

METHOD AND APPARATUS FOR PROVIDING HAPTIC EFFECTS TO A TOUCH PANEL

GOVERNMENT INTEREST

[0001] This invention was made with support under grant number DMI-0441692 from the National Science Foundation. The United States Government has certain rights in the invention.

FIELD OF THE INVENTION

[0002] The present invention relates to the field of computer interface systems. More particularly, the present invention relates to a user interface device that provides haptic effect in response to user inputs.

BACKGROUND OF THE INVENTION

[0003] As computer-based systems, appliances, automated teller machines (ATM), point-of-sale terminals and the like become more prevalent, the ease of use of the human-machine interface is becoming more and more important. Such interfaces should operate intuitively and with little or no training so that they may be employed by virtually anyone. Many conventional user interface devices are available on the market and include the keyboard, the mouse, the joystick, the touch screen, and the touchpad. One of the most intuitive and interactive interface devices known is the touch panel, which is also known as a touch screen, a touch pad, a touch screen display, and so forth. A touch panel includes a touch-sensitive input panel and a display device, usually in a sandwich structure and provides a user with a machine interface through touching a panel sensitive to the user's touch and displaying content that the user "touches."

[0004] A touch panel can be a small planar rectangular pad, which can be installed in or near a computer, an automobile, ATM machines, and the like. A conventional touch-sensitive component of a touch panel employs various types of touch sensing technology such as capacitive sensing, pressure sensing and the like as known in the art to detect locations being pressed on the panel. For example, a user contacts the touch-sensitive panel commonly with a fingertip to emulate a button press and/or moves his or her finger on the panel according to the graphics displayed behind the panel on the display device.

[0005] A problem associated with conventional touch panels is that they lack the capability of providing interactive tactile acknowledgements to indicate whether input has been accepted or rejected.

[0006] Accordingly, there is a need for a touch panel to provide an interactive tactile feedback to indicate whether a user's selection has been accepted or rejected and/or other appropriate or desirable effects.

SUMMARY OF THE INVENTION

[0007] A method and apparatus for generating haptic effects for a touch panel or other interface device employs a touch-sensitive panel, a display and an actuator. The actuator includes a first structural element and a second structural element, a biasing element and two magnetic devices. The first magnetic device is configured to be carried by the first structural element and the second magnetic device is configured to be carried by the second structural element. The

first structural element is coupled to a touch-sensitive panel and the second structural element may be coupled to the display or a relatively fixed item. The biasing element, which may be implemented as a spring, flexible blade, elastomeric element, flexure spring, resilient foam, rubber-like element, or other spring-like device, couples the first and second structural elements together and deforms to facilitate a movement between the first and second structural elements. The actuator provides haptic effects by facilitating relative movement between the first and second structural elements and the haptic effects are imparted to the touch-sensitive panel.

[0008] Additional features and benefits of the present invention will become apparent from the detailed description, figures and claims set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The accompanying drawings, which are incorporated into and constitute as part of this specification, illustrate one or more embodiments of the present invention and, together with the detailed description, serve to explain the principles and implementations of the invention.

[0010] In the drawings:

[0011] FIG. 1 is an elevational diagram illustrating an actuator for providing haptic effects in accordance with one embodiment of the present invention;

[0012] FIG. 2 is an elevational diagram illustrating alternative electromagnetic components for generating attractive magnetic force in an actuator in accordance with one embodiment of the present invention;

[0013] FIG. 3 is an elevational diagram of an alternative embodiment of an actuator in accordance with the present invention;

[0014] FIG. 4 is an elevational diagram of another embodiment of an actuator in accordance with the present invention;

[0015] FIG. 5 is an elevational diagram of a system employing an actuator in accordance with one embodiment of the present invention;

[0016] FIG. 6 is an elevational diagram illustrating a second equilibrium position of an actuator in accordance with one embodiment of the present invention;

[0017] FIG. 7 is a front perspective diagram of a system configured with a plurality of actuators in accordance with one embodiment of the present invention;

[0018] FIG. 8 is a flow diagram illustrating a method for generating haptic effects in accordance with one embodiment of the present invention; and

[0019] FIG. 9 is a block diagram illustrating a system having an actuator in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION

[0020] Embodiments of the present invention are described herein in the context of a method and apparatus for providing haptic effects to a touch panel. Those of ordinary skill in the art will realize that the following detailed description of the present invention is illustrative only and is