

[0022] According to the present invention, both an operation for generating an operation signal corresponding to the input positions and an operation for generating coordinate data are performed on the same operational plane. Accordingly, the operability is not degraded and input operations can be performed quickly.

[0023] In addition, since the reaction force generated when one of the indication marks are pushed is transmitted to the operator, the operator reliably recognizes that he or she has pushed the indication mark. Accordingly, operational mistakes can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. 1 is an exploded perspective view of an input apparatus according to a first embodiment of the present invention;

[0025] FIGS. 2A and 2B are sectional views of FIG. 1 cut along line II-II, wherein FIG. 2A shows a state in which the input apparatus is not operated and FIG. 2B shows a state in which the input apparatus is being operated;

[0026] FIG. 3 is a sectional view similar to FIG. 2A in which projecting members are provided as indication marks;

[0027] FIG. 4 is a functional block diagram of the input apparatus;

[0028] FIG. 5 is a flowchart of an input-mode switching process;

[0029] FIGS. 6A and 6B are perspective views showing examples of input operations;

[0030] FIG. 7 is a sectional view showing another example of a tactile-feel-generating unit;

[0031] FIG. 8 is an exploded perspective view of an input apparatus according to a second embodiment of the present invention; and

[0032] FIGS. 9A and 9B are sectional views of FIG. 8 cut along line IX-IX, wherein FIG. 9A shows a state in which the input apparatus is not operated and FIG. 9B shows a state in which the input apparatus is being operated.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0033] FIG. 1 is an exploded perspective view of an input apparatus according to a first embodiment of the present invention. FIGS. 2A and 2B are sectional views of FIG. 1 cut along line II-II, wherein FIG. 2A shows a state in which the input apparatus is not operated and FIG. 2B shows a state in which the input apparatus is being operated. FIG. 4 is a functional block diagram of the input apparatus according to the present invention, and FIG. 5 is a flowchart of an input-mode switching process. FIGS. 6A and 6B are perspective views showing examples of input operations.

[0034] In an input apparatus 1 shown in FIG. 1, which is formed as a mobile phone, a display panel 3 which serves as a display unit and an input unit are mounted on a housing 2. The display panel 3 is formed of a monochrome or color liquid crystal panel or of an electroluminescent (EL) panel.

[0035] The input unit includes a flat input device 4. The flat input device 4 is of a capacitive type or a pressure-sensitive type, and a coordinate can be input by using the flat

input device 4. When the flat input device 4 is of the capacitive type, an X-direction detection electrode and a Y-direction detection electrode, both of which are formed of Ag (silver) paste, are disposed such that they oppose each other in a matrix pattern with a resin sheet therebetween. The resin sheet is formed of, for example, polyethylene terephthalate (PET) which is insulative and has a predetermined dielectric constant. The flat input device 4 is constructed such that it can be bent by disposing the resin sheet and the electrodes on a substrate on which a conductive pattern is formed. Accordingly, when a dielectric member, for example, a finger, touches the surface of the flat input device 4, a coordinate can be input.

[0036] Alternatively, when the flat input device 4 is of the pressure-sensitive type, a resistor having a potential difference in the X and Y directions and a conductor are disposed such that they oppose each other. When the flat input device 4 is pushed by, for example, a finger, the conductor and the resistor come into contact with each other, causing a change in resistance. In this way, a coordinate is input.

[0037] In addition, the input apparatus 1 also includes an indicator sheet 7 which is laminated and fixed on the surface of the capacitive type or the pressure-sensitive type flat input device 4 (see FIGS. 1, 2A, and 2B). The indicator sheet 7 is formed of a resin such as PET, a silicone rubber, etc., and indication marks 8 are formed on the surface of the indicator sheet 7 by printing or transferring so as to indicate input positions corresponding to a plurality of characters, numbers, symbols, etc. The indication marks 8 are provided within circular lines which define the input positions, characters, numbers and symbols. The input positions, characters, number and symbols are formed inside the circular lines by printing or transferring.

[0038] The indicator sheet 7 may be formed in a shape having concavities and convexities such that regions at which the indication marks 8 are disposed protrude upward. Alternatively, as shown in FIG. 3, projecting members 8A formed of rubber or the like may be attached onto the surface of the indicator sheet 7, and characters, numbers, symbols, etc., may be formed on the surface of the projecting members 8A by printing or transferring.

[0039] A tactile-feel-generating unit 6 is disposed behind the flat input device 4. The tactile-feel-generating unit 6 includes a base 9 which is formed of a glass-epoxy resin or a metal and disposed inside the housing 2 and dome-shaped (diaphragm-like) inversion plates 10 which are arranged on the base 9. The inversion plates 10 are placed at positions corresponding to the indication marks 8.

[0040] In a state shown in FIGS. 2A and 3, which is a state in which the input apparatus 1 is not operated, neither the flat input device 4 nor the indicator sheet 7 is deformed. In addition, in this state, the dome-like shapes of the inversion plates 10 are maintained. In this state, when a desired indication mark 8 is pushed from above by a finger, a pen, or the like, both the flat input device 4 and the indicator sheet 7 are deformed and are bent inward, as shown in FIG. 2B. Accordingly, the corresponding inversion plate 10 is inverted by the pushing force, so that a reaction force is produced by the inversion plate 10. This reaction force is transmitted to the operator's finger as a tactile feel, so that the operator reliably recognizes that he or she has pushed the indication mark 8.