USER INTERFACE INCORPORATING EMULATED HARD KEYS

DESCRIPTION OF THE RELATED ART

Many electronic devices typically include some form of user interface to provide an input to the electronic device. For example, a user operates a keyboard to enter data into a computer, a keypad to enter a phone number into a telephone, a remote control to operate a television set, or, a touch screen to enter data into a PDA. The proliferation of such user interfaces has led to various efforts aimed at producing an integrated interface that combines several interfaces into a single unit. For example, among television remotes, a lot of effort has been directed towards producing a "universal" remote that combines the functionality of multiple remote controls. Similarly, efforts have been directed towards providing in hand-held devices such as cell phones and PDAs, a smart user interface that can emulate various input devices based upon a selection carried out by the user. A PDA, for example, may have a touch screen that can be used to emulate a telephone-keypad functionality, or can, alternatively, be used to emulate a QWERTY keyboard for entering e-mail text.

In general, designers have attempted to optimize the layout of user interfaces by minimizing the number of keys that are presented to the user. Generally, such a minimization is carried out by using certain types of "hard" keys or by using "soft" keys. Hard keys can be laid out optimally in various ways. In one approach, a hard key can be designed to operate as a "dual-function" key that depends upon a function setting carried out by using an additional function-selector key. One example of such an additional function-selector key is the VCR/TV selector key of a TV remote control.

Unfortunately, each of the devices that are controlled via a multi-function user interface may have unique operating modes that are not shared with other devices, necessitating the use of a significant number of "single-function" hard keys. For example, several operating modes of a VCR are unique to the VCR, while several operating modes of a TV are unique to the TV, thereby requiring one set of dedicated, single-function keys for the VCR, and a second dedicated set for the TV.

It can therefore be appreciated that the hard key approach does not provide an optimal solution because it requires a large keypad to accommodate a large number of hard keys. One approach that was taken to overcome such a limitation is to replace a hard key keypad with a "touch-screen" containing soft keys. The touch-screen solution alleviates the need for providing a large keypad because two different key functions can be provided in the same display area by selecting either one or another touch-screen display. Therefore, a VCR touch-screen would display various controls for a VCR, while a TV touch-screen would replace the VCR touch-screen whenever the user decides to use the remote control to control the TV rather than the VCR.

Unfortunately, the touch-screen solution also suffers from certain handicaps. For example, a key-activation feedback, such as the key-click of the mechanical keys of a QWERTY keyboard, cannot be efficiently provided to the user of a touch-screen. This handicap can be attributed to the multiplicity of positions that various control icons can have upon a touch-screen display. For example, the location of the PLAY button icon upon a VCR touch-screen may not coincide with any of the control icons that are generated upon a TV touch-screen. Consequently, neither the TV nor

the VCR control button icons can be designed to provide key-activation feedback in the form of a tactile response to finger pressure. As is known, tactile feedback is used to confirm the user's keystroke operation, thereby promoting speed and accuracy.

In an alternative to finger-operated soft-keys, soft-keys can also be operated using a stylus. The stylus approach provides certain advantages, especially for accommodating handwritten entries. Unfortunately, the stylus solution needs additional hardware in the form of the stylus, which can be easily lost or misplaced. Additionally, a stylus operator requires practice for carrying out handwritten data entry with an acceptable level of accuracy. This can lead to nervousness and frustration among novice users, many of whom are more familiar and more comfortable with a conventional QWERTY keyboard that provides tactile feedback. Generally, text entry using a QWERTY keyboard is significantly quicker than text entry using a stylus.

Based on the above-mentioned handicaps of existing user interfaces, an unaddressed need exists in the industry to overcome such deficiencies and inadequacies.

SUMMARY

One or more keyboards are emulated on the reconfigurable keyboard of a reconfigurable interface. In an exemplary embodiment, the reconfigurable keyboard has an array of microchambers. Each microchamber is operable to change from a first height to a second height. The exemplary embodiment additionally includes a keyboard emulator controller operable to set a first group of the microchambers in the array to the second height. The first group of microchambers collectively constitutes a first emulated hard key that emulates a first key of a first user-selected keyboard.

Clearly, some alternative embodiments may exhibit advantages and features in addition to, or in lieu of, those mentioned above. It is intended that all such alternative embodiments be included within the scope of the present invention, and be protected by the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Many aspects of the invention can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale. Instead, emphasis is placed upon clearly illustrating the principles of the invention. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

FIG. **1** shows a first exemplary embodiment of a device incorporating a reconfigurable keyboard of the present disclosure.

FIG. **2**A shows a first exemplary system that uses an array of microchambers for implementing the reconfigurable keyboard shown in FIG. **1**.

FIG. **2**B shows three adjacent microchambers contained in the array of microchambers illustrated in FIG. **2**A.

FIG. **2**C illustrates one exemplary system for activating one of the three microchambers shown in FIG. **2**B.

FIG. **2**D illustrates another exemplary system for activating one of the three microchambers shown in FIG. **2**B.

FIG. **3**A shows the array shown in FIG. **2**A configured, in a first exemplary embodiment, as a telephone keypad.

FIG. **3**B shows a cross-sectional view of the telephone keypad depicted in FIG. **3**A.

FIG. **4**A shows the array shown in FIG. **2**A configured, in a second exemplary embodiment, as a music-player keypad.