

## HAPTIC FEEDBACK SYSTEM

### FIELD OF THE INVENTION

**[0001]** This relates to devices that provide haptic feedback at a surface and, more particularly, to haptic devices capable of providing haptic sensations at different locations across a surface such as an input/output surface.

### BACKGROUND OF THE INVENTION

**[0002]** 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, joysticks, touch screens and the like. Touch screens, 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) 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.

**[0003]** The touch screen typically has a smooth touch-sensitive surface. As such, unlike standard keyboards that have physical buttons and keys that the user presses down to select, the UI virtual buttons and keys are selected merely by touching the touch screen at their displayed locations. As such, when a virtual button or key is touched, the user does not get the tactile feedback that pressing on the standard keyboard provides and must therefore watch the UI to ensure that the button or key was in fact touched.

### SUMMARY OF THE INVENTION

**[0004]** The invention relates, in one embodiment, to a haptic feedback device. The haptic feedback device includes a plurality of controllable nodes disposed between a first and a second surface. The controllable nodes are configured to change between transmission states and a non-transmission states so as to provide a localized haptic response in discrete regions of the first surface when the second surface is powered with a haptic signal.

**[0005]** The invention relates, in one embodiment, to a touch sensitive device. The touch sensitive device includes touch surface having a plurality of touch regions configured to detect a touch. The touch sensitive device also includes a plurality of haptic transmission nodes positioned proximate to the touch surface. Each haptic transmission node is configured to correspond to at least one touch region and is configured to be in a transmission state so as to transmit a haptic feedback signal to the at least one corresponding touch surface region when the at least one corresponding touch surface region receives the touch.

**[0006]** The invention relates, in one embodiment, to a system having a touch sensitive device and a haptic device. The system includes a surface. The surface may for example be a surface that interfaces with a user. The system also includes a

sensor arrangement configured to detect a location of an object in close proximity to the surface. The system additionally includes a haptic signal generator configured to produce a haptic signal when an object is detected. The system further includes a plurality of haptic transmission nodes positioned at different locations relative to the surface. The haptic transmission nodes are configured to receive the haptic signal from the haptic signal generator, and to change states in order control the transmission of the haptic signal to the surface. The haptic transmission nodes associated with the location of the object substantially transmitting the haptic signal to the surface. The haptic transmission nodes not associated with the location of the object substantially not transmitting the haptic signal to the surface.

**[0007]** The invention relates, in one embodiment, to a method for providing a haptic feedback signal to an input surface. The method includes identifying at least one haptic transmission node corresponding to a location of an input on the input surface. The method also includes placing the identified haptic transmission node into a transmission state. The method additionally includes generating a haptic feedback signal. The method further includes transmitting the generated haptic feedback signal via the at least one identified haptic transmission node to the location of the input on the input surface.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0008]** FIG. 1a illustrates a side view of an exemplary haptic system according to embodiments of the invention.

**[0009]** FIG. 1b illustrates a top view of the exemplary haptic system of FIG. 1a according to embodiments of the invention.

**[0010]** FIG. 2 illustrates a block diagram of an exemplary haptic system according to embodiments of the invention.

**[0011]** FIGS. 3a through 3f illustrate various states of exemplary haptic transmission nodes according to embodiments of the invention.

**[0012]** FIG. 4a illustrates a side view of an exemplary touch sensitive device with haptic feedback according to embodiments of the invention.

**[0013]** FIG. 4b illustrates a top view of the exemplary touch sensitive device of FIG. 4a according to embodiments of the invention.

**[0014]** FIGS. 5a through 5g illustrate various states of exemplary haptic transmission nodes of an exemplary touch sensitive device according to embodiments of the invention.

**[0015]** FIG. 6a illustrates a touch location on an exemplary touch sensitive device according to embodiments of the invention.

**[0016]** FIG. 6b illustrates haptic feedback at a touch location on an exemplary touch sensitive device according to embodiments of the invention.

**[0017]** FIG. 7 illustrates an exemplary channel waveguide on an exemplary touch sensitive device for transmitting haptic feedback according to embodiments of the invention.

**[0018]** FIG. 8 illustrates an exemplary haptic feedback circuit for a haptic system according to embodiments of the invention.

**[0019]** FIG. 9a illustrates a side view of another exemplary touch sensitive device with haptic feedback according to embodiments of the invention.

**[0020]** FIG. 9b illustrates a top view of the exemplary touch sensitive device of FIG. 9a according to embodiments of the invention.