

embodiment of the present invention, in the case where the operable element is configured as a user interface (UI) realized by a liquid crystal display (LCD) apparatus;

[0053] FIG. 4 illustrates an exemplary position sensor, herein configured by way of example as a sensor using electrostatic capacitive coupling;

[0054] FIG. 5 is a diagram for explaining the principle for producing friction in a user interface feedback apparatus in accordance with an embodiment of the present invention;

[0055] FIG. 6 illustrates an exemplary configuration of a user interface feedback apparatus in accordance with an embodiment of the present invention, herein configured by way of example as a two-dimensional (2D) user interface feedback apparatus;

[0056] FIG. 7 illustrates an exemplary configuration of a user interface feedback apparatus in accordance with an embodiment of the present invention, herein configured by way of example as a two-dimensional (2D) user interface feedback apparatus for use as a touch pad in a device such as a PC;

[0057] FIG. 8 illustrates an exemplary configuration of a user interface feedback apparatus in accordance with an embodiment of the present invention, herein configured by way of example such that an image is displayed on a screen by a projector, and wherein the user performs interface operations with respect to the image displayed on the screen;

[0058] FIG. 9 illustrates the configuration of the screen in the embodiment shown in FIG. 8;

[0059] FIG. 10A illustrates an exemplary configuration of a user interface feedback apparatus in accordance with an embodiment of the present invention, herein configured by way of example as a one-dimensional (1D) user interface feedback apparatus;

[0060] FIG. 10B illustrates an exemplary configuration of a user interface feedback apparatus in accordance with an embodiment of the present invention, herein configured by way of example as a one-dimensional (1D) user interface feedback apparatus;

[0061] FIG. 11 is a flowchart for explaining a processing sequence executed by a user interface feedback apparatus in accordance with an embodiment of the present invention; and

[0062] FIG. 12 illustrates an exemplary hardware configuration of a user interface feedback apparatus in accordance with an embodiment of the present invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0063] Hereinafter, a user interface feedback apparatus, a user interface feedback method, and a program in accordance with embodiments of the present invention will be described in detail and with reference to the accompanying drawings. The description will proceed as follows.

[0064] (1) Exemplary configuration of user interface feedback apparatus and explanation of principles

[0065] (2) Specific examples of user interface feedback apparatus

(1) Exemplary Configuration of User Interface Feedback Apparatus and Explanation of Principles

[0066] First, an exemplary configuration of a user interface feedback apparatus, and the operating principles thereof, will be described. A user interface feedback apparatus in accordance with an embodiment of the present invention provides

user interface feedback to users, and is applicable to a variety of information processing equipment. Such apparatus are referred to as tactile interfaces and haptic apparatus, for example. A user interface feedback apparatus in accordance with an embodiment of the present invention may, for example, be integrated with a liquid crystal display (LCD) apparatus as a haptic display, or used as a touch pad or large screen display apparatus.

[0067] For example, if an embodiment of the present invention is integrated with an LCD apparatus, the operable element may be displayed on the LCD as images or icons of elements such as switches, buttons, sliders, and dials. When the user performs an operation by touching such display images or icons with his or her finger, a physical sensation, such as that of friction, is produced in response to the user operation, thereby providing user interface feedback.

[0068] A user interface feedback apparatus in accordance with an embodiment of the present invention will now be described with reference to FIG. 2. The user interface feedback apparatus 100 shown in FIG. 2 includes an operable element 110. The user's finger 150 performs an operation with respect to the operable element 110.

[0069] The operable element 110 may be configured to be a user interface (UI) realized by an LCD apparatus. The user's finger 150 thus performs operations with respect to various switches, buttons, sliders, dials, or other elements displayed on the operable element 110.

[0070] An example of the operable element 110 is shown in FIG. 3, wherein the operable element 110 is configured to be a user interface (UI) realized by an LCD apparatus. On an operable element 110 like that shown by way of example in FIG. 3, icons (i.e., images) of various elements such as switches, buttons, sliders and dials are displayed. The user's finger 150 performs operations with respect to these icons (i.e., images). The user interface feedback apparatus 100 in accordance with the present embodiment then produces user interface feedback, such as friction, for example, in response to the user operations.

[0071] It should be appreciated that the operable element is not limited to being a display, and may also be configured as a simple surface. In the example shown in FIG. 2, the operable element 110 and a display 125 are shown separately as individual units. The operable element and the display may thus be configured separately. Alternatively, the operable element 110 and the display 125 may be combined in a configuration like that shown in FIG. 3.

[0072] As shown in FIG. 2, the operable element 110 includes an electrode sheet (i.e., a conductor) 111 and an insulator 112. The operable element 110 is configured such that the user's finger 150 does not touch the electrode sheet 111, but instead only contacts the insulator 112.

[0073] The operable element 110 is also provided with a position sensor 121 that detects the position of the user's finger 150, as well as a pressure sensor 122 that measures values such as the pressure and inclination due to the user's finger 150. The detected data from these sensors is input into a data acquisition module 123.

[0074] An example of the position sensor 121 will now be described with reference to FIG. 4, wherein the sensor is configured by way of example as a sensor using electrostatic capacitive coupling. In-phase, equipotential AC current flows are applied from the four corners of the operable element 110, and from the respective current values, X and Y coordinates