

**METHOD AND APPARATUS FOR  
PROVIDING A HAPTIC FEEDBACK  
SHAPE-CHANGING DISPLAY**

RELATED APPLICATIONS

**[0001]** This application claims priority to U.S. Provisional Patent Application Nos. 61/176,431 filed May 7, 2009, and 61/231,708 filed Aug. 6, 2009, the specification of each is herein incorporated by reference.

FIELD

**[0002]** Embodiments of the invention are directed to electronic interface devices, and more particularly to shape changing devices.

BACKGROUND INFORMATION

**[0003]** As portable computing devices such as cell phones and personal digital assistants (“PDAs”) become more prevalent in recent years, the ease of use relating to human machine interface has become increasingly important. A conventional portable computing device may include various input/output (“I/O”) methods to facilitate human-machine interface such as keypads, touch screens, dedicated buttons, track balls, mouse, and the like. For example, a user presses a region on a touch screen commonly with a fingertip to emulate a button press on a panel in accordance with graphics displayed behind the panel on the display device.

**[0004]** A wide variety of device configuration and/or shapes associated with typical portable computing devices are structured with various physical constraints, particularly with limited I/O options for the human-machine interface. Typical portable computing devices such as cell phones, for example, come in various shapes and designs, wherein each design of the cell phone is usually optimized to achieve an acceptable level of comfort for holding the phone. A drawback associated with a typical portable computing device is that the shape of the outer enclosure of the phone is normally designed for holding with one hand while talking. The shape or structure of a phone with optimized outer enclosure, however, is typically not suitable for various other scenarios such as typing text messages.

**[0005]** Similar drawbacks to those discussed above with regard to portable computing devices may also be associated with various conventional handheld gaming devices. In addition, conventional handheld gaming devices provide various haptic effects but may benefit from a richer range of such haptic effects to provide users with an improved gaming experience.

SUMMARY

**[0006]** One embodiment is a haptic device that includes a processor, a communication module coupled to the processor for receiving a shape input, and a housing for housing the communication module and including a deformable portion. The deformable portion includes a deformation actuator, and the processor provides a signal to the deformation actuator in response to the shape input to deform the housing. The shape of other areas of the device may also change in response to the signal. The shape changes may provide haptic effects, pro-

vide information, provide ergonomic changes, provide additional functionality, etc., to a user of the device.

BRIEF DESCRIPTION OF THE DRAWINGS

**[0007]** FIG. 1 is a block diagram illustrating a portable device capable of providing kinesthetic effects in accordance with embodiments of the present invention.

**[0008]** FIGS. 2a and 2b are block diagrams illustrating exemplary portable handheld devices in accordance with embodiments of the present invention.

**[0009]** FIG. 3 illustrates an example of a cell phone with a slider bar surface characteristic in accordance with embodiments of the present invention.

**[0010]** FIGS. 4a-4c illustrate examples of shape changing gaming devices in accordance with embodiments of the present invention.

**[0011]** FIG. 5 is a block diagram illustrating a shape changing device emulating a tennis racket gaming console in accordance with embodiments of the present invention.

**[0012]** FIG. 6 is a block diagram illustrating an example of control structure for a shape changing device in accordance with embodiments of the present invention.

**[0013]** FIG. 7 is a flow diagram illustrating a method of controlling a deformable surface for a device in accordance with embodiments of the present invention.

**[0014]** FIG. 8 illustrates a handheld device capable of providing haptic effects in accordance with various embodiments of the present invention.

**[0015]** FIG. 9 illustrates various haptic effects that may be provided via a handheld device in accordance with various embodiments of the present invention.

**[0016]** FIG. 10 illustrates an input and a haptic output that may be used to simulate a force haptic effect in accordance with various embodiments of the present invention.

**[0017]** FIG. 11 illustrates various views of a handheld device capable of providing various haptic effects in accordance with an embodiment of the present invention.

**[0018]** FIG. 12 illustrates various views of a handheld device capable of providing various haptic effects in accordance with an embodiment of the present invention.

**[0019]** FIG. 13 illustrates various views of a handheld device capable of providing various haptic effects in accordance with an embodiment of the present invention.

**[0020]** FIG. 14 is a block diagram of a deformation effect device in accordance with one embodiment of the invention.

**[0021]** FIG. 15 is a perspective view of a game controller in accordance with one embodiment of the invention.

**[0022]** FIG. 16 is a perspective view of a computer mouse in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION

**[0023]** One embodiment of the present invention is a portable computing system capable of macroscopically altering its physical shape using vibrotactile haptic feedback. The system, in one embodiment, includes an electronic communication component, housing, and a haptic surface. The electronic communication component for instance is capable of receiving a shape input and is configured to be a wireless communication device such as a phone or a gaming apparatus. The housing, also known as an outer enclosure of the system, houses the electronic communication component. The haptic surface which overlays at least a portion of the