

## TOUCH-SENSITIVE DISPLAY METHOD AND APPARATUS

### CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/118,406 filed on Nov. 26, 2008, the entire contents of which are incorporated herein by reference.

### BACKGROUND

[0002] Electronic devices, including portable electronic devices, have gained widespread use and may provide a variety of functions including, for example, telephonic, electronic messaging and other personal information manager (PIM) application functions. Portable electronic devices include, for example, several types of mobile stations such as simple cellular telephones, smart telephones, wireless personal digital assistants (PDAs), and laptop computers with wireless 802.11 or Bluetooth capabilities. These devices run on a wide variety of networks from data-only networks such as Mobitex® and DataTAC® networks to complex voice and data networks such as GSM/GPRS, CDMA, EDGE, UMTS and CDMA2000 networks.

[0003] Portable electronic devices such as PDAs or smart telephones are generally intended for handheld use and ease of portability. Smaller devices are generally desirable for portability. A touch screen display for input and output is useful on such handheld devices, as such handheld devices are small and are limited in space available for user input and output. Further, the screen content on touchscreen displays may be modified depending on the functions and operations being performed. These devices have a limited area for rendering content on the touch screen display and for rendering features or icons, for example, for user interaction. With continued demand for decreased size of portable electronic devices, touch screen displays continue to decrease in size.

[0004] Improvements in touch screen devices are therefore desirable.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1 is a block diagram of a portable electronic device in accordance with the disclosure.

[0006] FIG. 2 is a front view of the portable electronic device in accordance with the disclosure.

[0007] FIG. 3 is a cross-section view of the portable electronic device through line 3-3 of FIG. 2 in accordance with the disclosure.

[0008] FIG. 4 is a sectional view of a touch-sensitive display in accordance with the disclosure.

[0009] FIG. 5 illustrates a touch sensor layer of a touch-sensitive display in accordance with the disclosure.

[0010] FIG. 6 illustrates a touch sensor layer with a force sensor in accordance with the disclosure.

[0011] FIG. 7 illustrates a touch sensor layer with multiple discrete force sensors in accordance with the disclosure.

[0012] FIG. 8 is a flowchart showing a method of responding to a touch in accordance with the disclosure.

### DETAILED DESCRIPTION

[0013] A portable electronic device comprises at least one force sensor configured to generate a force signal based at least in part on a force applied to a touch-sensitive display and

a processor configured to receive the force signal and to provide a feedback signal when the force exceeds a force threshold. The at least one force sensor may be integrated into the touch-sensitive display. The at least one force sensor may be distributed within a layer of the touch-sensitive display. The touch-sensitive display may comprise a plurality of layers comprising a touch sensor and the at least one force sensor. A layer of the touch-sensitive display may comprise a touch sensor and at least one force sensor. The portable electronic device may comprise an actuator configured to provide tactile feedback in response to the feedback signal. The actuator may provide tactile feedback by moving the touch-sensitive display relative to a housing of the portable electronic device. The processor may be configured to utilize at least a location of a detected touch and the force signal to determine whether to provide the feedback signal. The controller may be configured to evaluate a time duration of the touch to determine, at least in part, whether to provide the feedback signal. The touch-sensitive display may be configured to provide a visual indicator associated with a location of the force when the force is below the force threshold.

[0014] A method comprises detecting a touch at a location on a touch-sensitive display, determining a force of the touch, and when the force exceeds a force threshold, providing tactile feedback and performing a function associated with the location. When the force is below the force threshold, no tactile feedback may be provided. When the force is below the force threshold, a visual indicator associated with the location may be provided. The method may further comprise evaluating the force of the touch and the location of the touch to determine whether to send a feedback signal to an actuator to provide the tactile feedback. When the location of the touch is not associated with a function, no tactile feedback may be provided when the force of the touch exceeds the force threshold. The method may further comprise determining a time duration of the touch and evaluating the time duration, at least in part, to determine whether to provide the tactile feedback. A computer readable medium may have computer-readable code executed by at least one processor of a portable electronic device to perform the methods described above.

[0015] A touch-sensitive display comprises at least one touch sensor and at least one force sensor integrated into the touch-sensitive display and is configured to determine a location of a touch on the touch-sensitive display. The touch sensor and the at least one force sensor may be formed during the same process. The touch sensor and the at least one force sensor may be formed of the same material.

[0016] For simplicity and clarity of illustration, reference numerals may be repeated among the figures to indicate corresponding or analogous elements. In addition, numerous specific details are set forth in order to provide a thorough understanding of the embodiments described herein. The embodiments described herein may be practiced without these specific details. In other instances, well-known methods, procedures and components have not been described in detail so as not to obscure the embodiments described herein. Also, the description is not to be considered as limited to the scope of the embodiments described herein.

[0017] The disclosure generally relates to an electronic device, which may be, for example, a portable electronic device. Examples of portable electronic devices include mobile, or handheld, wireless communication devices such as pagers, cellular phones, cellular smart-phones, wireless organizers, personal digital assistants, wirelessly enabled note-