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DESCRIPTION JPH0926832A

[0001]

FIELD OF THE INVENTION The present invention relates to an information processing device such as a personal computer (PC), and in particular to a compact, portable PC that is easier to use and allows for more functionality.

[0002]

2. Description of the Related Art With the emergence of notebook-type personal computers on the market, information processing devices are becoming smaller and lighter in weight.

In addition, many user-friendly operating systems (OS) and applications that use pointers have been developed, and personal computers are becoming more and more sophisticated. For this reason, many innovations have been made in the input devices and power supplies of personal computers to accommodate the need for smaller size and higher functionality. For example, notebook computers are commercially available that come equipped with pointing devices such as trackballs and sliders in addition to keyboards so that user-friendly operating systems and applications that use pointers can be used on the computer, making it possible to use the software without an external mouse.

[0003]

Furthermore, portable personal computers are also equipped with high-speed CPUs to increase processing speed, and LCDs with high resolution and large display areas, which has resulted in increased power consumption.

For this reason, some computers perform a resume process to shut down the system if there is no access for a certain period of time. Furthermore, some personal computers are designed to supply a lower frequency clock to a CPU that can operate at multiple frequency clocks if there is no access for a certain period of time.

[0004]

SUMMARY OF THE INVENTION In response to the trend toward smaller and more sophisticated portable personal computers, the inventors of the present application aimed to provide a more user-friendly and easier-to-use personal computer.

In addition, in response to the recent information society, the amount of time that even portable personal computers are used continuously is increasing, and it was also an object of the present invention to provide a personal computer that can extend the life of the power supply to match such a usage pattern. Another objective is to provide a personal computer that can incorporate functions that are expected to become more widespread in the future, such as an individual selective calling function (pager function). Of course, since it is a portable computer, one of the objectives is to create a personal computer that satisfies the demands for compactness, light weight, and low cost.

[0005]

To achieve these objectives, the inventors of the present invention have proposed a new type of personal computer that includes a sub-display that is equal to or smaller than the main display that conventional personal computers are equipped with.

In other words, an information processing device such as a personal computer according to the present invention has a main processor, a main display and a sub-display connected to the main processor via a bus, the sub-display being the same size as or smaller than the main display, and further having a first mode in which the main display and sub-display are operating, and a second mode in which only the sub-display is operating.

[0006]

There are many benefits to having a main display and a sub-display.

For example, in terms of data display and input, if the display area for a pop-up menu of an application running on the main display is allocated to the sub-display, operations such as menu selection can be performed without losing part of the image on the main display. In addition, the OS can also assign commands such as error display to the sub-display.

[0007]

By providing a sub-display in addition to the main display and further providing a touch panel over the sub-display, it becomes possible to perform various processes without reducing the display function of the main display, such as selecting a process displayed on a menu from the sub-display.

The touch panel may be a transparent or semi-transparent type that is placed on the sub-display, or may be an electromagnetic induction type that is placed under the sub-display. In addition, an area can be set in at least a part of the touch panel for inputting the movement of at least one of the cursor and pointer displayed on the main panel, for example, the relative amount of movement or direction, making it possible to use the touch panel as a pointing device. An area for pen input into an application displayed on the main display may be set in at least a part of the touch panel. By providing such an input area on the sub-display, it is not necessary to provide the main display with two functions, display and input. For example,

when it comes to pen input, not only does it make the screen easier to see, but it also eliminates the need for a touch panel on the main display, eliminating factors such as reduced contrast and increased costs that can be caused by touch panels. Furthermore, since the sub-display can be smaller than the main display, a touch panel with higher resolution can be provided. Therefore, it can be equipped with the functions of a high-precision pointing device and a pen input device, and it is easy to switch the input method depending on the operating situation or application.

[0008]

On the other hand, many functions of information processing devices do not require a large, high-resolution main display.

For example, it can display the time and schedule, display pager calls, receive emails, and function as a calculator. It is desirable that these functions and displays operate continuously 24 hours a day. However, there are limitations such as power consumption and display lifespan, making it impossible to display continuously. In contrast to this, in the information processing device of the present invention, it is possible to display these functions on the sub-display 24 hours a day, and the sub-display can be operated with less power consumption. Therefore, the service can be continued for 24 hours without placing a heavy burden on the power source.

[0009]

In this way, it is possible to control the sub-display and execute software to be processed on the sub-display using a sub-processor with lower processing power that is different from the main processor.

Therefore, in addition to a first mode in which the main processor and the sub-processor operate, a second mode in which only the sub-processor operates can be provided.

Furthermore, in the first mode, part of the processing of the main processor can be assigned to the sub-processor, so that an improvement in processing speed can be expected. On the other hand, in the second mode, the information processing device continues to operate, but only the sub-processor operates, so power consumption can be significantly reduced. It is also possible to switch from the second mode to the first mode by operating the sub-panel.

Depending on the operation on the sub-panel or the presence or absence of access, the display can be shifted from a first mode in which the main display and the sub-display operate to a second mode in which only the sub-display operates, and also from the second mode to the first mode.

[0010]

Instead of providing a sub-processor, a main processor capable of changing the frequency of the operating clock in at least two stages is adopted, and in the first mode the main processor can be operated with an operating clock of a high frequency, and in the second mode the main processor can be operated with an operating clock of a low frequency.

[0011]

The above-mentioned effects obtained by providing a sub-display can be obtained not only in portable information processing devices such as notebook personal computers, but also in desktop information processing devices.

[0012]

In portable information processing devices such as notebook-type devices, the main processor, main display, and sub-display are housed in the main body, and in this case, it is desirable to house the main display in the main body so that it is exposed when necessary, and the sub-display in the main body so that it is always exposed.

By providing a sub-display, the above-mentioned functions can be displayed continuously for 24 hours, so it is effective to keep the sub-display in a state where it can be seen at all times.

A sub-display can also be provided as an option, and in such a device, it is desirable to provide a slot for mounting a module equipped with a sub-display, and a display window through which the sub-display can always be seen from the outside when this module is mounted.

[0013]

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS The present invention will be described in more detail below with reference to a portable notebook computer as an embodiment of the present invention.

[0014]

<Outline of the Device> FIG. 1 shows the state in which the main body 2 of the notebook computer 1 of this embodiment is opened to expose the main LCD.

FIG. 2 shows the main body 2 closed with the main LCD stored away.

In this example, the personal computer 1 has a section 3 on which a high-resolution LCD panel 10 serving as the main display is mounted so that it can be rotated relative to a section 4 on which a keyboard 5 and other components are mounted. When the personal computer 1 is carried, the LCD panel 10 is closed as shown in FIG. 2, making it small and easy to carry.

At the same time, the LCD panel 10 and the keyboard are mutually covered to protect them from misoperation and damage. When operating the personal computer 1 using the LCD panel 10, the LCD panel 10 is opened as shown in FIG. 1 to expose the LCD panel 10 and the keyboard 5, creating an environment that is easy to operate.

[0015]

The personal computer 1 of this embodiment further includes a small sub-display 20 in front of the keyboard 5 .

The sub-display 20 is, for example, an LCD panel with an area of about 1/10 of the main display 10, and in this example may be a low-resolution monochrome display. The sub-display 20 is mounted at approximately the center of the tip of the portion where the keyboard 5 is mounted, and remains exposed even when the main LCD panel 10 is closed as shown in FIG.

Therefore, even when the personal computer 1 is carried, the sub-display 20 always appears on the front side, and the contents displayed on the sub-display 20 can be viewed without opening or closing the main body 2 of the personal computer 1. In addition, a nearly transparent touch panel (digitizer) 22 is attached to the surface of this sub-display 20, and as will be described later, it is possible to operate a pointer or cursor from above the sub-display 20 and to input using a pen. The touch panel is not limited to a transparent or semi-transparent one as in this example, and any non-contact type such as an electromagnetic induction type can be provided under the sub-display.

[0016]

In addition to connectors (not shown) for a power supply, a printer, etc., the side of the personal computer 1 in this example is provided with a slit 6 for attaching a PCMCIA card, which has a PCMCIA socket located inside.

Therefore, it is possible to diversify the functions of the personal computer 1 by inserting various types of cards compatible with the PCMCIA into this slot. For example, it is possible to insert a card 51 having an individual selective calling function (pager function) to receive calls and messages via radio. It is also possible to mount a card 54 equipped with a sub-display 55 . The main body 4 of the personal computer in this example is also designed to accommodate a card equipped with such a sub-display, and the area 7 near the slit 6 can be removed to fit the size of the sub-display so that the sub-display equipped on the card can be seen. When the card 54 equipped with a sub-display is installed in the personal computer of this example, two

sub-displays can be used in addition to the sub-display 20 that is pre-installed in the main body 2.

[0017]

<System Configuration> FIG. 3 shows a schematic system configuration of the personal computer of this embodiment.

The personal computer 1 in this example comprises a high-performance main CPU 11, such as a 32-bit or 64-bit main CPU that operates at a high speed of 100 MHz, memory 12, such as ROM and RAM, and a bus and bus controller 14 that connects the CPU 11 to various modules. The main CPU 11, memory 12 and bus controller 14 are connected by a local bus 13, and the bus controller 14 controls the input and output of data to and from various modules via an ISA bus 15. In addition to controlling the bus, the bus controller 14 of this example also controls interrupt resources. Therefore, signals that control the system status, such as SMI (System Management Interrupt), RI (Ring Indicator), and IRQ (Interrupt Request) for power management, are sent and received between the sub-CPU (described later) to control the operating status of the main CPU 11 and, correspondingly, the status of the video controller for the main display, etc.

[0018]

Various modules are connected to the ISA bus 15. For example, in FIG. 3, there are connected a peripheral controller 16 that controls the main input/output, a sub-CPU 29 that controls the

sub-display, and a PCMCIA controller 59 that controls communication with cards with various functions connected via a PCMCIA socket 50.

The peripheral controller 16 functions as a serial port controller, a parallel port controller, an FDD (floppy disk) controller, a controller for a DMA interface, etc., and also functions as an RTC (real-time clock).

[0019]

The video controller 17 controls the main LCD 10 together with the video RAM 18 connected thereto, and is compatible with VGA, SVGA, monochrome or color LCDs.

In recent years, high-resolution color LCDs that are compatible with color display applications such as 256 colors have been widely adopted for the main LCD 10, and to accommodate this, high-performance, large-capacity video controllers 17 and VRAM 18 have also been adopted.

[0020]

An example of a card that is inserted into the PCMCIA socket 50 and connected to the ISA bus 15 via the PCMCIA controller 59 is a pager card 51 .

There are several types of pager cards 51 depending on the communication method, and they are capable of calling a specific user by radio in a specific frequency band and simultaneously transmitting a message, etc. In addition, some watches are equipped with a function that allows time calibration using a pager card 51. Other RF cards 52 using radio waves, such as a PHS card or a GPS card, can also be mounted in the PCMCIA socket 50, and the functions of

each card can be added to the personal computer. Furthermore, a card 54 incorporating a small sub-LCD panel 55 can also be mounted in the socket 50. FIG. 3 shows an example of a PCMCIA card 54 equipped with a pager function 56 and incorporating a processor 57 that controls this pager function and an incorporated sub-LCD 55 . Of course, the present invention is not limited to this example, and it is possible to mount PCMCIA cards for various other utilities such as games and calculations.

[0021]

A sub-CPU 29 that controls the sub-LCD 20 is also connected to the ISA bus 15, and can control the sub-LCD 20 in cooperation with the main CPU 11 or by itself, and can control applications that run using the sub-LCD 20.

The sub-CPU 29 is connected to an LCD controller 28 for directly controlling the sub-LCD 20, and the LCD controller 28 is provided with a VRAM of an appropriate capacity. Furthermore, the sub-CPU 29 is also connected to an A/D (analog-to-digital) conversion module 27 that can convert data from a digitizer 22 installed on the sub-LCD 20 . The personal computer of this example is also provided with a serial interface 26 directly connected to the sub-CPU 29, and a pager module 25 or another RF module 24 can be attached to this serial interface. Therefore, instead of using the PCMCIA socket 50 described above, the serial interface 26 can be used to provide a pager function, and cards or modules each having different functions can be connected to achieve multi-functionality.

[0022]

The sub-CPU 29 of the personal computer in this example also controls interrupt control with the system and performs power management for the entire system.

As described above, the sub-CPU 29 transmits and receives signals related to SMI, RI, and IRQ to and from the bus controller 14, thereby controlling the entire system including the state of the main CPU 11. At the same time, the sub-CPU 29 is also connected to the power controller 23, and controls the system power 23a and the sub-CPU-related system power 23b in accordance with each mode, such as full-on mode, doze mode, and suspend mode, which will be described later.

[0023]

<Functional Block> FIG. 4 shows a functional block diagram of the personal computer 1 of this embodiment.

In the main system 41 operated by the main CPU 11, application software such as spreadsheets runs on the top layer 42, and an operating system (OS) runs on the layer 43 below that. Various device drivers run in the lower layer 44 of this OS. The device drivers include, for example, a character recognition engine 45, a kana-kanji conversion device (FEP) 46, a pointing device driver 47, and a sub-LCD device driver 48, as well as various other device drivers for the main LCD, FDD, HDD, printer, etc. The character recognition engine 45 is a functional module that executes character recognition using ink data from the digitizer 22 on

the sub-LCD, which is input in conjunction with data from the FEP 46 . The FEP 46 performs kana-kanji conversion, captures ink data, and manages the user interface for the character recognition function. The pointing device driver 47 is a functional module for transmitting and receiving data relating to the subsystem 61 operated by the sub-CPU 29 , particularly data relating to the digitizer (touch panel) 22 . Furthermore, the sub-LCD device driver 48 is a functional module for transmitting and receiving display-related data for the sub-LCD 20 connected to the subsystem 61 .

[0024]

In this way, in the personal computer of this example, the main system 41 is equipped with device drivers that exchange data with the subsystem 61, and the OS or application software runs these device drivers, allowing the main system 41 to control the subsystem 61 and the sub-LCD 20.

Conversely, the subsystem 61 can also control the main system 41 via a device driver and send data to it.

[0025]

The subsystem 61 has, at its top layer 62, a main system interface 63 which is a functional module for exchanging various data with the main system 41.

Furthermore, software for communication and the like that operates in the environment of the subsystem 61 runs on this top layer 62 . Furthermore, in this lower layer 64, a sub LCD

display control module 65, a touch panel input control module 66, a state retention module 67, an external interface module 68, and the like operate. The sub-LCD display control module 65 develops the display data into a bitmap, is actually connected to the sub-LCD 20 in terms of hardware, and directly controls the LCD display. The touch panel input control module 66 receives the resistively divided voltage data of the touch panel 22 via the A/D conversion module 27, and converts the data input from the touch panel 22 into coordinate data. The status retention module retains the status of each function that must be retained when controlling the main and subsystem states, such as when an SMI is issued and the system is in power management mode, and rewrites the status as necessary. The status retention module also has the function of monitoring the battery status, etc. The external interface module 68 manages data communication between external devices and the sub-CPU, such as receiving a ring indicator (RI) and measuring battery data.

[0026]

<System Operation Status> The personal computer of this example manages the operation status of the main CPU 11, main LCD 10, and other modules in several modes.

The transition between the modes is shown in FIG. A cold start 71 is when the entire system is restarted. The personal computer 1 in this example can operate 24 hours a day by employing the sub-LCD 20 and the sub-CPU 29, so that it is restarted when the sub-CPU 29 is reset or when the system is started up after a system fatal error command is issued.

[0027]

The full-on mode 72 is a state in which the main CPU 11 is fully operational, and all systems including the main LCD 10 are on.

In this mode, the main CPU 11, the sub-CPU 29, the main LCD 10 and the sub-LCD 20 are operating, and the functions of the personal computer of this embodiment can be fully utilized. The main CPU 11 and the sub-CPU 29 can execute many functions at high speed.

[0028]

The doze mode 73 is a mode in which the speed of the operating clock of the main CPU 11 is reduced to a fraction of its original speed using a clock divider function or the like.

In this mode, the display state of the main LCD 10 is also set to a slow refresh state with a lowered refresh rate. The doze mode 73 is a mode that reduces power consumption while keeping the main CPU 11 in an operating state, and allows for a quick transition to the full-on mode 72 .

[0029]

The suspend mode 74 is a mode in which power consumption is further reduced than in the doze mode 73 .

In this mode, power is supplied to the main CPU 11, but the operating clock is stopped, and the main CPU 11 consumes almost no power. Furthermore, all peripheral devices controlled

by the peripheral controller 16 are kept in an off state. The power supply to the main LCD 10 is also turned off. Therefore, the power consumed by peripheral devices is almost zero, and power consumption can be significantly reduced. In this mode, programs such as the OS are kept loaded, so that when transitioning to full-on mode 72, the trouble of rebooting and the power consumption of devices required for that can be avoided. However, compared to the doze mode 73, some time is required for checking the peripheral environment, etc., and time is also required for the display on the main LCD 10 to return to normal.

[0030]

The hibernate mode 75 is a mode for further reducing power consumption, and is a state in which power supply to the entire system is stopped except for the sub-CPU 29 and the RTC function of the peripheral controller.

Therefore, in this mode, only processing that can be handled by the sub-CPU 29 and its system, i.e., the sub-LCD 20 and touch panel 22, etc., can be performed, and transition to full-on mode 72 is made via a stage in which the OS is rebooted.

[0031]

Examples of triggers for transitioning to each mode are as follows:

A transition to the cold start 71 occurs (S1) upon detection of a system reset or a system fatal error. Then, when the hardware initialization and system diagnosis are completed at the cold start, the system transitions to full-on mode 72 (S2). In full-on mode 72, if there is no access

for a predetermined time, a transition to doze mode 73 occurs (S3), and on the other hand, if a resume event occurs in doze mode 73, a transition to full-on mode 72 occurs (S4). Resume events include touching the touch panel 22 on the sub-LCD 20 to input an input or to instruct restarting a program, or receiving data (ring, RI) from a pager function connected to the personal computer. In addition to the pager function, other functions that accept data transmitted from external sources, such as input from various RF modules, external input from a modem connected to a serial port, and detection of incoming email, can also be included in resume events.

[0032]

The mode transitions to the suspend mode 74 if there is no further access for a predetermined period of time in the doze mode 73 (S5).

If the personal computer is set up to transition to suspend mode when the power is turned off, turning off the power switch will cause the computer to transition from full-on mode 72 to suspend mode 74 (S8). The suspend mode 74 may be transitioned to the full-on mode 72 by a resume event similar to that described above, or by turning on the power switch (S6).

[0033]

The mode transitions to the hibernation mode 75 if there is no further access for a predetermined period of time in the suspend mode 74 (S7).

If the system is set to transition to hibernation mode 75 by turning on/off the power switch, turning off the power switch in full-on mode 72 transitions to hibernation mode 75 (S10), and turning on the power switch in hibernation mode 75 transitions to full-on mode 72 (S9). The power switch may be mechanical, and since the sub-LCD in this example is always displayed, it is also possible to realize the power switch as a software switch using the sub-LCD 20, touch panel 22 and sub-CPU 29.

[0034]

In this way, the personal computer of this example is provided with four modes 72 to 75, and by transitioning between these modes, it is possible to achieve both reduced power consumption and expanded functionality.

Furthermore, by providing a sub-CPU 29 and the associated sub-LCD 20 and touch panel 22, predetermined functions can be operated 24 hours a day in an environment with very little power consumption. In a portable personal computer such as a notebook computer as in this example, when the main LCD is not in use, it is closed and enters a suspend mode 74 or a hibernation mode 75 . Therefore, in the personal computer of this embodiment, the sub-LCD 20 can be always viewed even when the main LCD is closed, and predetermined functions can be operated continuously through the sub-LCD 20 24 hours a day.

[0035]

Of course, it is also possible for the main CPU 11 itself or each system to independently manage the clock of the main CPU 11 in each mode and manage the power supply to each system.

In this example, the personal computer manages the status of the main CPU 11 and each system using signals from a sub-CPU 29 that operates 24 hours a day, and the power supply to each system is managed by a power controller 23 connected to the sub-CPU 29. For example, when the doze mode 73 is changed to the suspend mode 74, the sub CPU 29 sends a signal to the bus controller 14 to issue an SMI, and the main CPU 11 is put into a halted state. On the other hand, if the system is set to transition to full-on mode 72 upon sensing an incoming call from a pager, the sub-CPU 29 sends a ring instruction (RI) to the bus controller 14 and issues a resume instruction to the main CPU 11 to resume to full-on mode.

[0036]

The transition between modes is not limited to the above.

For example, it is possible to transition between modes depending on the hardware situation, such as a battery abnormality. In full-on mode 72, when the A/D conversion function of the sub-CPU detects a drop in battery voltage, the sub-CPU 29 issues an SMI to the main CPU 11 via the bus controller 14, performs SMI processing for the system connected to the main CPU 11, and transitions to suspend mode 74 or hibernation mode 75. In SMI processing, an SMI (system management interrupt) causes the system to transition to system management mode, where the CPU state and memory are saved and power supply to the CPU and the

system connected to it is stopped, and the CPU and the system connected to it can be restored by a resume event, etc. By providing such a process, troubles such as data loss can be avoided even if there is an abnormality in the battery.

[0037]

<Examples of Use of Sub-LCD as Input Side> Below, several examples of use of the sub-LCD 20, which is a sub-display provided in the personal computer of this embodiment, and the touch panel 22 placed on top of this sub-LCD 20 will be described.

First, FIG. 6 shows an example in which the touch panel 22 is used as a pointing device for moving a cursor or pointer displayed on the main LCD 10. In FIG. In this example, when a finger is pressed against the touch panel 22 and moved in the direction in which the pointer is to be moved, the signal from the touch panel 22 is A/D converted and input as data for moving the pointer, such as the relative amount of movement and direction. Therefore, the user can control the movement of the pointer or cursor via the touch panel in the same way as when operating a pointing device such as a trackball. The entire surface of the sub-LCD 20 may be provided as an area for moving a pointer or the like, or a limited area of the sub-LCD 20 may be used for moving a pointer or the like, and the remaining area may be used to provide the same function as a mouse click button. The display of the area according to these purposes can be freely set using the sub-LCD 20. Furthermore, by using the touch panel 22 to operate a pointer or the like, it is possible to freely operate the OS and applications in a user-friendly manner using a pointer without using a mouse or the like.

[0038]

FIG. 7 shows how pen input is made to an application via the touch panel 22 provided on the sub-LCD 20.

There are cases where characters are input (FIG. 7(a)) and cases where images are input (FIG. 7(b)), and both of these can be set by the display on the sub-LCD 20, and the user can input data using the pen in the designated area and input data into the OS or application running on the main LCD 10.

[0039]

6 and 7 are examples in which data can be input from the sub-LCD 20. In the example shown in FIG.

Conventionally, there is known a portable word processor or the like that has a touch panel attached to the main LCD 10 to allow pen input. In contrast to this, the personal computer of this embodiment allows pen input without providing a touch panel on the main LCD 10 side. Therefore, it is possible to eliminate the deterioration of contrast of the main LCD due to the provision of a touch panel, the difficulty of viewing due to display and input being performed at the same time, and the inconvenience in operation. Furthermore, since there is no need to provide an input area on the main LCD side, the displayable area can be utilized to the maximum extent. Furthermore, since the size of the touch panel can be limited to the size of the sub-LCD, the cost can be reduced and the weight can also be reduced. Furthermore, since

the touch panel can be small, it is possible to employ a high-density touch panel, which is convenient for pen input.

[0040]

Examples of using the sub-LCD 20 as an input side are not limited to the above-mentioned pointer operation and pen input.

Another possible input method is to display an input menu on the sub-LCD 20 and have the user select input data using the touch panel 22. By using the sub-LCD 20, an input area separate from the display on the main LCD 10 can be created, which allows for a variety of other uses, making it possible to realize a personal computer that is even easier to input and operate. One example is to display operation guidance on the sub-LCD side, which allows detailed guidance and error messages to be output regardless of the display on the main LCD. In this way, the personal computer according to the present invention can realize a more user-friendly personal computer that can be easily used by anyone, regardless of age or gender.

[0041]

Input from the sub LCD using the touch panel is performed in full-on mode 72, and when no input is continuously performed, the mode transitions to doze mode 73 to reduce power consumption.

Then, when the touch panel is pressed again, the doze mode 73 can be transitioned to the full-on mode 72 . The mode transition using the touch panel is performed, for example, as follows.

First, in full-on mode 72, input and pointer operations are performed. After that, if the user does not touch the touch panel for a predetermined time, the device automatically transitions to the doze mode 73, which is a power saving state. Next, when the user touches any part of the touch panel 22, the sub-CPU 29 operates as a resume event, and the clock speed of the main CPU 11 is restored, and the refresh rate of the main LCD 10 is also returned to high speed. In the doze mode 73, only the battery display 79 is displayed on the sub-LCD 20. Of course, it is also possible to display the current mode on the sub-LCD 20 or to display a display for limiting the area to be touched when transitioning between modes.

[0042]

The battery display 79 changes depending on the drop in battery voltage. For example, when the voltage is above a certain value, the battery display appears on the sub-LCD, and disappears if there is an abnormality in the battery, such as a drop in voltage.

If an abnormality occurs in the battery, the SMI process is carried out as described above, and data and memory are saved.

[0043]

<Example of Use of Sub LCD as Output Side> FIG. 8 shows an example in which the function of displaying messages received from a pager module or the like is assigned to the sub LCD 20.

For example, in the suspend mode 74, the main CPU 11 is in a stopped state, and power is not supplied to the main LCD 10 either. In this suspend mode 74, when the pager module 25 or

pager card 51 attached to the personal computer detects the arrival of data, the sub-CPU 29 is used to download the message. Then, the message is displayed on the sub-LCD 20. Therefore, the arrival of data from the pager can be detected and a message can be displayed without restarting the main CPU 11 or the main LCD 10. Similarly, even in the hibernation mode 75, messages received by the pager can be displayed on the sub-LCD 20. Similarly, it is possible to set the sub-LCD 20 to have a function of displaying other signals from the outside via RF, and the sub-LCD 20 can also be used to process communications via a telephone line.

[0044]

In this way, by providing the sub-LCD 20 in the personal computer of this embodiment, it is possible to add a function that is desired to operate continuously for 24 hours, and to greatly reduce the power consumed while the function is operating.

Therefore, by adding a pager function to the personal computer of this example, the information received thereon can be displayed in real time at all times, and information can be transmitted to the user without delay.

[0045]

Even in the doze mode 73 or the full-on mode 72, it is advantageous to display messages from a pager or the like on the sub-LCD 20 side.

In the doze mode 73, it is not necessary to wake up the main CPU 11 just to display the message. On the other hand, even in the full-on mode 72, the message from the pager can be

displayed immediately on the sub-LCD 20 without disturbing the display of the application currently being operated displayed on the main LCD 10.

[0046]

Conversely, it is also possible to transition to full-on mode when the pager module detects an incoming call.

If such a setting is made, when a message is downloaded by the pager module, the sub-CPU 29 displays the contents on the sub-LCD 20 and also sends RI to the bus controller 14 to transition to full-on mode. Therefore, in this setting, when an incoming call is detected, the main CPU 11 resumes operation at full speed with a high frequency clock signal, and the main LCD 10 also resumes displaying.

[0047]

As explained above, the sub-LCD 20 provided in the personal computer of this embodiment is mainly used for input display and pager display, and unlike the main LCD 10, it may have a low resolution such as 64×32 or 128×64 .

Of course, a color display may be used, but even if it is monochrome, the above-mentioned merits of adding the sub-LCD 20 can be obtained. Therefore, the provision of the sub-LCD 20 does not increase the cost significantly. Conversely, since the touch panel 22 is provided on

the sub-LCD 20 instead of the main LCD 10, the cost can be reduced and the main body can be made thinner. Furthermore, as mentioned above, since the area to be covered is small, a high-resolution touch panel can be installed.

[0048]

The size of the sub-LCD 20 is not limited to this example, and may be the same as or smaller than the main LCD.

The sub-LCD 20 may have a low resolution. The sub-CPU 29 that controls such a sub-LCD 20 does not perform processing that requires high speed or input/output of large amounts of data, so the sub-CPU 29 may be a 4-bit or 8-bit CPU. Furthermore, a low operating clock speed of several MHz or less is sufficient. Therefore, the power consumed by the sub-CPU 29 is very small. Furthermore, since it operates on a low frequency operating clock, the influence of noise from the sub-CPU 29 on RF functions such as a pager unit is small, and incoming call detection and message downloading can be performed accurately and reliably.

[0049]

In the above example, the processing performed by the sub-CPU 29 is described as detecting an incoming call from a pager and downloading, but the processing is not limited to this. For example, it is possible to continuously provide services such as schedule management and calculator functions using the sub-CPU 29 and sub-LCD 20, etc., separately from the main CPU.

[0050]

Furthermore, when the sub-LCD 20 operates independently in the suspend mode or hibernation mode, the clock frequency of the main CPU 11 may be lowered to control the sub-LCD 20 instead of the sub-CPU 29 .

As shown in FIG. 9, a sub-LCD 20 and a touch panel (digitizer) 22 may be connected to the ISA bus 15 via an LCD controller 28 and an input interface 27, respectively, and controlled by the main CPU 11. In such a system, the main CPU 11 does not completely stop in suspend mode 74 or hibernation mode 75, but is further divided using a clock switching mechanism 80 controlled by the bus controller 14 or the main CPU 11, and a clock signal of a lower frequency than that in doze mode 73 is supplied to the main CPU 11.

[0051]

In the above example, a sub-LCD is provided in the main body of the personal computer, but it is also possible to add a sub-LCD by attaching a PCMCIA card 54 equipped with a sub-LCD as explained with reference to FIG. 1.

Furthermore, the number of sub-LCDs is not limited to one, and it is of course possible to provide a plurality of sub-LCDs for use with a pointing device or pen input, for displaying messages from a pager, etc.

[0052]

Furthermore, in this example, a notebook-type portable personal computer is used as an example, but even in information processing devices such as desktop personal computers or office computers, by providing a sub-LCD, the same advantages as those described above can be obtained in terms of display, input operation, and power consumption.

In addition, in this example, a notebook computer is used as an example, and therefore liquid crystal displays (LCDs) are used for the main display and sub-display, but it goes without saying that these displays may also be CRTs or plasma displays. Furthermore, since the explanation is given using a notebook type personal computer as an example, the shape of the main body is also explained as a type in which the main LCD opens and closes. However, the shape of the personal computer is not limited to this example, and it is sufficient if the sub-LCD can always be viewed even when the main LCD is not in use.

[0053]

As explained above, the information processing device of the present invention is provided with a sub-display that is equal to or smaller than the main display that conventional information processing devices are equipped with, and further, it is proposed that this information processing device be used to perform processing in at least two modes: a mode in which the main display and sub-display operate, and a mode in which only the sub-display operates.

This new type of information processing device provides the various effects described above. For example, in terms of data input and output, a touch panel can be placed on top of the sub-

display and used as a pointing device or for pen input. Not limited to this, the information processing device of the present invention can use a sub-display for input in addition to the main display, so that various application software that is easier for users to use can be developed and run in environments different from conventional ones.

[0054]

The sub-display may also be used as an output device to display the time, schedule, pager call, and the like.

Such applications do not require the same functionality as the main display, but it is desirable for them to operate continuously for 24 hours. In the information processing device of the present invention, these applications can be operated continuously using the sub-display.

While these applications are running, the main display and the main CPU that runs it can be stopped, which reduces the load on the power supply and significantly extends the life of the power supply. Furthermore, in the information processing device of the present invention, a specific application can be continuously run using the sub-display, so it is effective to adopt a new shape in which the sub-display is always exposed to the outside even when the main display is stored.

[0055]

BRIEF DESCRIPTION OF THE DRAWINGS

[0056]

1 is a perspective view showing an outline of a notebook-type personal computer according to an embodiment of the present invention, showing a state in which the main LCD is open.

[0057]

2 is a perspective view of the notebook computer shown in FIG. 1, showing the state in which the main LCD is closed.

[0058]

3 is a block diagram showing the internal configuration of the notebook computer shown in FIG. 1.

[0059]

4 is a functional block diagram showing the functional configuration of the notebook computer shown in FIG. 1.

[0060]

5 is a diagram showing the mode transition state of the notebook computer shown in FIG. 1.

[0061]

6 is a diagram showing an example in which the sub-LCD of the notebook computer shown in FIG. 1 is used as a pointing device.

[0062]

7 is a diagram showing an example in which the sub-LCD of the notebook computer shown in FIG. 1 is used for pen input.

[0063]

8 is a diagram showing an example in which the sub-LCD of the notebook computer shown in FIG. 1 is used to display a pager message.

[0064]

9 is a block diagram showing a different configuration example of the notebook computer of the present invention.

[0065]

Explanation of symbols

[0066]

1. Personal computer 2. Personal computer main body 3. Portion equipped with main LCD 4. Portion equipped with keyboard and sub-LCD 5. Keyboard 6. Slot for PCMCIA card 7. Window

for sub-LCD provided as PCMCIA card 10. Main LCD 11. Main CPU 12. Memory 13. Local bus 14. Bus controller 15. ISA bus 16. Peripheral controller 17. Video controller 18. Video RAM 20. Sub-LCD 22. Touch panel (digitizer) 23. Power controller 24. RF module 25. Pager module 26. Serial interface 50. PCMCIA socket 51. PCMCIA pager card 52. PCMCIA RF card 54. PCMCIA card equipped with sub-LCD 80. Clock switching mechanism