HAND-HELD DEVICE WITH TOUCHSCREEN AND DIGITAL TACTILE PIXELS

FIELD OF THE INVENTION

[0001] Embodiments of the present invention are related to handheld devices and more particularly to hand-held devices that utilize touchscreens.

BACKGROUND OF THE INVENTION

[0002] Touchscreens are displays which also have the ability to detect the location of touches within the display area. This allows the display to be used as an input device, removing the keyboard and/or the mouse as the primary input device for interacting with the display's content. Such displays can be attached to computers or, as terminals, to networks. Touchscreens also have assisted in recent changes in the design of personal digital assistant (PDA), satellite navigation and mobile phone devices, making these devices more usable.

[0003] Touchscreens have become commonplace since the invention of the electronic touch interface in 1971 by Dr. Samuel C. Hurst. They have become familiar in retail settings, on point of sale systems, on automatic teller machines (ATMs) and on PDAs where a stylus is sometimes used to manipulate a graphical user interface (GUI) and to enter data. The popularity of smart phones, PDAs, portable game consoles and many types of information appliances is driving the demand for, and the acceptance of, touchscreens.

[0004] Existing touch screens are configured to receive a mechanical input and provide a visible output. However, existing touch screens are not configured to provide both a visible and a mechanical output.

[0005] It is within this context that embodiments of the present invention arise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The teachings of the present invention can be readily understood by considering the following detailed description in conjunction with the accompanying drawings, in which:

[0007] FIG. **1**A is a block diagram of a hand-held device according to an embodiment of the present invention.

[0008] FIG. **1**B is a three-dimensional diagram of a hand-held device according to an embodiment of the present invention.

[0009] FIG. **1**C is a three-dimensional diagram of a hand-held device according to another alternative embodiment of the present invention.

[0010] FIG. **1**D is a three-dimensional diagram of a hand-held device according to another alternative embodiment of the present invention.

[0011] FIG. **1**E is a side elevation diagram of a hand-held device according to another alternative embodiment of the present invention.

[0012] FIG. **2** is a flow diagram of illustrating operation of a hand-held device of the type shown in FIGS. **1**A-**1**E.

[0013] FIG. **3** is a three-dimensional diagram illustrating use of a portion of the tactile array as a command button in a hand-held device according to an embodiment of the present invention.

[0014] FIG. **4** is a three-dimensional diagram illustrating use of a portion of a tactile array as a scroll wheel in a hand-held device according to an embodiment of the present invention.

[0015] FIG. **5** is a three dimensional diagram illustrating use of a portion of a tactile array to indicate an end of a scrolling in a hand-held device according to an embodiment of the present invention.

[0016] FIGS. **6**A-**6**B are three dimensional diagrams illustrating use of a portion of a tactile array as a level indicator in a hand-held device according to an embodiment of the present invention.

[0017] FIG. **7** is a three-dimensional diagram of an electronic device according to an alternative embodiment of the invention.

DESCRIPTION OF THE SPECIFIC EMBODIMENTS

[0018] Although the following detailed description contains many specific details for the purposes of illustration, anyone of ordinary skill in the art will appreciate that many variations and alterations to the following details are within the scope of the invention. Accordingly, the exemplary embodiments of the invention described below are set forth without any loss of generality to, and without imposing limitations upon, the claimed invention.

[0019] According to an embodiment of the invention, a shown in FIG. **1**A, a handheld electronic device **100** includes a case **101** with a touch screen **102** formed on a major surface of the case **101**. The case may be of sufficiently small size that it can be held in a user's hand. An array of one or more digital tactile pixels **104** may be located proximate an edge of the touch screen **102**. The device may include a controller **103**, the components of which may be located within the case **101**. The controller **103** includes a processor **106** operably coupled to the touch screen **102**. In some embodiments, the device **100** may include multiple processors **106** if parallel processing is to be implemented. The device **100** may be configured for use as a game device, a phone, a portable media player, an email device, web browser device and the like.

[0020] The touch screen **102** may be based on any suitable touch screen technology, such as resistive, surface-acoustic wave (SAW) capacitive, infrared, strain gauge, optical imaging, dispersive signal technology, acoustic pulse recognition, frustrated total internal reflection or graphics tablet based on magneto-strictive technology to locate the tip of a stylus. By way of example a resistive touch screen panel may be composed of several layers including two thin metallic electrically conductive and resistive layers separated by thin space. When some object touches this kind of touch panel, the layers are connected at certain point. The panel then electrically acts similar to two voltage dividers with connected outputs. This causes a change in the electrical current which is registered as a touch event which may be sent to the processor **106** for processing.

[0021] Surface Acoustic Wave technology uses ultrasonic waves that pass over the touch screen panel. When the panel is touched, a portion of the wave is absorbed. This change in the ultrasonic waves registers the position of the touch event and sends this information to the controller for processing.

[0022] A capacitive touch screen panel may be coated with a material, e.g., indium tin oxide that conducts a continuous electrical current across the sensor. The sensor therefore exhibits a precisely controlled field of stored electrons in both the horizontal and vertical axes. When the capacitive touch screen's 'normal' capacitance field (its reference state) is altered by an externally applied electric field, e.g., from a user's finger, electronic circuits located at each corner of the