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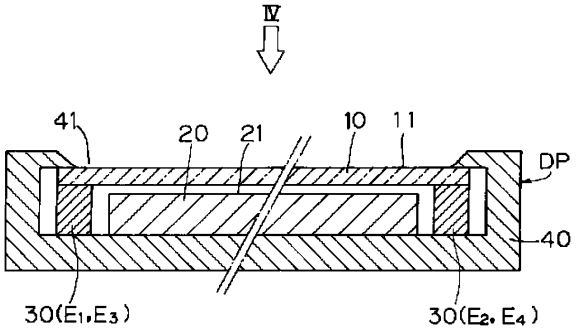
(54) Title of Invention INFORMATION DISPLAY DEVICE AND OPERATION INPUT DEVICE

(57) Abstract
[Problem] To provide an information display device with a small number of operating surface and display surface peripheral parts providing a reliable sense of operation and enabling a tracing operation without a push stroke.
[Resolution Means] An operating panel 10 is arranged on a liquid crystal display panel 20, and the operating panel 10 is supported by piezoelectric elements E1 through E4. Pressing an operating surface 11 of the operating panel 10 with a finger generates voltage at both ends of the piezoelectric elements E1 through E4, and an operating force and an operating position are sensed by detecting and calculating said voltage. High frequency is applied to the piezoelectric elements E1 through E4 when an operating force larger than a predetermined threshold is sensed, which thus causes the operating surface 11 to vibrate. This vibration allows an operator to obtain a reliable sense of operation. The number of parts is small because the sensing of the operating force applied to the operating surface and the application of the vibration to the operating surface 11 are performed using the common piezoelectric elements E1 through E4. Furthermore, a tracing operation is made possible because an operating force smaller than the predetermined threshold causes no reaction.



Specification
Title of Invention: INFORMATION DISPLAY DEVICE AND OPERATION INPUT DEVICE

[DETAILED DESCRIPTION OF THE INVENTION]
[TECHNICAL FIELD OF THE INVENTION]
[0001]
The present invention relates to an information display device and an operation input device used in, for example, factory automation (FA) devices, automatic vending machines, automatic ticket vending machines, automatic teller machines, home appliances, medical operating equipment, information equipment, handheld terminals, game devices, and the like.

[CONVENTIONAL TECHNOLOGY]
[0002]
Devices where a touch panel is arranged on a display are in wide use as one type of information display device having an operation input function. Touch panels are extremely thin, and have the advantage of providing a high degree of freedom for selecting an area that can be used as a switch.
[0003]
Conversely, however, because the push stroke of touch panels is nearly zero, said panels lack a sense of touch (sense of operation) for indicating that operation inputs have been performed, such that operators are often left with a sense of doubt over whether operation inputs have actually been received on a device side.
[0004]
To counter such circumstances, schemes have been devised whereby a visual reaction, such as changing or flashing a display color of an operation location, or an auditory reaction, such as generating an electronic sound, is generated when an operation input is actually received.

[PROBLEM TO BE SOLVED BY THE INVENTION]
[0005]
However, there is a problem with devices using visual reactions in that the display color change cannot be seen due to being hidden by a finger of an operator. Furthermore, visually impaired individuals, like as those suffering from amblyopia, and the like, will find it difficult to confirm changes if the display color change is subtle.
[0006]
Moreover, with devices using auditory reactions, electronic sounds can be drowned out by ambient noise and go unheard. The electronic sound can be made louder to remedy this; however, if this is done, for example, in a location where a plurality of automatic ticket vending machines are lined up together, it can be impossible to tell which automatic ticket vending machine the sound is coming from. Additionally, making the electronic sound excessively loud in the case of a mobile phone can be an imposition on individuals in the vicinity of said phone. Furthermore, deaf people cannot hear reactions created using electronic noises.
[0007]
While cases of devices using touch panels were described above, these problems are common to all information display devices having operating units that lack substantive push strokes, and are thus not limited to information display devices using touch panels.

[OBJECT OF THE INVENTION]
[0008]

The present invention was created to solve conventional technical problems like those described above, and thus a first object thereof is to provide an information display device able to give a reliable sense of operation even though an operating unit lacks a substantive push stroke.

[0009]

A second object of the present invention is to realize a simple information display device where the number of parts in the vicinity of a display surface or an operating surface have been reduced.

[0010]

Furthermore, a third object of the present invention is to permit an operating method (tracing operation) for reaching a target operating region by sliding a finger on the display surface, and to make it so that a device side does not erroneously display a reaction before an actual pressing operation can be performed in the target operating region during such a tracing operation.

[0011]

Additionally, a fourth object of the present invention is to differentiate between a reaction from a location where a pressing operation was performed and a reaction from a device side caused by an operating force, to thus provide a varied sense of operation.

[0012]

Moreover, a fifth object of the present invention is to provide a device having a large area for a display surface and an operating surface.

[0013]

Finally, one object of the present invention is to provide an operation input device that uses the principle of realizing an information display device like that described above.

[FUNDAMENTAL PRINCIPLE OF THE INVENTION]

[0014]

In response to the first object described above, the present invention uses a mechanical reaction such as a vibration or a small displacement, and the like, of an operating surface as a response to an operation input from a device side. For example, the operating surface can be vibrated using a piezoelectric element (that is, a piezoelectric vibrator or a piezo element) to thus give an operator a reliable sense of operation.

[0015]

By the way, sensing an operation input to an operating surface is a fundamental requirement for an information display device having an operation input function. Therefore, a device configured to generate a mechanical reaction like a vibration, and the like, in an operating surface must have a function for sensing an operation input and a function for generating the mechanical reaction.

[0016]

Thus, the inventors of the present invention focused on the fact that a piezoelectric element is a function means (hereinafter referred to as a bi-directional function means) able to convert a mechanical action and an electrical signal in two directions. That is, a mechanical reaction such as a vibration, and the like, is generated when an electrical signal is applied to such a bi-directional function means while, on the other hand, an electrical reaction such as voltage, and the like, is generated when a pressing force is applied to said bi-directional function means.

[0017]

Thus, realizing both an operation sensing function and a mechanical reaction generating function through one (or one set of) bi-directional function means through an aggressive use of the characteristics of such bi-directional function means is a fundamental principle of the present invention.

[0018]

That is, with the present invention, of the various functions of the bi-directional function means, an operation input is sensed through a "function for converting mechanical pressure into voltage (or current)," and a mechanical reaction is generated in an operating surface through a "function for converting voltage (or current) into a mechanical reaction."
[0019]

By this, a reliable sense of operation can be given without increasing the number of parts.

[SPECIFIC CONFIGURATION FOR SOLVING THE PROBLEM]
[0020]

The information display device of the invention according to claim 1 configured in accordance with the principle described above provides; (a) an information display surface, (b) a transparent or semi-transparent operating unit having a predetermined operating surface arranged on the information display surface, (c) bi-directional function means coupled with the operating unit able to convert a mechanical action and an electrical signal in two directions, (d) operating signal extracting means for extracting an electrical signal generated by the bi-directional function means through an operating force applied to the operating surface as an operating signal; and (e) drive control means for sending an electric drive signal to the bi-directional function means in response to the operating signal.
[0021]

Furthermore, a mechanical reaction generated by the bi-directional function means through the drive signal is transmitted to the operating surface and is captured as a sense of touch of an operator.
[0022]

In the invention according to claim 2, the drive control means in the information display device according to claim 1 has (e-1) operating signal determining means for comparing the operating signal to a predetermined threshold and sending the drive signal to the bi-directional function means when the operating signal exceeds the threshold.
[0023]

In the invention according to claim 3, the operating signal determining means in the information display device according to claim 2 changes the mode of the drive signal in accordance with the size of the operating signal.
[0024]

In the invention according to claim 2, the bi-directional function means in the information display device according to claims 1 through 3 has, (c-1) a plurality of unit function means spatially arranged mutually separated from one another each able to convert a mechanical action and an electrical signal in two directions, and the information display device also has, (f) position signal generating means for generating a position signal expressing an operating position on the operating surface based on a plurality of electrical signals generated by the plurality of unit function means through an operating force applied to the operating unit.
[0025]

In the invention according to claim 5, the information display device according to claim 4 has three or more unit function means arranged and dispersed two-dimensionally as the plurality of unit function means.
[0026]

In the invention according to claim 6, the operating surface in the information display device according to claim 5 is a rectangular surface, and the information display device has four unit function means arranged more or less at the four corners of the rectangular surface as the plurality of unit function means.
[0027]

The invention according to claim 7 is the information display device according to any one of claims 1 through 3, where the operating means has, (b-1) a touch panel for generating a position signal corresponding to an operating position on the operating surface.

[0028]

The invention according to claim 8 is the information display device according to any one of claims 4 through 7 where the drive control means changes the threshold for the operating signal based on the position signal.

[0029]

The invention according to claim 9 is the information display device according to any one of claims 4 through 7 where the drive control means changes the mode of the drive signal based on the position signal.

[0030]

The invention according to claim 10 is the information display device according to any one of claims 2 through 9 also having, (g) logic gate means for transmitting the generation of the position signal to predetermined information processing means when the operating signal exceeds the threshold.

[0031]

The invention according to claim 11 is the information display device according to any one of claims 1 through 10 where the bi-directional function means includes a piezoelectric element.

[0032]

In the invention according to claim 12, the information display device according to any one of claims 1 through 10 is housed in a portable housing having a predetermined main surface, and the operating surface is exposed on the main surface and is made portable.

[0033]

The invention according to claim 13 is the information display device according to claim 12 also having one or a plurality of operating switches arranged securely on a surface other than the main surface of the housing for receiving an operation based on content displayed on the display surface.

[0034]

The invention according to claim 14 was configured with a focus on the characteristics of an operating position caused by the detection of a pressing force in the inventions according to claims 1 through 13.

[0035]

That is, the information display device of the invention according to claim 14 has, (a) an information display surface, (b) a transparent or semi-transparent operating unit having a predetermined operating surface arranged on the information display surface, (c) a plurality of unit function means arranged spatially dispersed in a range so as to be coupled with the operating unit, each capable of converting a mechanical action into an electrical signal, (d) operating signal extracting means for extracting an electrical signal generated by the plurality of unit function means through an operating force applied to the operating surface as a plurality of operating signals, and (e) position signal generating means for generating a position signal expressing an operating position on the operating surface based on the plurality of operating signals.

[0036]

Furthermore, the invention according to claim 15 was configured with a focus on the detection of a pressing force and a portion of a mechanical reaction caused thereby without regard to the presence or absence of a display surface in the inventions according to claims 1 through 13.

[0037]

That is, the operation input device has, (a) an operating unit having a predetermined operating surface, (b) bi-directional function means coupled with the operating unit able to

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