

the operational mode of an electronic device. For example, in an embodiment utilizing a PDA, such as PDA 31 in Fig. 5, a user may activate one of many modes, including, for example, the phone interface shown in Fig. 5, the application interface shown in Fig. 11, an address book, email, or other modes. Referring to Fig. 5, in one such embodiment, the user clicks a button 32 to activate the phone application. When the user clicks the button, the PDA 31 displays a phone interface 38. While the PDA 31 is in phone mode, the actuator provides a persistent haptic effect indicating to the user that the phone mode is active. In this way, the user is able to determine the mode of the PDA 31 without visually referring to it.

[0088] Another embodiment of the present invention provides the user with distinct haptic effects for modes within a cell phone or other electronic device. Referring to Fig. 3, users of cell phones, such as cell phone 14, often store a list of number that are frequently dialed in a memory associated with one or a combination of number keys 10. In such an embodiment, the user may click a function key before clicking the number key 10, providing a signal to the phone 31 that the user will specify a number to dial by clicking a number key combination. In one embodiment of the present invention, when the user clicks the function button, the actuator provides a persistent haptic effect, indicating to the user that the cell phone is in the rapid-dialing mode. The haptic effect alerts the user to the fact that when the user selects a number-key combination, the cell phone will dial the phone number associated with the number-key combination in memory. By providing a haptic effect identifying the mode that the cell phone 31 is in, the embodiment minimizes or eliminates the user's need to refer to the cell phone 31 visually.

[0089] In another embodiment of the present invention, an actuator provides feedback when an option or function is unavailable (referred to herein as "negative feedback"). In such an embodiment implemented in a cell phone, such as cell phone 31 shown in Fig. 3, the user is able to place calls. The user dials a combination of number keys 10 and then presses the send key 11 to execute the phone call. In an embodiment utilizing negative feedback, if the user enters an invalid phone number, for example, a phone number including only 6 digits, the cell phone provides negative feedback, indicating that the send function is not available. The negative feedback may, for example, comprise a very low frequency buzz. In another embodiment, the actuator provides negative feedback to the user if the user clicks a redial button (not shown) without having previously dialed a number.

[0090] Other embodiments and uses of the present invention will be apparent to those skilled in the art from consideration of this application and practice of the invention disclosed herein. The present description and examples should be considered exemplary only, with the true scope and spirit of the invention being indicated by the following claims. As will be understood by those of ordinary skill in the art, variations and modifications of each of the disclosed embodiments, including combinations thereof, can be made within the scope of this invention as defined by the following claims.

Claims

1. A computer-readable medium having instructions, the instructions including instructions that cause a processor to: detect a first pressure on a first input device; provide a first tactile sensation to the first input device; detect a second pressure on the first input device, the second pressure greater than the first pressure; and provide a second tactile sensation to the first input device.

2. The computer-readable medium of claim 1 further comprising stored instructions, the stored instructions including instructions which, when executed by a processor, cause the processor to: detect a third pressure on the first input device, the third pressure greater than the second pressure; and provide a third tactile sensation to the first input device.

3. The computer-readable medium of claim 2 further comprising stored instructions, the stored instructions including instructions which, when executed by a processor, cause the processor to: detect a fourth pressure on the first input device, the fourth pressure greater than the third pressure; and provide a fourth tactile sensation to the first input device.

4. The computer-readable medium of claim 1, the first tactile sensation different from the second tactile sensation.

5. The computer-readable medium of claim 1 further comprising stored instructions, the stored instructions including instructions which, when executed by a processor, cause the processor to provide the first tactile sensation to a second input device.

6. The computer-readable medium of claim 5 further comprising stored instructions, the stored instructions including instructions which, when executed by a processor, cause the processor to provide the second tactile sensation to the second input device.

7. The computer-readable medium of claim 1 further comprising stored instructions, the stored instructions including instructions which, when executed by a processor, cause the processor to: detect a third pressure on a second input device; and provide a third tactile sensation to the second input device.

8. The computer-readable medium of claim 7, the third tactile sensation different from the first tactile sensation.

9. The computer-readable medium of claim 7 further comprising stored instructions, the stored instructions including instructions which, when executed by a processor, cause the processor to: detect a fourth pressure on the second input device, the fourth pressure greater than the third pressure; and provide a fourth tactile sensation to the second input device.

10. The computer-readable medium of claim 1, the first tactile sensation different from the second tactile sensation.

11. The computer-readable medium of claim 10, the first tactile sensation comprising a different frequency than the second tactile sensation.

12. The computer-readable medium of claim 1, the first input device comprising a button on a mobile telephone.

13. The computer-readable medium of claim 1, the first input device comprising a soft-key on a touchpad.

14. The computer-readable medium of claim 2 further comprising stored instructions, the stored instructions including instructions which, when executed by a processor, cause the processor to: upon detecting the first pressure, provide a first signal indicating a first alphanumeric character; upon detecting the second pressure, provide a second signal indicating a second alphanumeric character; and upon detecting the third pressure, provide a third signal indicating a third alphanumeric character.