyboard. One approach is to provide tactile feedback mechanisms, such as dots, bars, or other shapes on all or at least many keys. Different keys or groups of keys may have different feedback mechanisms, e.g., a first feedback mechanism may be assigned to "home row" keys, with a second feedback mechanism assigned to keys adjacent the home row, with a third assigned to peripheral keys, which are neither home row keys nor adjacent the home row. Alternatively, an articulating frame may be provided that extends when the surface is being used in a typing mode and retracts when the surface is used in some other mode, e.g., a pointing mode. The articulating frame may provide key edge ridges that define the boundaries of the key regions or may be used to provide tactile feedback mechanisms within the key regions. The articulating frame may also be configured to cause concave depressions similar to mechanical key caps in the surface. In another embodiment, a rigid, non-articulating frame may be provided beneath the surface. A user will then feel higher resistance when pressing away from the key centers, but will feel a softer resistance, which may be enhanced by filling the gaps with a foam or gel material or air.

[0012] Using these arrangements, as well as individual elements of each or combinations thereof, it is possible to pro-