

**MULTIMODAL ADAPTIVE USER
INTERFACE FOR A PORTABLE
ELECTRONIC DEVICE**

BACKGROUND

[0001] 1. Technical Field

[0002] This invention relates generally to electronic devices having user interfaces, and more particularly to an electronic device having a user interface, such as a keypad, that may be configured to present a variety of device-mode-based keypad configurations to a user.

[0003] 2. Background Art

[0004] Portable electronic devices, such as radiotelephones, are becoming more and more popular. According to some estimates, over two billion mobile telephones are in use across the world today. As more people come to use mobile devices, designers and engineers are creating devices that integrate more and more features. For instance, many mobile telephones today also include digital camera functions and text messaging functions. Some even include music playback functions.

[0005] One issue associated with the integration of new features and functionality with devices like mobile telephones involves the user interface. Traditional mobile telephones only included twelve to fifteen keys. These keys included the standard 12-digit telephone keypad, along with a "send" key and an "end" key. Such devices are sometimes not compatible with new features and functions as new modes of operation require new, dedicated keys or input devices in addition to the basic phone keys. Further, the devices may also require additional keys for the purpose of navigation or initiation of the modes within the device.

[0006] One solution to the need for more keys in the user interface is to simply add more buttons to the device. Some devices, for example, include full keypads with forty to fifty keys. The problem with this solution is that many mobile devices, including mobile telephones, are getting smaller and thinner. When many keys are clustered in one location, the likelihood of user confusion or difficulty with operation of the device increases. What's more, in a particular mode, many of the keys are not needed. For example, when a device is in a camera mode, the number keys 1-9 are generally not needed to take pictures.

[0007] A further problem associated with user interfaces involves visibility. It is desirable to be able to see user interfaces in both low-light and bright-light environments. When device user interfaces are crowded with many keys, each key is generally configured to be as small as possible while still permitting acceptable usage characteristics. The typical way to illuminate a user interface is with a backlight, where a light behind the keys projects through the keys. As the keys get smaller and are placed more closely together, the surface area of each key through which light may pass becomes smaller. This results in less visible user interface in low-light conditions.

[0008] Thus there is a need for an improved user interface for electronic devices that provides a plurality of user interfaces, where each interface includes keys required for a particular mode of operation, and which exhibits good visibility in both low-light and bright-light conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 illustrates an electronic device having a shutter enabled dynamic keypad in accordance with one embodiment of the invention.

[0010] FIG. 2 illustrates an exploded view of one embodiment of a dynamic keypad interface in accordance with the invention.

[0011] FIG. 3 illustrates a sectional view of one embodiment of a dynamic keypad interface in accordance with the invention.

[0012] FIG. 4 illustrates one embodiment of a capacitive sensor in accordance with the invention.

[0013] FIG. 5 illustrates one embodiment of a proximity sensor in accordance with the invention.

[0014] FIG. 6 illustrates an exploded view of a twisted nematic liquid crystal display in accordance with one embodiment of the invention.

[0015] FIG. 7 illustrates an optical shutter in the opaque state in accordance with one embodiment of the invention.

[0016] FIG. 8 illustrates an exemplary segmented optical shutter having sample shutters open, or in the translucent state, in accordance with the invention.

[0017] FIG. 9 illustrates a segmented electroluminescent device in accordance with one embodiment of the invention.

[0018] FIG. 10 illustrates one embodiment of a resistive switch layer in accordance with the invention.

[0019] FIG. 11 illustrates one embodiment of a substrate layer in accordance with the invention.

[0020] FIG. 12 illustrates one embodiment of a tactile feedback layer in accordance with the invention.

[0021] FIG. 13 illustrates an exploded view of one embodiment of a dynamic keypad interface in accordance with the invention.

[0022] FIG. 14 illustrates a perspective view of an assembled dynamic keypad interface in accordance with one embodiment of the invention.

[0023] FIG. 15 illustrates a perspective view of an assembled dynamic keypad interface being inserted into an electronic device in accordance with one embodiment of the invention.

[0024] FIG. 16 illustrates a resistive switch sensing area in accordance with one embodiment of the invention.

[0025] FIG. 17 illustrates a capacitive switch sensing area in accordance with one embodiment of the invention.

[0026] FIG. 18 illustrates an exemplary multimodal device in an OFF or low-power state in accordance with one embodiment of the invention.

[0027] FIG. 19 illustrates an exemplary multimodal device in accordance with one embodiment of the invention.

[0028] FIG. 20 illustrates an exemplary multimodal device in accordance with one embodiment of the invention.

[0029] FIG. 21 illustrates an exemplary multimodal device in accordance with one embodiment of the invention.

[0030] FIG. 22 illustrates an exemplary multimodal device in accordance with one embodiment of the invention.

[0031] FIG. 23 illustrates an exemplary multimodal device in accordance with one embodiment of the invention.

[0032] FIG. 24 illustrates an exemplary multimodal device in accordance with one embodiment of the invention.

[0033] Skilled artisans will appreciate that elements in the figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. For example, the dimensions of some of the elements in the figures may be exaggerated relative to other elements to help to improve understanding of embodiments of the present invention.