

## USER INTERFACE HAVING CHANGEABLE TOPOGRAPHY

### CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application No. 61/140,050, filed Dec. 22, 2008, the contents of which are herein incorporated by reference in their entirety for all purposes.

### FIELD OF THE INVENTION

[0002] This relates to user interfaces and, more particularly, to user interfaces that can change topography.

### BACKGROUND OF THE INVENTION

[0003] Many types of input devices are presently available for performing operations in a computing system, such as buttons or keys, mice, trackballs, touch sensor panels, joy-sticks, touch pads, touch screens and the like. Touch screens and touch pads, in particular, are becoming increasingly popular because of their ease and versatility of operation as well as their declining price. Touch screens can include a touch sensor panel, which can be a clear panel with a touch sensitive surface, and a display device that can be positioned behind the panel so that the touch sensitive surface can substantially cover the viewable area of the display device. Touch screens can allow a user to perform various functions by touching the touch sensor panel using one or more fingers, a stylus or other object at a location dictated by a user interface (UI) comprising virtual buttons, keys, bars, displays, and other elements, being displayed by the display device. In general, touch screens can recognize a touch event and the position of the touch event on the touch sensor panel, and the computing system can then interpret the touch event in accordance with the display appearing at the time of the touch event, and thereafter can perform one or more actions based on the touch event.

[0004] Similarly, touch pads can include a touch sensor panel having a touch sensitive surface. Touch pads can allow a user to perform various functions by touching the touch sensor panel using one or more fingers, a stylus or other object at a location dictated by a UI comprising a touch space. In general, touch pads can recognize a touch event and the position of the touch event on the touch sensor panel, and the computing system can then interpret the touch event in accordance with the position of the touch event, and thereafter can perform one or more actions based on the touch event.

[0005] Touch screens and touch pads can typically have a smooth fixed outer surface through which inputs/outputs can be made. For example, the outer surface can act as an input mechanism that receives touch inputs such as taps, slides and other gestures. With touch screens, the outer surface can further act as a window for displaying text and graphics that change during use. In most cases, the physical surfaces of these devices can be smooth and fixed. In some cases, they can be flat and planar. They generally do not include tactile features like buttons and therefore can be used across many modes, applications or platforms. However, because these surfaces generally do not include tactile features, the user can

have a difficult time locating UI elements without looking at the visual screen to ensure that the desired location is touched.

### SUMMARY OF THE INVENTION

[0006] This relates to a user interface that can physically change topography to create different tactile configurations at the user interface surface. In some embodiments, the user interface can change topography according to a desired user interface state. The user interface state can, for example, be based on a mode of an electronic device in which the user interface is used and/or a particular preference of a user. In some embodiments, the user interface can change topography according to an event, such as a touch event on the user interface surface. The changing topography can define different user interface layouts according to the needs of device.

[0007] In some embodiments, the user interface can include a shape changeable surface configured to selectively alter topography of the user interface so as to provide a variable tactile feel of the user interface. The shape changeable surface can include individual nodes that can be raised above or lowered below the initial surface. Alternatively, the shape changeable surface can include shape changeable material that can change shape to form discrete shapes above or below the initial surface. Alternatively, the shape changeable surface can include deformable material that can deform into discrete forms above or below the initial surface.

[0008] In some embodiments, the user interface can include shape changeable nodes proximate to the user interface surface and configured to selectively alter so as to alter a proximate region of the surface in order to alter topography of the user interface. The nodes can include electromechanical devices that can move to push against or pull away from the surface. Alternatively, the nodes can include shape changeable elements that can change shape to push against or pull away from the surface. Alternatively, the nodes can include deformable elements that can deform to push against or pull away from the surface.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 illustrates an exemplary user interface that can change topography according to embodiments of the invention.

[0010] FIG. 2 illustrates an exemplary user interface that can change topography by selectively altering individual shape changeable nodes according to embodiments of the invention.

[0011] FIG. 3 illustrates an exemplary user interface that can change topography by selectively altering a group of shape changeable nodes according to embodiments of the invention.

[0012] FIG. 4 illustrates an exemplary user interface that can change topography using various modules according to embodiments of the invention.

[0013] FIG. 5 illustrates an exemplary method for changing the topography of a user interface according to embodiments of the invention.

[0014] FIG. 6 illustrates an exemplary touch screen having a user interface that can change topography according to embodiments of the invention.

[0015] FIG. 7 illustrates an exemplary touch screen having a user interface that can change topography to form virtual buttons according to embodiments of the invention.