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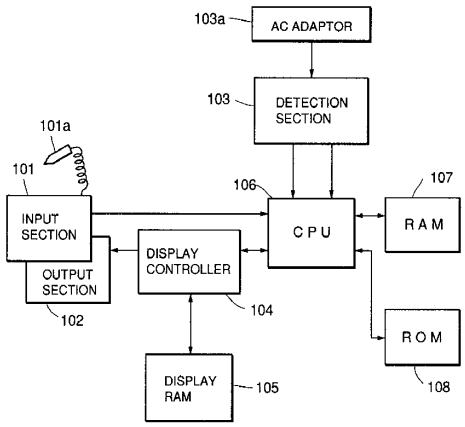
(54) **Apparatus for controlling image display.**

(57) An input-output integrated type electronic apparatus is arranged to enable the orientation of a displayed picture to be changed according to the orientation of the apparatus in a used state, whereby the facility with which the apparatus is used is improved. To change the display orientation, the content of a displayed picture is changed on the basis of a detected orientation of the apparatus.

FIG. 1



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BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to an input-output integrated type information processor capable of controlling the orientation in which a picture is displayed on a display screen.

Description of the Related Art

Fig. 18 is a block diagram of the hardware construction of a conventional input-output integrated type information processor. Data is input through an input section 101 by a special pen 101a. A picture is displayed on an output section 102 in accordance with the content of a display random access memory (RAM) 105 by a display controller 104.

A central processing unit (CPU) 106 controls the overall operation of the processor. A RAM 107 and a ROM 108 are connected to the CPU 106. The orientation in which a picture is displayed on the display screen is fixed. This processor is not designed to have means for changing the picture display orientation.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an electronic apparatus capable of changing the orientation of a displayed picture according to the orientation of the apparatus in a used state.

To achieve this object, according to one aspect of the invention, there is provided an electronic apparatus comprising input means for inputting information, display means including a display screen for displaying information, a casing for accommodating the input means and the display means, detection means for detecting orientation of the casing when the apparatus is used, and control means for changing the orientation of a picture displayed on the display screen on the basis of the detection made by the detection means.

According to another aspect of the invention, there is provided an electronic apparatus comprising input means for inputting information, display means including a display screen for displaying information, a casing for accommodating the input means and the display means, a base for receiving the casing, detection means for detecting the orientation of the casing relative to the base, and control means for changing the orientation of a picture displayed on the display screen on the basis of the detection made by the detection means.

According to still another aspect of the invention, there is provided an electronic apparatus comprising input means for inputting information, display means for displaying information, a casing for accommodating the input means and the display means, detection means for detecting the orientation of the casing when the apparatus is used, and control means for changing the orientation of a display content of the display means on the basis of the detection made by the detection means.

In accordance with another aspect of the present invention, an input-output type information processor includes input means for inputting information, display means including a display screen for displaying information, detection means for detecting the orientation of the apparatus in a used state and a control means for controlling the orientation in which a picture is displayed on the display screen of the apparatus are provided to enable the apparatus orientation in a used state to control the display orientation on the display screen without requiring a special operation by the user.

These and other objects, aspects, features and advantages of the present invention will become apparent from the following detailed description of the preferred embodiments taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of the hardware construction of a first embodiment of the present invention;

Fig. 2 is a circuit diagram of a detection section 103;

Fig. 3 is a diagram of an external appearance of a processor in accordance with the first embodiment;

Figs. 4(a) to 4(h) are diagrams of the relationship between the DC plug insertion direction and the display orientation;

Fig. 5 is a block diagram of the hardware construction of a second embodiment of the present invention;

Fig. 6 is a diagram of an external appearance of a processor in accordance with the second embodiment;

Fig. 7 is a circuit diagram of a detection section 501;

Fig. 8 is a diagram of an external appearance of a main unit of a processor in accordance with a third embodiment;

Fig. 9 is a schematic cross-sectional view of the main unit;

Fig. 10 is a bottom view of the main unit;

Fig. 11 is a first schematic cross-sectional view of a recess 1001 of the main unit;

Fig. 12 is a second schematic cross-sectional view of the recess 1001 of the main unit;

Fig. 13 is a diagram of an external appearance of a sub unit;
Fig. 14 is a schematic cross-sectional view of a hook portion 1303 of the sub unit;
Figs. 15(a) to 15(d) are diagrams of an example of an operation of combining/separating the main and sub units;
Fig. 16 is an external appearance view of another example of the operation of combining/separating the main and sub units;
Fig. 17 is a circuit diagram of a detection section in accordance with the third embodiment;
Fig. 18 is a block diagram of the hardware construction of a conventional input-output integrated type information processor;
Fig. 19 is a flowchart of a control process;
Fig. 20 is a diagram of a display screen;
Figs. 21(a) to 21(d) are diagrams of picture rotation;
Fig. 22 is a flowchart of a control process;
Fig. 23 is a diagram of an external appearance of a sub unit;
Fig. 24 is a diagram of a control process;
Fig. 25 is a diagram of a control process;
Fig. 26 is a block diagram of a main unit;
Fig. 27(a) is a cross-sectional view of a combined state of main and sub units;
Fig. 27(b) is a diagram of a switch of the main unit;
Fig. 28 is a block diagram of the sub unit; and
Fig. 29 is a flowchart of operating an optical communication plane.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention will be described below with reference to the accompanying drawings.

Fig. 1 shows blocks of the hardware construction of an embodiment of the present invention. Each of elements shown in block outline in Fig. 1 as well as in Figs. 2, 5, 17, 18, 26 and 28, is well known per se, and a specific type of construction is not critical to carrying out the invention or to a disclosure of the best mode for carrying out the invention. An input section 101 is, for example, a pressure sensitive type tablet. Data is input by writing on the tablet with a special pen 101a.

An output section 102 is a display device, e.g., a liquid crystal display. The input section 101 and the output section 102 form an input-output integrated unit.

A detection section 103 detects the orientation of the information processor in a used state and sends a result of the detection to a CPU 106. An AC adaptor 103a extends from the detection section 103.

A display controller 104 displays information or images on the output section 102 in accordance with the content of a display RAM 105. The display controller 104 rewrites the display RAM 105 by a command from the CPU 106.

The display RAM 105 stores data for displaying through the output section 102.

The CPU 106 controls the overall operation of the information processor in accordance with control procedures stored in the memories 107 and 108.

The memory 107 is a RAM for storing display data and a control procedure, and the memory 108 is a control memory ROM in which a control procedure shown in Fig. 19 or 22, for example, is stored.

Fig. 2 is a detailed circuit diagram of the detection section 103. As shown in Fig. 2, there are four power supply channels having DC jacks 201 to 204, and a DC plug 206 is inserted into one of the DC jacks 201 to 204 to supply power. From each DC jack, a power supply line extends and a ground line and a picture orientation control signal line also extend.

An AC adaptor 205 is used to supply power from a home AC outlet and to convert AC power into DC power. DC power is supplied through the power supply line, the ground line and each picture orientation control signal line. A line 207 in Fig. 2 indicates a main body of the information processor.

Fig. 3 shows the outward appearance of the processor. The input pen 101a extends from a frame 301. The DC jacks 201 to 204 are provided in four side surfaces of the frame. (DC jacks 203 and 204 are not seen in Fig. 3.)

The operation of controlling the orientation in which a picture is displayed in accordance with this embodiment will be described below. Display contents displayed in a displayed picture are stored as bit map data in the display RAM 105. Fig. 4(a) shows an example of a display, and Fig. 4(b) shows the content of the display RAM 105 corresponding to this display example.

When the DC plug 206 is inserted into one of the DC jacks 201 to 204, electric power is supplied to the processor and one of picture orientation control signals a to d is sent to the CPU 106. The CPU 106 rewrites data in the display RAM 105 in accordance with a high level signal in picture orientation control signals a to d by a conversion formula shown below. However, CPU 106 does not convert data if the picture orientation control signal a is high.

(1) If the picture orientation control signal b is high,

$$\text{bit}(x, y) = \text{old bit}\left(\text{int}\{{}^{a}_{b}\, y\}, \text{int}\{{}^{b}_{a}\, (a - x)\}\right) \quad ⓐ$$

(2) If the picture orientation control signal c is high,

bit (x, y) = old bit (int{a - x}, int{$\frac{b}{a}$ (b - 7)}) ⓑ

(3) If the picture orientation control signal d is high,

bit (x, y) = old bit (int{$\frac{a}{b}$ (b - y)}, int{$\frac{b}{a}$ x}) ⓒ

In these equations, a and b represent picture sizes, bit (x, y) represents data of (x - int{$\frac{x}{8}$ × 8) at address ($\frac{a}{8}$ y + int{$\frac{x}{8}$ }) in the display RAM 105. Also, int{$\frac{a}{b}$ y} represents an integer part of the value of $\frac{a}{b}$ y.

Fig. 4(c) shows the state of the display RAM 105 after rewriting of the content thereof shown in Fig. 4(b).

The display controller 104 displays converted data in the display RAM 105 through the output section 102 to change the orientation in which a picture is displayed. Fig. 4(d) shows a picture displayed in accordance with the content of the display RAM 105 shown in Fig. 4(c) . Figs. 4(g) and g-(h) schematically show pictures in a case where the orientation in which the picture is displayed as shown in Fig. 4(a) is converted. Figs. 4(e) and 4(e and 4(f) are schematic diagrams corresponding to Figs. 4(a) and 4(c). As is apparent from Figs. 4(e) to 4(h), an operator using the processor can select an optimal picture display orientation in any situation by inserting the DC plug 206 into the DC jack at a position such that the AC adaptor 205 does not interfere with an input operation, i.e., the DC jack at the top of the processor as viewed by the operator.

Fig. 17 shows an example of a detection circuit of a third embodiment for detecting the orientation in which the processor is used. The circuit has pull-down resistors 1701 and 1702.

If the main unit is combined with a sub unit in a position such that a longitudinal axis of the main unit extends perpendicularly to a direction in which the operator faces the main unit (hereinafter referred to as "widthwise position") or in another position such that the longitudinal axis extends parallel to this direction (hereinafter referred to as "longitudinal position"), one of two electrodes 1201a and 1201b is electrically connected. The operation of controlling the orientation in which a picture is displayed by using picture orientation control signals is performed in the same manner as in the first and second embodiments.

The main unit and the sub unit are separately formed in accordance with the third embodiment. In such a case, when the main unit is used by being combined with the sub unit, a user can select the picture display orientation without being conscious of the selection.

Needless to say, the same effect can also be attained in a case where the user uses the main unit while the main unit is separated from the sub unit, if the first or second embodiment is practiced by being combined with the third embodiment.

Fig. 19 shows a flowchart of a picture display orientation changing process executed by the CPU as described above. In step 1901, the orientation of the processor in a used state is detected according to one of picture orientation control signals a to d set to high level. In step 1902, data in the display RAM 105 is transferred to the CPU 106. In step 1903, the data conversion method corresponding to the orientation of the processor in use detected in step 1901 is selected. If signal b is high, the data is converted in accordance with the equation ⓐ in step 1904. If signal c is high, the data is converted in accordance with the equation ⓑ in step 1905. If signal d is high, the data is converted in accordance with the equation ⓒ in step 1906. If signal a is high, the data is not converted. Next, in step 1907, the converted data is transferred to the display RAM 105 and, in step 1908, the display controller 104 outputs the data in the display RAM 105, thereby changing the orientation in which the picture is displayed.

In the above-described embodiment, a signal indicating the state of connection between a plurality of DC jacks and a plurality of DC plugs is used as means for detecting the orientation of the processor in a used state.

Alternatively, an orientation detection means using an input pen may be formed.

Fig. 5 shows blocks of the hardware construction of an embodiment of the present invention. A block 501 represents a detection section for detecting the orientation of a processor in a used state.

Fig. 6 shows the outward appearance of the processor in accordance with this embodiment. The processor has a frame 601 having four side surfaces. Connectors 602 to 605 in which a cord of an input pen 101a is inserted are respectively mounted in the side surfaces of the frame 601. (Connectors 604 and 605 are not illustrated in Fig. 6.) Each of the connectors 602 to 605 forms a depressed type switch which is depressed when the cord of the pen 101a is inserted.

Fig. 7 is a circuit diagram of an example of the detection section 501. Depressed switches 701 to 704 are arranged in correspondence with the connectors 602 to 605 along with pull-down resistors 705 to 708.

If the pen 101a is inserted into one of the connectors 602 to 605, the corresponding one of the depressed switches 701 to 704 is depressed and the corresponding one of picture orientation

controls signals a to d is sent to the CPU 106. The CPU 106 determines the display orientation from the received picture orientation control signal and converts data in the display RAM 105. In the above-described embodiment, data conversion is effected by changing the ratio of the longitudinal and widthwise sizes. In this embodiment, however, data conversion may be effected by changing display areas. Fig. 20 shows the relationship between a whole picture area 2001 and a display area 1002. The CPU 106 displays a picture by transferring data of the display area 2002 to the display RAM 105 through the display controller 104. That is, the displayed picture is changed by changing the display area or the order of transfer of data in the display area.

Fig. 22 shows a flowchart of another picture display orientation changing process in accordance with this embodiment. In step 2201, a display area is selected from the whole picture area shown in Fig. 20 to display a picture such as that shown in Fig. 21(a), and corresponding data is transferred to the CPU 106. In steps 2202 and 2203, a display area is selected to display a picture such as that shown in Fig. 21(b), and corresponding data is transferred to the CPU 106 to be converted. Similarly, in steps 2204 and 2205, and in steps 2206 and 2207, display areas are selected to display pictures such as those shown in Fig. 21(c) and 21-(d), respectively.

In the above-described embodiment, the means for detecting the orientation of the processor in a used state cannot be used when a battery or the like is used as a power source for the processor, since the detection means is based on the detection of the state of connection between DC jacks and DC plugs. In contrast, the processor of this embodiment is advantageous in that it is possible to detect the orientation of the processor in a used state and to control the picture display orientation even in use in which much importance is attached to the portability or a feature of the input-output integrated type, that is, when a home power supply is not used.

In the above-described first and second embodiments, the orientation of an input-output integrated type information processor is detected from the state of connection between the information processor and a cord. However, the orientation of this type of processor may be detected from the state of connection between a main unit and a sub of the processor by arranging the units in such a manner that the main unit is formed of a digitizer, a liquid crystal display, a CPU, a battery, backup memory, a hard disk and other components, while the sub unit is formed of a floppy disk drive, an I/O port such as an RS232, a network interface and other components, and that the main unit and the sub unit can be attached and detached (combined and separated) in a plurality of directions.

The construction of the main unit of a processor arranged in this manner will be described below.

Fig. 8 is a perspective view of an appearance of the main unit. The main unit has a casing having a generally rectangular external configuration. The casing is formed of an upper casing member 801, a middle casing member 802 and a lower casing member 803 each made of a resin. A generally rectangular opening is formed in a central portion of the upper casing member 801, and a digitizer 804 having an input surface is provided at the opening. A liquid crystal display (LCD) is provided under the digitizer 804. A holder 806 for an input pen 805 described later, a main switch 807, a knob 808 for adjusting the contrast of the LCD, an illustrated IC card connector and DC jack are provided on side portions of the middle casing member 802. Also, guide portions 1601a to 1601d in the form of elongated holes or recesses (Fig. 16) forming part of a means for combining the main and sub units are provided in two places in a side surface portion of the middle casing member 802 corresponding to the remote-most side as shown in Fig. 8 and in two places in an adjacent left side surface portion. A connector for connecting the input pen 805 is provided in the vicinity of the center of a right side surface portion. In this embodiment, this connector is covered with the holder 806 and cannot be seen in the external appearance. The input pen 805 and this connector are connected by a cord 809, which can be wound in a gap between a main unit side surface portion and the holder 806.

Fig. 9 is a schematic cross-sectional view (along the line I - I) of the main unit. Fig. 10 is a bottom view of the main unit. An LCD 901 and the digitizer 804 are fixed in a superposed state in the middle casing member 802. A printed circuit board 902 on which a CPU, memories, an LCD controller, a digitizer controller, a power supply circuit and other components are mounted is fixed below the LCD 901. The upper, middle and lower casing members 801, 802, and 803 are fixed to each other by screws or elastic hooks (snap-action fixing means). Further, two recesses 1001 and 1002 and a plurality of hemispherical projections 903a to 903d forming a part of the combining means are provided on a bottom surface of the main unit formed by the lower casing member 803. Also, a plurality of optical communication windows 1003a to 1003d arranged along the longitudinal axis, channels 1004a to 1004d for receiving the cord 809 pressed thereinto are formed in the bottom surface. The height of the projections 903a to 903d is smaller than that of rubber feet 1005a to 1005d.

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