

panel. By performing an input process corresponding to the touch position detected by the front surface sensor and the back surface sensor, the disposition of the sensors on both surfaces of the device can realize an advanced input process.

[0016] In the input device, when one of the back-surface sensor and the front-surface sensor performs touch detection, the control unit may perform an input process of selecting an input item, and when the other performs touch detection, the control unit may perform an input process of adjusting a value related to the selected input item.

[0017] For example, when one of the back-surface sensor and the front-surface sensor performs touch detection, the input item is selected; and when the other performs touch detection, the parameter related to the selected input item is input. This realizes a selection among a plurality of items and a detailed adjustment of the selected item.

[0018] The input device may further include an actuator for temporarily vibrating the casing provided with the display panel. In the input device, the control unit may control vibrations of the actuator in accordance with a touch-detection state obtained by the back-surface sensor.

[0019] By providing the actuator that temporarily vibrates the casing mounted on the display panel, vibrations of the actuator is controlled in accordance with a touch detection state of the sensor. For example, when some input process is executed in response to a touch on the back surface of the device, the actuator temporarily vibrates the device to be able to let the user notice that input is performed. This improves the operability of the system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. 1 is a perspective view showing an example construction of an apparatus (PDA) provided with an input device according to one embodiment of the present invention;

[0021] FIG. 2 is a cross-sectional view showing an example internal layout of the apparatus according to one embodiment of the present invention;

[0022] FIG. 3 is an illustration showing an example diagram of a sensor according to one embodiment of the present invention;

[0023] FIGS. 4A and 4B are graphs showing detection characteristics of one embodiment of the present invention;

[0024] FIG. 5 is an illustration showing an example single-handed operation of the device according to one embodiment of the present invention;

[0025] FIG. 6 is a flowchart showing an example input process of one embodiment of the present invention;

[0026] FIGS. 7A, 7B, and 7C are illustrations showing other example operations of the device according to another embodiment of the present invention;

[0027] FIG. 8 is an illustration showing another example operation of the device according to another embodiment of the present invention;

[0028] FIG. 9 is a cross-sectional view of an example construction of the device according to still another embodiment of the present invention;

[0029] FIG. 10 is an illustration showing an example operation of the device shown in FIG. 9; and

[0030] FIG. 11 is an illustration showing another example operation of the device shown in FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0031] FIG. 1 shows a perspective view of an input device according to the present invention applied to a PDA 100. In the PDA 100, a casing for a data processing terminal is provided with a display panel 110 mounted on the front surface thereof. The display panel 110 includes a liquid crystal display panel to show various types of characters and graphics, for example. Operation keys 101 are provided at a lower end of the front surface of the PDA 100.

[0032] A back-surface touch sensor 120 is disposed inside the casing for detecting a touch on the back surface of the casing. The display area of the display panel 110 is substantially equal to the touch detection area of the back-surface touch sensor 120 so that the back-surface touch sensor 120 can detect a touch on substantially the entire area directly below the display area of the display panel 110. The back-surface touch sensor 120 can detect a touch by a living body such as a finger as well as the position being touched (hereinafter, referred to as "touch position"). The actual construction of the back-surface touch sensor 120 will be described below.

[0033] FIG. 2 shows a cross-sectional view of an example layout of the display panel 110 and the back-surface touch sensor 120. The display panel 110, which has a relatively large display area, is provided on the front surface of the PDA 100. Directly below the display panel 110 inside the casing is the back-surface touch sensor 120 that includes a substrate provided with touch-sensitive electrodes attached to a part of the casing. A slight concave 100a is provided at the position of the casing where the substrate including the back-surface touch sensor 120 is disposed, so that the position of the back-surface touch sensor 120 can be noticed by tactile sensation. In FIG. 2, for simplicity, only the physical relationship between the display panel 100 and the back-surface touch sensor 120 is shown, and the layout of the other components of the PDA 100 is omitted.

[0034] FIG. 3 shows an example construction of the back-surface touch sensor 120. The substrate having the back-surface touch sensor 120 formed thereon is disposed directly below the display panel 110. On the surface of the substrate, a first group of a plurality of electrodes 121 (hereinafter, referred to as "the first group 121") and a second group of a plurality of electrodes 122 (hereinafter, referred to as "the second group 122") are alternately disposed at predetermined intervals in a linear manner. The first group 121 serves as transmission electrodes while the second group 122 serve as reception electrodes. In FIG. 3, for simplicity, the electrodes of the first group 121 and the second group 122 are aligned in only one line. However, when the back-surface touch sensor 120 is required to have a large touch detection area, a plurality of electrode rows must be provided. For example, when it is necessary to detect a touch on substantially the entire area of the display panel 110, the area of the substrate having the back-surface touch sensor 120 must be substantially equal to that of the display panel 110, and the electrodes of the first group 121