virtual click wheel, the present invention enables a user to find and operate the virtual click wheel non-visually.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The above and other objects and advantages of the invention will be apparent upon consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

[0014] FIG. **1** shows an illustrative cross-section of an exemplary transparent piezoelectric actuator in accordance with some embodiments of the present invention;

[0015] FIG. **2** shows an exemplary grid of individually-addressable transparent piezoelectric actuators;

[0016] FIG. **3** shows exemplary control signals for selectively activating an individual piezoelectric actuator;

[0017] FIG. **4** shows an exemplary electronic device with a touchscreen that is configured to provide localized tactile feedback in accordance with some embodiments of the present invention;

[0018] FIG. **5** shows a cross-section of the side of an exemplary grid of transparent piezoelectric actuators overlaying a touchscreen;

[0019] FIG. **6** shows an exemplary graphical user interface that may be presented by a device comprising a touchscreen input component;

[0020] FIG. **7** shows an exemplary block diagram of circuitry that can be included in an electronic device in accordance with some embodiments of the present invention; and

[0021] FIGS. **8**A and **8**B show flowcharts for an exemplary method in accordance with some embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] Recent developments in technology allow smaller electronic devices to have increased functionality. However, as more functionality is packed into smaller devices, the user interface component(s) of the electronic devices (e.g., keyboard, number pad, click wheel, etc.) are increasingly becoming the limiting factor.

[0023] One solution is to utilize a touchscreen user interface component. A touchscreen user interface component enables the same physical space to be used a number of ways. A single touchscreen user interface component can be used instead of a plurality of other user input and display components.

[0024] However, as discussed briefly above, touch-based user interface components can present various challenges to visually impaired users, especially when the touch-based user interface component is used in conjunction with a display screen. As used herein, the phrase "visually impaired" refers to users that are permanently visually impaired (e.g., blind) or temporarily visually impaired (e.g., able to see, but are unable or unwilling to divert their attention to their electronic device's display screen, because there is not enough light to see, they are driving, etc.). Police officers, for example, sometimes have a laptop computer in their patrol cars. A laptop computer's mouse pad that is in accordance with the present invention, could provide haptic feedback to the officer, so that the officer does not have to look at the computer screen while driving.

[0025] Audio cues and/or specialized menu hierarchies, for example, could also assist visually impaired users when interacting and utilizing their touchscreen devices. In such embodiments, the display component can be omitted from the electronic device altogether. Systems, methods, computer readable media and other means for utilizing a multi-touch user interface component in the absence of a visual display are discussed in more detail in commonly assigned U.S. patent application Ser. No. _____, entitled "NON-VISUAL CONTROL OF MULTI-TOUCH DEVICES" (client docket no. P5665US1), which is incorporated herein by reference in its entirety.

[0026] Although the present invention could be used in conjunction with audio cues and/or specialized menu hierarchies, the present invention could just as easily be used in the absence of specialized audio cues and/or menu hierarchies. The present invention, among other things, can provide haptic feedback to help a user find a virtual button or other user-selectable input element with a touch-based input component. Localized dynamic haptic feedback can enable, for example, a visually impaired user to feel what is being displayed, locate a virtual button and select the virtual button by tapping it. Additional systems, methods, computer readable media and other means for combining dynamic haptic feedback with a touch-based input components, as well as examples of when and how to use dynamic haptic feedback are discussed in more detail in commonly assigned U.S. patent application Ser. No. _____, entitled "TACTILE FEEDBACK IN AN ELECTRONIC DEVICE" (client docket no. P5345US1), which is hereby incorporated herein by reference in its entirety.

[0027] Among other things, the present invention teaches how to provide dynamic, localized haptic feedback. Throughout this disclosure, examples related to a touchscreen input component of a portable media device are used to describe the present invention. One skilled in the art will appreciate that dynamic, localized haptic feedback can be used with any type of surface and/or input component of any type of device. For example, dynamic haptic feedback can be integrated into a motor vehicle's steering wheel, stereo system, audio volume knob, television remote control, computer peripheral device, doorknob, chair, mouse pad, and/or any other device or component of a device. One skilled in the art will also appreciate that dynamic, localized, haptic feedback can be provided using any touch-based sensation including vibration, heat, shock, and/or any other sensation a user can feel.

[0028] FIG. **1** shows an exemplary, cross-sectional view of piezoelectric actuator **100**, which is in accordance with some embodiments of the present invention. The surface area of piezoelectric actuator **100** can be, for example, 10 square millimeters, 10 square micrometers, 10 square nanometers, or any other size that is physically possible.

[0029] Piezoelectric actuator **100** includes electrodes **102** and **104** and piezoelectric material **106**, any or all of which can be transparent, opaque, or a combination thereof. Piezoelectric material **106** can include, for example, one or more natural crystals (such as, e.g., Berlinite, cane sugar, quartz, Rochelle salt, topaz, and/or any tourmaline group mineral(s)), man-made crystals (such as, e.g., Gallium orthophosphate or langasite), ceramics, bone, polymers, and/or any other material that is able to mechanically deform in response to an applied electric potential, which is sometimes referred to herein as the piezoelectric effect. Piezoelectric material **106** is sandwiched between transparent electrodes **102** and **104**. In the present invention, the materials used in electrodes **102** and