

In a second exemplary embodiment, each of the sensory feedback elements **805**, **810**, and **815** comprises an electrode that provides an electric charge under control of the keyboard emulator controller **115**. In the example shown in FIG. **8A**, sensory feedback element **810** provides such a charge. Consequently, when the user places his or her finger against sensory feedback element **810**, the electric charge provides an electrical stimulus that is felt as a mild electric shock by the user, thereby indicating the presence of an emulated hard key. Here again, a pressure sensor is used to detect a finger pressure greater than a preset threshold. When the finger pressure is greater than the preset threshold, which is indicative of a key operation, keyboard emulator controller **115** provides a stimulus to the sensory feedback elements for generating a second sensory feedback such as a vibration, a temperature change, a change in visual appearance, change in size etc. The second sensory feedback additionally provides tactile feedback to the user because the second sensory feedback is generated only when the user operates the emulated hard key.

In a third exemplary embodiment, the temperature of each of the sensory feedback elements **805**, **810**, and **815** is controlled by keyboard emulator controller **115**. In the example shown in FIG. **8A**, sensory feedback element **810** is configured to provide first sensory feedback in the form of a first temperature. Consequently, when the user places his or her finger against sensory feedback element **810**, heat is transferred between sensory feedback element **810** and the user's finger thereby indicating the presence of the emulated hard key.

Furthermore, in the third exemplary embodiment, a pressure sensor is used to detect a finger pressure greater than a preset threshold which indicates key operation of the emulated hard key. When the finger pressure is greater than the preset threshold, keyboard emulator controller **115** provides a stimulus to the sensory feedback elements for generating a second sensory feedback such as a vibration, a temperature change, a change in visual appearance, change in size etc. This second sensory feedback additionally provides tactile feedback to the user because the second sensory feedback is generated only when the user operates the emulated hard key.

In a fourth exemplary embodiment, the appearance of each of the sensory feedback elements **805**, **810**, and **815** is controlled by the keyboard emulator controller **115**. In the example shown in FIG. **8A**, sensory feedback element **810** provides a first visual appearance indicative of the presence of an emulated hard key. For example, sensory feedback element **810** displays a blue color indicative of the presence of the emulated hard key, while sensory feedback elements **805** and **815** each display a gray color indicative of the inactive surface of the reconfigurable keyboard. As described above, a pressure sensor is used to detect key operation, and initiate second sensory feedback, for example, by changing the color of sensory feedback element **810** from the blue color to a red color thereby indicating key operation. The red color additionally provides tactile feedback indicating key operation.

It will be understood that various combinations of emulated hard key presence and emulated hard key operation indicators are used in various embodiments. For example, a vibrator may be used as the presence indicator of an emulated hard key, together with a visual indicator for indicating key operation.

FIGS. **8B** and **8C** illustrate a first example of a sensory feedback array **820** configured as a telephone keypad **800**. In this exemplary embodiment each of the 12 telephone keys

has been emulated by 16 adjacent sensory feedback elements that form a square key corresponding to each of the telephone keys. For example, the telephone key with numeral "7" has been emulated by activating a 4x4 array of adjacent sensory feedback elements **817**.

FIG. **8C** shows a cross-sectional view of keypad **800**. Keypad **800** includes an array **200** of sensory feedback elements and a display screen **850** overlaying array **200**. In this exemplary embodiment, the surface of keypad **800** is flat. When the user places his or her finger upon the label "7" of display screen **850**, sensory feedback elements **817** located under the label "7" provide a vibration to indicate the presence of an emulated hard key. When the user increases the pressure applied by his or her finger to operate the key, sensory feedback elements **817** provide a second vibration to indicate key operation. Alternatively, sensory feedback elements **817** may provide a sensation of heat when the user operates the key.

On the other hand, sensory feedback elements **818** that correspond to an inactive surface of keypad **800** will not provide a sensory feedback when the user places his or her fingertips upon this inactive surface even if a label is present upon this inactive surface. For example, such a label may correspond to a brand name or a model number of the product and does not have an emulated hard key located under the label. Display screen **850** typically comprises a flexible sheet of material that may be similar to the one described above using FIG. **3B**.

Embodiments may further include other sensory feedback indicators such as, a variation in the texture of the keypad surface, a "stickiness" of the keypad surface, and a variation in the stiffness of the keypad surface. These embodiments may also incorporate audible and visual feedback indicators.

FIG. **9** shows a flowchart of one exemplary method of keyboard emulation using a reconfigurable keyboard such as the keyboard shown in FIG. **1**. In block **905**, a reconfigurable keyboard and a selector for selecting a first emulated keyboard or a second emulated keyboard are provided. For example, the first emulated keyboard may be a telephone keypad, while the second emulated keyboard corresponds to a PDA.

Query block **910** determines whether the first emulated keyboard has been selected. When the first emulated keyboard is selected, a first key of the first emulated keyboard is emulated by configuring at least a portion of the reconfigurable keyboard to emulate a first hard key. The action of block **915** pertains to generating an emulated hard key of the first emulated keyboard by, for example, raising the height of a portion of the reconfigurable keyboard. Consequently, if the first emulated keyboard is a telephone keypad, the emulated hard key corresponds to a raised numerical key, for example, numeral "7."

When the first emulated keyboard is not selected, query block **920** determines whether the second emulated keyboard has been selected. When the second keyboard has been selected, a first key of the second emulated keyboard is emulated by configuring at least a portion of the reconfigurable keyboard to emulate a second hard key. The action of block **925** pertains to generating an emulated hard key of the second emulated keyboard by, for example, raising the height of a portion of the reconfigurable keyboard. Therefore, if the second emulated keyboard is a PDA keypad, the generated emulated hard key is a raised key corresponding to a text alphabet, for example, the alphabet "A."

The above-described embodiments are merely set forth for a clear understanding of the principles of the disclosure. Many variations and modifications may be made without