

display 516, the actuator may output a haptic effect simulating the texture of water. In other embodiments, the actuator may output haptic effects configured to simulate different textures. In some embodiments, the user may assign a texture to be associated with selection box 506 and another texture to be associated with the remainder of display 516.

[0079] In some embodiments, the texture may be associated with the text within selection box 506. For example, in some embodiments, the actuator may output a course texture when the user interacts with tall letters such as "l" and a soft texture when the user interacts with short letters such as "a." In another embodiment, the actuator may output a course texture when the user interacts with uppercase letters and a softer texture when the user interacts with lowercase letters. In still other embodiments, the texture may be associated with other factors, for example, font, font size, length of the text, or length of individual words.

[0080] In some embodiments, messaging device 502 may comprise more than one actuator. In such an embodiment, these actuators may be used in combination to generate haptic effects. For example, when the haptic effects of each actuator are combined, they may form a single haptic effect that simulates a texture. In other embodiments, messaging device 502 may use the actuators separately. For example, a first actuator may output a first haptic effect when the user interacts with the section of display 516 associated with selection box 506, and a second actuator may output a second haptic effect when the user interacts with the remainder of display 516.

[0081] FIG. 6 is an illustration of a system for using textures in graphical user interface widgets according to one embodiment of the present invention. FIG. 6 comprises a system 600, which is similar to system 500 above. As shown in FIG. 6, messaging device 602 comprises a display 616 positioned underneath a touch-sensitive interface. In some embodiments (not shown in FIG. 6), system 600 may further comprise a manipulandum, such as a mouse, scroll wheel, or roller ball, which allows the user to interact with the graphical user interface on display 616.

[0082] As shown in FIG. 6, display 616 comprises text 604. Display 616 further comprises highlighted text 606, which in the embodiment shown in FIG. 6, comprises two instances of the word "parents." In some embodiments, the user may select text to be highlighted, for example by tapping the location of display 616 associated with that text. In other embodiments, a text editing program may have automatically highlighted 606, for example as a part of a search function of the text editing program. In such an embodiment, highlighted text 606 may comprise every instance of a search term in the text file.

[0083] Messaging device 602 further comprises an actuator (not shown in FIG. 6) configured to output a haptic effect configured to simulate a texture. In some embodiments, the user can feel this texture on the surface of display 616. For example, in some embodiments, when the user touches the section of display 616 associated with highlighted text 606, the actuator may output a haptic effect configured to simulate a texture. Further, in such an embodiment, the actuator may be configured to output a haptic effect simulating a different texture when the user touches a section of display 616 that is not associated with highlighted text 606. For example, when the user interacts with highlighted text 606, the actuator may output a haptic effect simulating the texture of grass. Further, when the user interacts with the remainder of display 616, the actuator may output a haptic effect simulating the texture of

ice. Such an embodiment may enable the user to quickly determine all the locations of a search term within a document, without looking at the document. In other embodiments, the actuator may output haptic effects configured to simulate different textures. In some embodiments, the user may assign a texture to be associated with highlighted text 606 and another texture to be associated with the remainder of display 616. In some embodiments, messaging device 602 may comprise more than one actuator, as described herein in relation to system 500.

[0084] FIG. 7 is an illustration of a system for using textures in graphical user interface widgets according to one embodiment of the present invention. FIG. 7 comprises a system 700, which is similar to system 500 above. As shown in FIG. 7, messaging device 702 comprises a display 716 positioned underneath a touch-sensitive interface. In some embodiments (not shown in FIG. 7), system 700 may further comprise a manipulandum, such as a mouse, scroll wheel, or roller ball, which allows the user to interact with the graphical user interface on display 716.

[0085] As shown in FIG. 7, display 716 comprises numeric keypad 704. Within numeric keypad 704 is texture key 706, which in the embodiment shown in FIG. 7 is the number 5. In other embodiments, a different key may comprise texture key 706, for example, the user may assign any key to be the texture key. Further in other embodiments, numeric keypad 704 may comprise a different type of keypad, for example a QWERTY keyboard, or some other keyboard known in the art.

[0086] Messaging device 702 further comprises an actuator (not shown in FIG. 7) configured to output a haptic effect configured to simulate a texture. In some embodiments, the user can feel this texture on the surface of display 716. For example, in some embodiments, when the user touches the section of display 716 associated with texture key 706 the actuator may output a haptic effect configured to simulate a texture. In such an embodiment, the actuator may not output a texture when the user touches other sections of the numeric keypad 704. In other embodiments, the actuator may be configured to output a different texture when the user interacts with the other sections of numeric keypad 704, but output no texture when the user interacts with other sections of display 716. Such an embodiment may allow the user to quickly determine his/her finger's location on numeric keypad 704, without looking at display 716.

[0087] In some embodiments, messaging device 702 may be configured to output more complex haptic effects configured to simulate unique textures associated with each key on numeric keypad 704. For example, in some embodiments, messaging device 702 may output haptic effects configured to simulate edges for each key on numeric keypad 704. In some embodiments, these haptic effects may comprise vibrations that simulate four edges on each key. In some embodiments, the haptic effects may be further configured to simulate a depth or surface feature for each key. In one embodiment, the haptic effect may be configured to simulate keys that are not perfectly flat, for example keys that are slightly concave. This functionality may enable the user to distinguish one key from another, and may further allow the user to distinguish the center of a key from the edge of a key. In some embodiments, similar functionality may be applied to simulate textures on a larger keyboard, for example, a full QWERTY keyboard. In some embodiments, messaging device 702 may comprise more than one actuator, as described herein in relation to system 500.