TOUCH PANEL INPUT DEVICE

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a touch panel input device, and in particular, to a touch panel input device which is disposed in a display section including a liquid-crystal device (LCD) and in which a coordinate signal is sensed using a change in a position depressed by a finger (fingertip), a pen or the same in association with a content displayed on the display section and the coordinate signal thus sensed is inputted to a device connected to the touch panel input device.

DESCRIPTION OF THE PRIOR ART

[0002] A touch panel input devices of prior art include a touch panel of transparent resistive film type. **FIG. 1** shows in a cross-sectional view a configuration of the touch panel using transparent resistive films **500** of the prior art.

[0003] The touch panel **500** shown in **FIG. 1** includes a transparent film **51**, a first transparent resist film **52**, a second transparent resistive film **53**, a glass substrate **54**, and a dot spacers **55** disposed over an upper surface of the second transparent resistive film **53** with a fixed gap therebetween.

[0004] The transparent film **51** includes a flexible transparent film member constituting a surface section of the touch panel **500**. The film **51** includes, for example, a transparent plastic film such as polyethylene terephthalate (PET). The film **51** has a flexibility enough to easily bend or to easily change its form when depressed by a finger or a pen.

[0005] The first transparent resistive film **52** includes a transparent conductive film made of, for example, indium tin oxide (ITO) or SnO_2. The film **52** is arranged entirely on a lower surface of the transparent film **51** and has nearly a uniform thickness. When the film **51** is pushed by a finger, the film **52** is distorted together with the film **51**.

[0006] The second transparent resistive film **53** includes, like the first transparent resistive film **52**, a transparent conductive film made of the above-mentioned same materials. The film **53** is arranged throughout on an upper surface of the glass substrate **54**, which will be described later, and has nearly a uniform thickness.

[0007] The glass substrate **54** forms a bottom section of the touch panel. The film **53** having a uniform thickness is disposed entirely on an upper surface of the glass substrate **54**.

[0008] The dot spacers **55** prevent the first transparent resistive film **52** on the transparent film **51** from being brought into contact with the second transparent resistive film **53** arranged on the glass substrate **54** in an no-input state of the panel **500**. Additionally, density of dot spacers **55** determines magnitude of pressure required to bring the transparent resistive film **52** into contact with the transparent resistive film **53**.

[0009] **FIG. 2** shows in a cross-sectional view a state of the touch panel **500** using transparent resistive films of the prior art in which the panel is depressed by a touch panel pen or a fingertip of a user.

[0010] When the user pushes, by his or her finger or a pen, the transparent film **51** on the upper surface side of the touch panel **500**, the films **51** an **52** are rendered to a distorted state as shown in **FIG. 2**.

[0011] The film **51** on the upper surface side of the touch panel **500** is bent by pressure of the pen or a fingertip, and the first transparent resistive film **52** makes contact with the second transparent resistive film **53**. The films **52** and **53** are set to an electrically conductive state. By sensing the conductive state, the panel **500** detects an event of depression on the film **51**.

[0012] **FIG. 3** shows constitution of a sensor circuit to sense an input coordinate position in a touch panel using transparent resistive films of the prior art. The position sensor senses a pair of coordinates (input coordinates) of a contact point between the films **52** and **53**.

[0013] The input coordinate sensor of the touch panel shown in **FIG. 3** includes a first transparent resistive film **601**, a second transparent resistive film **602**, a first resistor **603** schematically shown on the first film **601**, a second resistor **604** schematically shown on the second film **602**, analog switches **605** to **608**, and analog-to-digital (A/D) converters **609** and **610**.

[0014] Although each of the resistors **603** and **604** includes one resistor having an ordinary contour in **FIG. 3**, the resistor actually has a planar shape, namely, a transparent resistive film like the first and second transparent resistive films **601**.

[0015] The first resistor **603** (first transparent resistive film **601**) has two electrodes respectively connected to the analog switches **605** and **606**. The switches **605** and **606** are coupled with a power source voltage V and ground, respectively.

[0016] The second resistor **604** (second transparent resistive film **602**) includes two electrodes linked with the analog switches **607** and **608**, respectively. Connected to the switches **607** and **608** are a power source voltage V and ground, respectively.

[0017] In **FIG. 3**, the first and second transparent resistive films **601** and **602** are fixed or laminated onto each other such that the electrodes **605** and **606** of the film **601** are vertical to the electrodes **607** and **608** of the film **602**. The first and second electrodes **603** and **604** are respectively coupled with the A/D converters **609** and **610**.

[0018] Referring to the input coordinate sensing circuit shown in **FIG. 3**, description will be given of operation to sense a contact point, namely, a pair of coordinates associated with actual depression on the touch panel. Assume that the transparent film **51** of the touch panel **500** is depressed at a position by a fingertip or a pen of the user, for example, as shown in **FIG. 2** and the upper and lower films **52** are brought into contact with each other at the depressed position.

[0019] **FIG. 4** shows a first configuration of a state of the input coordinate sensor in which the touch panel is in the state of **FIG. 2**. When the user pushes a particular point on the touch panel in the situation of **FIG. 4**, the sensor conducts control operation to drive switches thereof to enter a subsequent state.

[0020] As a result of the control operation of the switches, a linear potential distribution is formed on the first resistor **603** ranging from a voltage V (volt) to 0 (volt) in a direction as indicated by an arrow mark a as shown in **FIG. 4**.

[0021] In **FIG. 4**, an arrow mark b designates a point (to be referred to as a "contact point" herebelow) at which the