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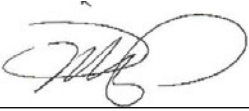
I served as Chief Examiner of the certified court interpreter test for the State of California and as a contract translator and interpreter for various federal agencies through the U.S. Department of State of for more than a decade. I served as an instructor at the University of California at Berkeley and the Middlebury Institute of International Studies at Monterey.

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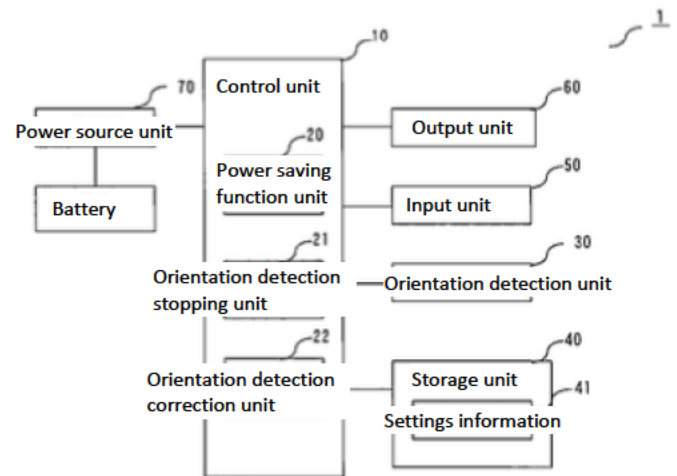
(54) (TITLE) **PORTABLE INFORMATION PROCESSING APPARATUS AND CONTROL METHOD THEREOF**

(57) (ABSTRACT)

(PROBLEM) To provide a portable information processing apparatus with an excellent power saving function.

(MEANS TO SOLVE THE PROBLEM) The portable information processing apparatus is provided with a power saving function unit for stopping or restricting various functions to suppress power consumption and extend the operation time, an orientation detection unit capable of detecting the orientation of the main unit with respect to gravity, a storage unit for storing and holding conditions as setting information for operating the power saving function unit in association with the orientation of the main unit with respect to gravity, and a control unit for acquiring information pertaining to orientation outputted by the orientation detection unit and controlling the power saving function unit on the basis of the setting information recorded in the storage unit.

(SELECTED DRAWING) FIG. 1



(CLAIMS)

(Claim 1)

A portable information processing apparatus characterized in being provided with
a power saving function unit for stopping or restricting various functions during startup to suppress power consumption and extend the operation time,
an orientation detection unit capable of detecting the orientation of the main unit with respect to gravity,
a storage unit for storing and holding conditions, as setting information, for operating the power saving function unit in association with the orientation of the main unit with respect to gravity, and
a control unit for acquiring information pertaining to orientation outputted by the orientation detection unit and controlling the power saving function unit on the basis of the setting information recorded in the storage unit.

(Claim 2)

The portable information processing apparatus set forth in claim 1 characterized in that
the control unit acquires information pertaining to orientation from the orientation detection unit, operates the power saving function unit on the basis of the setting information recorded in the storage unit, and operates an orientation detection stop unit for stopping an operation carried out using information relating the orientation until there is an input from an input unit receiving a user operation.

(Claim 3)

The portable information processing apparatus set forth in claim 1 or 2 characterized in that
the setting information has a region that can be set by a user or an application program creator, and
the control unit controls the power saving function unit on the basis of the setting information set by the user or the application program creator.

(Claim 4)

The portable information processing apparatus set forth in any of claims 1 to 3 characterized in that
the setting information has a region for each application program that can be set by a user or an application program creator, and
the control unit uses the setting information set for each application program to control the power saving function unit.

(Claim 5)

The portable information processing apparatus set forth in any of claims 1 to 4 characterized in that
the setting information has a region that can stipulate an operation for switching to a power saving mode, and
the control unit immediately switches to the power saving mode on the basis of the information pertaining to orientation and the setting information when the position is held horizontal in a stored orientation opposite to the direction of gravity.

(Claim 6)

The portable information processing apparatus set forth in any of claims 1 to 5 characterized in that
the setting information has a region that can stipulate an operation for switching to a power saving mode, and
the control unit immediately switches to the power saving mode stipulated in the setting information on the basis of the information pertaining to orientation and the setting information when, within a prescribed time, the user changes the form from the used orientation to a stored orientation, the user changes the orientation to the direction opposite the direction of gravity in a prescribed direction and/or at a prescribed acceleration, and the position is held horizontally after those changes.

(Claim 7)

The portable information processing apparatus set forth in any of claims 1 to 6 characterized in that
the setting information has a region that can stipulate a user operation for switching to a power saving mode, and the control unit compares an operation stored in the setting information to an actual operation and automatically changes the orientation suitable for switching to the power saving mode from the use state on the basis of on the current operation.

(Claim 8)

The portable information processing apparatus set forth in any of claims 1 to 7 characterized in that the setting information has a region for temporarily storing a user operation, and the control unit ascertains a user operation stored in the setting information and automatically changes the orientation for switching to the power saving mode corresponding to the application program in use.

(Claim 9)

The portable information processing apparatus set forth in any of claims 1 to 8 characterized in that when changing the screen display so as to use the display unit vertically or horizontally with respect to the user, the control unit operates the orientation detection correction unit for correcting the sensor output value of the orientation detection unit so as to correspond to the changed direction of the display screen, and re-reads the corrected information pertaining to orientation to identify the orientation.

(Claim 10)

The portable information processing apparatus set forth in any of claims 1 to 8 characterized in that when changing the screen display so as to use the display unit vertically or horizontally with respect to the user, the control unit operates the orientation detection correction unit to change an electric circuit line so that the sensor output value of the orientation detection unit corresponds to the changed display screen, and re-reads the corrected information pertaining to orientation to identify the orientation.

(Claim 11)

The portable information processing apparatus set forth in any of claims 1 to 10 characterized in that the setting information has a region capable of stipulating a condition for operating the power saving function in response to the display screen direction, and when the display screen direction changes with respect to the user, the control unit identifies the form and display screen direction and identifies the orientation corresponding to the identified form and display screen direction.

(Claim 12)

The portable information processing apparatus set forth in any of claims 1 to 11 characterized in that the setting information has a region capable of stipulating a condition for operating the power saving function in response to the display screen direction, and the control unit re-reads the sensor output value of the orientation detection unit to identify the orientation when the screen is displayed so that the display unit is used horizontally with respect to the user, and re-reads the X-axis and the Y-axis of the sensor output value to identify the orientation when the screen is displayed so that the display unit is used vertically with respect to the user.

(Claim 13)

The portable information processing apparatus set forth in any of claims 1 to 12 characterized in that the setting information has a region corresponding to a right-hand setting and a left-hand setting, and the control unit uses the selected setting information to operate the power saving function unit, the user having inputted either right-hand or left-hand in advance.

(Claim 14)

The portable information processing apparatus set forth in any of claims 1 to 13 characterized in that the control unit stores and holds a user operation in the input unit for a prescribed period of time, and makes the power saving function unit operate to make a correction on the basis of the operation quantity inputted in the prescribed period of time.

(Claim 15)

The portable information processing apparatus set forth in any of claims 1 to 13 characterized in that the control unit stores and holds a user operation in the input unit for a prescribed period of time, and makes the power saving function unit operate to make a correction on the basis of the operation quantity inputted in the prescribed period of time and of an output of the orientation detection unit when an input is detected.

(Claim 16)

The portable information processing apparatus set forth in any of claims 1 to 15 characterized in that the setting information has a region for storing a power generation quantity of a fuel cell corresponding to an incline, and the control unit estimates the power generation quantity of the fuel cell on the basis of a sensor output value from the orientation detection unit, and calculates the available power quantity on the basis of the estimated value to control the power saving function unit.

(Claim 17)

The portable information processing apparatus set forth in any of claims 1 to 15 characterized in that the setting information has a region for storing the power generation quantity of a fuel cell corresponding to an incline, and the control unit estimates the orientation of the fuel cell on the basis of a sensor output value from the orientation detection unit, and controls the power generation quantity of the fuel cell.

(Claim 18)

The portable information processing apparatus set forth in any of claims 1 to 15 characterized in that the setting information has a region for storing the power generation quantity of a fuel cell corresponding to an incline, and the control unit controls the power saving function unit on the basis of a sensor output value from the orientation detection unit and the setting information, and controls the fuel cell to generate the power quantity needed after controlling the power saving function unit.

(Claim 19)

A method for controlling a portable information processing apparatus characterized in having a step for using a power saving function unit and an orientation detection unit that outputs, as information pertaining to orientation, an orientation determined from an incline with respect to the direction of gravity and a form to acquire from a storage unit setting information stored as a condition for carrying out a power saving control in response to an orientation with respect to gravity, a step for acquiring an orientation of a main unit with respect to gravity as information pertaining to orientation from the orientation detection function unit, and a step for controlling the power saving function on the basis of the acquired information pertaining to orientation and a condition of power saving control recorded as the setting information.

(Claim 20)

The method for controlling a portable information processing apparatus set forth in claim 19 characterized in having a step for stopping, after a switch to a power saving function, an operation for using the information pertaining to orientation until there is an input from an input unit.

(Claim 21)

The method for controlling a portable information processing apparatus set forth in claim 19 or 20 characterized in having a step for the user of the apparatus or a creator of an application program used on the apparatus by the user to set the setting information.

(Claim 22)

The method for controlling portable information processing apparatus set forth in any of claims 19 to 21 characterized in that the setting information is set with an operation condition for switching to a power saving mode.

(Claim 23)

The method for controlling portable information processing apparatus set forth in any of claims 19 to 22 characterized in that the setting information is set with an operation condition for immediately switching to a power saving mode when a position is held horizontally in a stored orientation in the direction opposite of gravity.

(Claim 24)

The method for controlling a portable information processing apparatus set forth in any of claims 19 to 23 characterized in that the setting information is set with a condition for stipulating a user operation for switching to a power saving mode.

(Claim 25)

The method for controlling a portable information processing apparatus set forth in any of claims 19 to 24 characterized in having a step for variably storing a condition for switching to a power saving mode in association with orientation as the setting information, detecting a user operation, and overwriting the setting information so that the orientation at the time of operation is associated with a normal mode.

(Claim 26)

The method for controlling a portable information processing apparatus set forth in any of claims 19 to 24 characterized in having a step for variably storing a condition for switching to a power saving mode in association with orientation as the setting information, detecting a user operation, and overwriting the setting information of the orientation for switching to the power saving mode on the basis of the orientation at the time of the operation.

(Claim 27)

The method for controlling a portable information processing apparatus set forth in any of claims 19 to 26 characterized in that the setting information is set with a condition for switching to a power saving mode in response to an application program in use.

(Claim 28)

A method for controlling a portable information processing apparatus set forth in any of claims 19 to 27 characterized in having a step for identifying the display direction of a display screen, and correcting a setting condition which is a condition for carrying out a power saving control in response to an orientation with respect to gravity stored in setting information so as to respond to a change in the display screen direction.

(Claim 29)

A method for controlling a portable information processing apparatus set forth in any of claims 19 to 28 characterized in having a step for identifying the display direction of a display screen and correcting the orientation with respect to gravity so as to respond to a change in the display screen direction.

(DETAILED DESCRIPTION OF THE INVENTION)

(TECHNICAL FIELD)

(0001)

The present invention relates to a portable information processing apparatus. More specifically, the present invention relates to a portable information processing apparatus having a sensor capable of detecting an orientation with respect to gravity.

(BACKGROUND ART)

(0002)

In recent years, there has been an increasing trend in power consumption as multi-functionality and high functionality have advanced in information processing apparatuses carried by users, typified by a portable terminal apparatus.

A portable information processing apparatus using a battery as the main power source needs to use the limited battery capacity efficiently, and power savings is extremely important. Therefore there is the problem of how to efficiently save power with both lower power consumption and higher functionality.

(0003)

Examples of technology relating to a power saving function in a portable information processing apparatus include the portable information processing apparatuses described in Patent Documents 1 and 2.

(0004)

The portable terminal apparatus described in Patent Document 1 has a sensor means for detecting a physical action carried out by the portable terminal apparatus user to view the screen of the display unit during application startup, and a switch from a normal power supply mode to a power saving mode and back again is controlled by a control unit on the basis of an output from the sensor. The portable terminal apparatus has an accelerator sensor as the sensor means and controls the switch to the power saving mode and back again on the basis of portable terminal apparatus tilting or vibration after analysis of the acceleration sensor output.

(0005)

Patent Document 2 describes a folding portable terminal apparatus provided with a front display and a back display which are turned on and off in response to an output of a gravity sensor that detects the angle of the portable terminal apparatus. Patent Document 2 also describes a reverse button in the portable terminal apparatus for the user to give a reverse instruction for turning the front display and the back display on and off. Patent Document 2 describes providing a hysteresis characteristic to the determination of the output value of the gravity sensor used in switching between the front display and the back display of the portable terminal device.

(0006)

A general portable information processing apparatus has a function for setting a power saving mode after a prescribed time has elapsed without an input operation by the user.

(PRIOR ART DOCUMENTS)

(PATENT DOCUMENTS)

(0007)

(PATENT DOCUMENT 1) Patent Appl. Publication No. JP 2007-080219

(PATENT DOCUMENT 2) Patent Appl. Publication No. JP 2007-281864

(OUTLINE OF THE INVENTION)

(PROBLEM THE INVENTION IS INTENDED TO SOLVE)

(0008)

The use of an acceleration sensor (gravity sensor) capable of orientation detection has been proposed in the operation control of a power saving function in a portable information processing apparatus such as the portable terminal apparatuses described in Patent Documents 1 and 2.

(0009)

However, in the control method of Patent Document 1, a switch is made from the ordinary mode to the power saving mode when the tilt of the portable terminal apparatus detected by sensor is within a prescribed range, and a return is made from the power saving mode to the ordinary mode when outside the prescribed range, so there is the problem of continuous repeated switching between the ordinary mode and the power saving mode when near the prescribed range (near the threshold value). (0010)

In the control method described in Patent Document 2, the problem of repeating the switch to power reduction and back again is solved as a problem of the portable terminal apparatus described in Patent Document 1 by providing a hysteresis characteristic to the determination by the control unit, but further improvement is needed in the power reduction function.

(0011)

The present invention was devised taking the above problems into consideration, and it is an object of the present invention to provide a portable information processing apparatus that uses an orientation detection unit capable of detecting orientation to achieve a superior power reduction function.

(MEANS TO SOLVE THE PROBLEM) (0012)

The portable information processing apparatus of the present invention is characterized in being provided with a power saving function unit for stopping or restricting various functions during startup to suppress power consumption and extend the operation time, an orientation detection unit capable of detecting the orientation of the main unit with respect to gravity, a storage unit for storing and holding conditions, as setting information, for operating the power saving function unit in association with the orientation of the main unit with respect to gravity, and a control unit for acquiring information pertaining to orientation outputted by the orientation detection unit and controlling the power saving function unit on the basis of the setting information recorded in the storage unit.

(0013)

The method for controlling a portable information processing apparatus of the present invention is characterized in having a step for using a power saving function unit and an orientation detection unit that outputs, as information pertaining to orientation, an orientation determined from an incline with respect to the direction of gravity and a form to acquire from a storage unit setting information stored as a condition for carrying out a power saving control in response to an orientation with respect to gravity, a step for acquiring an orientation of a main unit with respect to gravity as information pertaining to orientation from the orientation detection function unit, and a step for controlling the power saving function on the basis of the acquired information pertaining to orientation and a condition of power saving control recorded as the setting information.

(EFFECT OF THE INVENTION)

(0014)

According to the present invention, a portable information processing apparatus is provided that uses an orientation detection unit capable of detecting orientation to achieve a superior power reduction function.

(BRIEF DESCRIPTION OF THE DRAWINGS)

(0015)

(FIG. 1) A block view showing the portable information processing apparatus in the mode.

(FIG. 2) An explanatory view showing axes X, Y and Z, which are rotating axes of the portable information processing apparatus. (FIG. 3) An explanatory view showing rotation about the axes in the X-Y plane.

(FIG. 4) An explanatory view showing rotation about the axes in the X-Z plane.

(FIG. 5) An explanatory view showing rotation about the axes in the Y-Z plane.

(FIG. 6) An explanatory view showing, as examples, information for determining associated regions at planar angles of the portable information processing apparatus.

(FIG. 7) An explanatory view showing, as examples, the setting regions of orientations in the setting information.

(FIG. 8) An explanatory view showing, as examples, the setting regions of operation modes for orientations in the setting information.

(FIG. 9) An explanatory view showing, as examples, hysteresis setting regions in the setting information.

(FIG. 10) An explanatory view showing, as examples, other hysteresis setting regions in the setting information.

(FIG. 11) An explanatory view exemplifying setting regions of processing operations for operations pertaining to orientation in the setting information.

(FIG. 12) An explanatory view exemplifying setting regions of processing operations for input operations in the setting information.

(FIG. 13) An explanatory view exemplifying hysteresis setting regions corresponding to a right-hand setting and a left-hand setting in the setting information.

(FIG. 14) An explanatory view exemplifying setting regions in which affiliated regions are determined for planar angles corresponding to a right-hand setting in the setting information.

(FIG. 15) An explanatory view exemplifying setting regions in which affiliated regions are determined for planar angles corresponding to a left-hand setting in the setting information.

(FIG. 16) A flowchart showing the operation of the portable information processing apparatus.

(FIG. 17) A block view showing the schematic configuration of a portable terminal apparatus in an embodiment.

(FIG. 18) An explanatory view showing a portion of the setting information in the present embodiment.

(FIG. 19) An explanatory view showing a portion of the setting information in the present embodiment.

(FIG. 20) An explanatory view showing the Y-Z plane in an embodiment.

(FIG. 21) A flowchart showing an example of the entire operation for the power saving settings of the portable terminal apparatus in an embodiment.

(FIG. 22) An explanatory view showing the setting information overwritten in embodiment 2.

(FIG. 23) A flowchart showing the operation of the portable terminal apparatus in embodiment 2.

(FIG. 24) An explanatory view showing the setting information in embodiment 3.

(FIG. 25) An explanatory view showing the setting information in embodiment 3.

(FIG. 26) An explanatory view showing the X-Z plane in embodiment 3.

(FIG. 27) A perspective view showing an overview of the portable terminal apparatus of embodiment 4.

(MODES FOR WORKING THE INVENTION)

(0016)

A modes for working the present invention is described with reference to the drawings. Descriptions for structures not closely related to the present invention are simplified or omitted.

(0017)

FIG. 1 is a block view showing a portable information processing apparatus 1 in a mode of the invention. Referring to FIG. 1, the portable information processing apparatus 1 comprises a control unit 10, a power saving function unit 20, an orientation detection unit 30, a storage unit 40, an input unit 50, an output unit 60, and a power source unit 70.

(0018)

The portable information processing apparatus 1 can be used for many purposes as energy stored in a battery is acquiring through the power source unit 70 and the control unit 10 is operated as various means.

(0019)

The control unit 10 is provided with a power saving function unit 20 and efficiently uses energy stored in the battery. The power saving function unit 20 stops or restricts various functions during startup to curb power consumption and extend the operation time. The control unit 10 is provided with, according to need, an orientation detection stop unit 21 and an orientation detection correction unit 22.

The term "power saving function" as used here refers to a function for stopping or limiting various functions to curb power consumption, such functions being, for example, not displaying the display screen, turning off the backlight of the display unit, slowing the computational processing of the control unit and the like, and blocking power to a device not being used.

(0020)

The orientation detection stop unit 21 uses information pertaining to orientation to stop an operation until there is an input from the input unit 60 receiving a user operation. In further detail, after the orientation detection stop unit 21 operates, a desired power savings is achieved by stopping or not identifying an output from the orientation detection unit 30 until an input operation is received.

(0021)

The orientation detection correction unit 22 corrects, as needed, the sensor value output from the orientation detection unit 30 so as to adjust a desired angle or change an axis direction to correspond to the screen. The correction may be made by converting a signal with an electrical circuit or by re-reading a value with information processing. Also, the correction may be carried out by rewriting setting information 41 as described below.

(0022)

The orientation detection unit 30 detects the direction of the main unit (sensor) with respect to gravity. The orientation detection unit 30 may also identify the shape of the portable information processing apparatus 1 and be capable of detecting the rotational direction and acceleration thereof. In further detail, the orientation detection unit 30 outputs, as information related to the orientation, the incline of the main unit with respect to the direction of gravity and the orientation determined from the form. The orientation detection unit 30 may be configured with, for example, a three-axis acceleration sensor, a gravity sensor, and a switch or sensor for detecting orientation.

(0023)

The shape of the portable information processing apparatus 1 is determined by the positional relationship of the main unit, the display unit, and the like in the portable information processing apparatus with a movable display unit and the like. For example, if the portable information processing apparatus 1 is foldable, the shape is determined by the folded state and the display unit angle. If the display unit of the portable information processing apparatus 1 is rotary sliding, the shape is determined by the position of the display unit with respect to the main unit, the display direction of the display screen (the screen being vertical or horizontal with respect to the long side of the display unit) and the like. Similarly, the shape is determined by the reversal (turned) state and display direction of the display unit and the like if the display unit and the like are reversible (can be turned over). Also, a shape containing a retractable antenna may be determined if a retractable antenna is present.

(0024)

The storage unit 40 stores the setting information 41, which is conditions for operating the power saving function unit 20 and the like.

The setting information 41 describes the orientation with respect to gravity corresponding to a sensor output (information pertaining to orientation) of the orientation detection unit 30. The setting information 41 describes a power saving setting associated with each orientation. The "power saving setting of the setting information 41" refers to, for example, a condition for switching to the power saving mode, or a combination of a stop of power supply to a specific device and a power saving operation or the like. The setting information 41 may be stored so as to be modifiable (rewritable) during startup such that the condition for switching to the power saving mode is associated with the orientation and the content described below is combined with the use form.

(0025)

The setting information 41 may be provided with a region that can be set by the user or an application program creator. The may be one such region for each application program. The region may be set by the user or the application program creator to be available as one condition for operating the power saving function unit 20.

(0026)

The setting information 41 may be provided with a region capable of stipulating an operation for switching to the power saving mode. Similarly, the setting information 41 may be provided with a region capable of stipulating a user operation for switching to the power saving mode. These regions can be used as conditions for operating the power saving function unit on the basis of an operation of the portable information processing apparatus 1 or an inputted operation.

(0027)

The setting information 41 may also be provided with a region for temporarily storing a user operation, a region capable of stipulating a condition for operating the power saving function in response to the display screen direction, a region corresponding to the right-hand setting or the left-hand setting, and a region capable of stipulating a hysteresis (undetermined region) setting value.

(0028)

If, for example, a direct methanol fuel cell (DMFC) for varying the power generation quantity according to the incline of the main unit and the amount of fuel is used as the battery, the portable information processing apparatus 1 may be provided with a region for storing the power generation quantity and the orientation of the DMFC corresponding to the incline of the main unit (the orientation of the portable information processing apparatus 1) as setting information 41.

The setting information 41 is exemplified below with reference to the drawings.

(0029)

Next the orientation of the portable information processing apparatus is described in detail.

FIG. 2 is an explanatory view showing the XYZ axes, which are rotary axes of the portable information processing apparatus 1. In the present mode, the reference point with respect to gravity is defined as shown in FIG. 2 as are the X axis, the Y axis, and the Z axis, which are the rotary axes of the main unit. In the portable information processing apparatus 1 exemplified in FIG. 2, the reference point of rotation is set on the inside of roughly the center of the main unit, and the X axis, the Y axis,

and the Z axis are set centered on the reference point. The position where the reference point is set is arbitrary and may be at the center of gravity, at the sensor position, or at some other position.

(0030)

FIG. 3 to 5 are explanatory views showing rotation about each of the axes in the X-Y plane, the X-Z plane, and the Y-Z plane. The rotation about the Z axis in the X-Y plane is determined by an angle θ_z as shown in FIG. 3.

Similarly, the rotation about the Y axis in the X-Z plane is determined by an angle θ_y as shown in FIG. 4.

Similarly, the rotation about the X axis in the Y-Z plane is determined by an angle θ_x as shown in FIG. 5.

The axis angles are respectively shown as θ_x , θ_y , and θ_z . θ_x , θ_y , and θ_z are each a value from 0° to 180° , and the (counterclockwise) rotations shown in the drawings are handled as positive values and reverse (clockwise) rotations are handled as negative values.

More specifically, a state in which the display surface of the portable information processing apparatus 1 is placed facing up and horizontal is defined such that $\theta_x = 0^\circ$, $\theta_y = 0^\circ$, and $\theta_z = 0^\circ$.

(0031)

The portable information processing apparatus 1 exemplified in FIG. 2 to 5 is a sliding type in which the input unit 60 [*sic*: 50] slides out from the bottom. The orientation detection unit 20 of the portable information processing apparatus 1 is provided with a detector (sensor or switch) for detecting the sliding state. As described above, the orientation includes changes in the form (shape) such as the sliding state, the state of the display unit position with respect to the main unit, and the state of the display screen, and the states are identified by the control unit 10.

(0032)

The control unit 10 of the portable information processing apparatus 1 has an input temporary storage function for storing an input by the user in the input unit 50 for a prescribed time. This function may store in the storage unit 40 the input quantity, the number of inputs, input frequency, an input program, or the like when making an input in the input unit 50.

(0033)

A number of table information items stored in the storage region of the setting information 41 are exemplified below. By storing any or all of the below table information items, information pertaining to orientation from the orientation detection unit 30 can be used to finely control the power saving function.

(0034)

FIG. 6(a) to (c) are explanatory views exemplifying information for determining regions associated with planar angles of the portable information processing apparatus 1.

(0035)

θ_1 to θ_4 of each plane shown in FIG. 6 are used to determine the current associated region and have an angle whose value is found by dividing the planar angle into a desired range.

To provide a specific example, if θ_1 and θ_3 , which are X-Y planar angles θ_z (FIG. 6(a)), are stipulated to be 15° , the range from the front of the portable information processing apparatus 1 to a 15° rotation to the left can be stipulated as Z1, and similarly the range from the front to a 15° right rotation to the left [*sic*: right] can be stipulated as Z4. By stipulating θ_2 and θ_4 appropriately, ranges when using facing the side can be stipulated.

Values can be stipulated to obtain ranges with a desired angle for the X-Z planar angle θ_y° and the Y-Z planar angle θ_x° similarly to the X-Y planar angle θ_z° .

(0036)

By storing such setting information 41 in the storage unit 40, it is possible for the control unit 10 of the portable information processing apparatus 1 to identify the associated region at the current point by identifying the angle (incline) with respect to gravity from the sensor output of the orientation detection unit 30. Depending on the type of sensor used in the orientation detection unit 30, a voltage value or the like may be outputted instead of angle information, in which case, the voltage value range of XYZ outputs can be used to detect the orientation.

(0037)

FIG. 7 is an explanatory view exemplifying orientation setting regions in the setting information 41. As shown in FIG. 7, the control unit 10 sets (identifies) the orientation of the portable information processing apparatus 1 on the basis of information pertaining to orientation outputted by the orientation detection unit 30 by reading information stored beforehand in association with information pertaining to orientation.

In the exemplification of FIG. 7, the control unit 10 of the portable information processing apparatus 1 identifies the associated region shown in FIG. 6 from the inclines of the XYZ axes with respect to gravity, identifies the form (shape) of the portable information processing apparatus 1, and identifies the orientation at that time.

(0038)

FIG. 8 is an explanatory view exemplifying setting regions of operation modes with respect to orientation in the setting information 41. As shown in FIG. 8, the control unit 10 sets the operation mode of the portable information processing apparatus 1 by reading information stored in advance in association with the orientation of the portable information processing apparatus 1, said orientation having just been identified.

(0039)

The setting information 41 may be provided with regions for setting a hysteresis setting value, an application type setting, an operation setting and the like according to need.

(0040)

FIG. 9 is an explanatory view exemplifying hysteresis setting regions in the setting information 41. As shown in FIG. 9, when the control unit 10 identifies the orientation, an indeterminate region (angle) can be provided to prevent a phenomenon in which the region repeatedly changes due to slight variation at the set region boundary.

(0041)

FIG. 10 is an explanatory view exemplifying other hysteresis setting regions in the setting information 41. In FIG. 10, the hysteresis value is set corresponding to a region boundary. In detail, while one value was set for each plane in the hysteresis setting regions shown in FIG. 9, each hysteresis setting region shown in FIG. 10 is provided so that a desired value can be set at the boundary of divided regions

(0042)

FIG. 11 is an explanatory view exemplifying set regions of processing operations for operations (switching) pertaining to orientation in the setting information 41. As shown in FIG. 11, the setting information 41 may store desired processing (a function) corresponding to an operation pertaining to orientation detected using sensor output of the orientation detection unit 30. With these regions provided, the control unit 10 is able to carry out a desired processing operation in response to an operation pertaining to orientation.

(0043)

FIG. 12 is an explanatory view exemplifying set regions of processing operations for input operations in the setting information 41. The setting information 41 may store desired processing (a function) carried out in response to an input operation detected by the input unit 60 [sic: 50] as shown in FIG. 12.

(0044)

FIG. 13 is an explanatory view exemplifying hysteresis set regions corresponding to a right-hand setting and a left-hand setting in the setting information 41. As shown in FIG. 13, the setting information 41 may be provided with regions corresponding to a right-hand setting and a left-hand setting for use in orientation identification or sensor output correction.

(0045)

FIG. 14 and FIG. 15 are explanatory views exemplifying setting regions in which associated regions are determined for each planar angle corresponding to a right-hand setting and a left-hand setting in the setting information 41. The setting information 41 may store a right-hand setting and a left-hand setting for use in orientation identification as shown in FIG. 14 and FIG. 15.

(0046)

The portable information processing apparatus 1 thus configured operates as described below.

FIG. 16 is a flowchart showing the operation of the portable information processing apparatus 1.

The control unit 10 of the portable information processing apparatus 1 reads programs and the setting information 41 from the storage unit 40 (step S01).

The control unit 10 acquires information pertaining to orientation outputted by the orientation output unit 30 at each prescribed timing (step S02).

The control unit 10 uses the orientation detection correction unit 22 as needed to correct data and orientation (step S03).

The control unit 10 controls the power saving function unit 20 on the basis of the setting information 41 and information pertaining to orientation (step S04).

The control unit 10 uses the orientation detection stop unit 21 according to need to stop an operation that uses information pertaining to orientation until there is an input operation in the input unit 50 by the user (step S05). By doing so, once the power saving mode is set, the portable information processing apparatus can hold its state until there is a key operation or the like.

(0047)

In addition to the operation described above, the control unit 10 may use the change in information pertaining to orientation and the setting region of processing operations for operations pertaining to orientation recorded in the setting information 41 to immediately switch to the power saving mode without using the normal power saving function, which uses a timer function or the like, when, for example, there is downward movement with respect to gravity and the position is held in a stored orientation in the direction opposite to gravity (refer to FIG. 11, line 3). If the control unit 10 is thus operated, it is possible to switch to the power saving settings by treating the user operation of placing the portable information processing apparatus 1 horizontally as not indicating an intention of use.

A timer function can be added to the operation described above, such that the control unit 10 immediately switches to the power saving mode when, within a prescribed time, the user changes the form from the orientation being used to a stored orientation, the orientation changes to the direction opposite of gravity with a prescribed direction and/or acceleration, and that position is held after those changes. If the control unit 10 operates in this manner, it can be confirmed that there is no intention of use when the user changes the orientation of the portable information processing apparatus 1 according to a plurality of conditions within a prescribed period of time, and a switch to the power saving settings can be made immediately. (0048)

Also, after the form changes to a stored orientation, if downward movement is detected and then stops and the stopping position is then maintained, a switch may be made immediately to power saving mode.

(0049)

The control unit 10 may store and hold a user operation inputted from the input unit 50 at the same time as the operation described above or a prescribed time therebefore. If that operation is stored and held, the control unit 10 can ascertain the user's operation with reference to the information pertaining to orientation and the setting region of the processing operation for the input operation, and carry out a processing operation such as switching from the current inputted operation state to the power saving mode.

(0050)

The control unit 10 can be operated so as to reference the information pertaining to orientation and the setting region of processing operation for input operations to identify input to the user's main key (such as one of the tenkey pad keys or the cursor key), and set the current orientation angle to standard mode for a prescribed time. Similarly, input to the user's main key may be identified, the setting information 41 automatically overwritten so as to associate the orientation at the time of operation to the normal mode, and an automatic change made to suitable orientations for switching from the current use mode to the power saving mode. It is desirable to add processing to return the settings to the default settings after a prescribed time has elapsed.

In a situation such as where the user is using the portable information processing apparatus 1 while lying down face up such as when on a bed, the condition is ascertained on the basis of an input operation into the input unit 50, and use in normal mode without switching is enabled even if the display unit is facing downward (the direction of gravity acceleration). In other words, in contrast to carrying out an operation in which the display is stopped when the display unit is facing downward in power saving control such as with reference to only the sensor output angle, with the operation described above, reference is made to the user's operation along with the sensor output angle, so even if, for example, a downward orientation is detected with the sensor output, this orientation for switching to the power saving settings is removed from the normally associated region when there is an operation indicating intention to continue use.

The control unit 10 may adapt to the form of the portable information processing apparatus 1 from information pertaining to orientation, and carry out a control so as to make a correction and change or re-read the XYZ outputs for the information pertaining to orientation.

(0051)

As an example, when there is a switch to the screen display so that the display unit is used vertically or horizontally with respect to the user according to a sensor output of the orientation detection unit 30, the control unit 10 carries out an operation to switch the outputs of the X axis and the Y axis, making it possible to suitably switch the operation for orientation with the timing of the screen switch. After the display screen direction is switched with respect to the user, the control unit 10 can identify the form and the display screen direction and identify the orientation corresponding to the identified form and display screen direction.

Ordinarily, the display direction of the display screen can be identified and a correction made to the orientation with respect to gravity so as to accommodate the changed direction of the display screen and to the conditions for the power saving control corresponding to the orientation with respect to gravity.

(0052)

For the operation to switch the outputs, an information processing approach may be used in which the control unit 10 again reads the sensor output values from the orientation detection correction unit 22 so as to respond to the switch in the display screen, or an electrical circuit approach may be used in which the wire is changed so that the sensor output values correspond to the switch in the display screen.

By operating in this manner, it is possible to operate the power saving control for a portable information processing apparatus in both the so-called vertical style and horizontal style.

(0053)

The setting information 41 of the storage unit 40 may be provided with an information acquisition pattern pertaining to left-hand or right-hand orientation or information for use in correction, and the selected pattern or information pertaining to correction used by the control unit 10 with the user having inputted either left-hand or right-hand in advance.

By carrying out such an operation, it is possible to set the orientation corresponding to the user's dominant hand holding the portable information processing apparatus 1, reducing unneeded power.

(0054)

Because right-handed users often hold the portable information processing apparatus 1 to the right of the center of the body and left-handed users often hold the portable information processing apparatus 1 to the left, power can be saved by switching to power saving in response to the side on which the apparatus is held.

(0055)

The setting information 41 of the storage unit 40 may be provided with information of a hysteresis region for information pertaining to left-hand or right-hand orientation, and the selected hysteresis region used by the control unit 10 with the user having inputted either left-hand or right-hand in advance.

By operating in this manner, an undetermined region corresponding to the user's dominant hand holding the portable information processing apparatus 1 can be set, reducing needless power.

(0056)

Also, a user operation in the input unit 60 may be stored and held in the setting information 41 for a prescribed period of time, and the power saving function unit 20 controlled on the basis of an output of the operation amount or the like inputted during a prescribed time and an output from the orientation detection unit 30. If a user operation is detected in the input unit 60 at this time, the time for switching to the power saving mode may be adjusted according to the operation amount or the like.

(0057)

The portable telephone [*sic*: information processing] apparatus 1 may be switched to the power saving mode immediately when placed in the reverse orientation (turned over). Any or a combination of the degree of acceleration acquired using the orientation detection unit 20, the direction of acceleration, and shock (such as tapping or shaking) may be added as conditions required for this mode change.

(0058)

By doing so, it is possible to switch to the power saving mode when, for example, an operation for turning over the portable telephone [*sic*: information processing] apparatus 1 is carried out at a speed no less than a predetermined value in a predetermined direction. Also, a switch to the power saving mode may be made in response to a light tap after the portable telephone [*sic*: information processing] apparatus 1 is turned over.

(0059)

The setting information 41 may store, along with the region for temporarily storing the user's operation, the orientation for switching to the power saving mode associated with an application program. The control unit 10 may operate so as to automatically change, on the basis of an input operation, the orientation for switching to the power saving mode corresponding to an application program in operation. The control unit 10 may also operate so as to ascertain the user's operation, overwrite the setting information 41 and automatically change the orientation for switching to the power saving mode corresponding to an application program in use.

The control unit 10 may enable a general-purpose application program operating on the portable information processing apparatus 1 to set a prescribed region of the setting information 41. It is desirable that said small area [*sic*: said region] be active only when the application program is starting up and also that active application programs have priority. As an example, an operation may be carried out such as to add, during an application program startup, a setting that is active only during startup of the application program to a setting region of processing operations for operations pertaining to orientation in the setting information 41.

In this manner, a part or all of the power saving function can be controlled by an application program as desired by the application program creator or the user.

A plurality of regions may be provided in the setting information 41, the plurality of regions corresponding to a plurality of application programs that overwrite the regions, and power saving settings made for each application program. In this case, it is desirable to have a priority setting. By doing so, the control unit 10 can ascertain the user's operation and switch to the power saving mode suitable for the application program in use. Also, with a priority setting, suitable power saving control can be carried out according to priority when a competition arises between applications programs or between the OS and an application program.

(0060)

If the battery is a fuel cell such as a direct methanol fuel cell (DMFC) whose power generation quantity varies depending on the fuel amount and incline, a region can be provided in the setting information 41 for storing the power generation quantity of the fuel cell corresponding to the incline, the power generation quantity of the fuel cell can be estimated on the basis of a sensor output value from the orientation detection unit 30, the available power quantity calculated on the basis of the estimated value, and the power saving function unit 20 controlled so as to be no greater than the calculated power quantity.

(0061)

If a means is provided for controlling the power generation quantity of the fuel cell, the control unit 10 can estimate the orientation of the fuel cell on the basis of information pertaining to orientation from the orientation detection unit 20, and control the power generation quantity of the fuel cell. The control unit 10 may control operation of the fuel pump, air pump or the like inside the fuel cell as a means to control the power generation quantity of the fuel cell.

(0062)

After controlling the power saving function unit 20 on the basis of information pertaining to orientation of the orientation detection unit 30, the control unit 10 may control the fuel cell to generate the power quantity needed.

(0063)

As described above, the control unit 10 ascertains the orientation state of the portable information processing apparatus 1 with respect to gravity and operates the portable information processing apparatus on the basis of the setting information 41, achieving a superior power saving function.

(0064)

Next multiple embodiments are presented to describe the present invention.

(EMBODIMENT 1)

(0065)

The present invention is described with embodiment 1 using a portable terminal apparatus as an example of a portable information processing apparatus.

(0066)

FIG. 17 is a block view showing the schematic configuration of a portable terminal apparatus 100 in the embodiment. The portable terminal apparatus 100 shown in FIG. 17 is overall configured from an information processing system and a wireless communication processing system, and data is transmitted between a control unit 101 and a wireless unit 102.

(0067)

The wireless unit 102 is connected to an antenna unit 103 used in sending and receiving wireless signals and is capable of wireless communication with a communication destination.

The control unit 101 is connected to a power source unit 104 that supplies power acquired from a battery to the entirety of the portable terminal apparatus 100. The control unit 101 is connected to, as I/O units, a call transmission unit 105 that converts the user's voice signals to electrical signals, a call receiving unit 106 that converts electrical signals from the other party to voice signals, a speaker 107 that reproduces music, voice, notification sounds and the like, a display unit 108 that displays various information, and an operation unit 109 that carries out operations on outgoing/incoming signals and various functions of the portable terminal apparatus.

The control unit 101 is connected to an orientation detection sensor 110 that detects the operation direction, the direction with respect to gravity, vibration, form and the like of the portable terminal apparatus 100. The orientation detection sensor 110 uses a switch to detect the form and a three-axis acceleration sensor.

The control unit 101 is connected to a storage unit 111 for storing the state of the portable terminal apparatus along with various data, programs and the like. The storage unit 111 is provided with a setting storage region 113 for holding and storing data and setting values used to control an apparatus state monitoring unit 112 described below as well as various setting information items of the portable terminal apparatus 100.

The apparatus state monitoring unit 112 ascertains the orientation of the portable terminal apparatus 100 and controls the power saving state on the basis of information pertaining to orientation acquired from the orientation detection sensor 110, information stored in the setting storage region 113, and the like. The apparatus state monitoring unit 112 also corrects the detected orientation according to need. The apparatus state monitoring unit 112 also stops various operations on the basis of an output from the orientation detection sensor 110 according to need.

(0068)

The setting storage region 113 stores an angle setting value that determines the associated region in the Y-Z planar angle. The angle setting value for determining the undetermined region angle in the Y-Z planar angle is stored according to need. The setting storage region 113 records information for determining the operation mode according to orientation. That is, the setting storage region 113 holds and stores, as setting information, a condition for operating the power saving function corresponding to the orientation.

In the case of an operation to switch to the power saving mode when the direction of the portable terminal apparatus 100 is reversed during normal mode use or when a prescribed power saving mode is turned on, the setting storage region 113 records the setting information for achieving an operation to hold the power saving mode without modification even if the portable terminal device 100 returns to the ordinary mode region. In further detail, information associating the region and the power saving mode is recorded as setting information in a region that can stipulate an operation for switching to the power saving mode.

(0069)

FIG. 18 and FIG. 19 are explanatory views showing a portion of the setting information in the present embodiment.

Referring to FIG. 18, a region is provided in which a Y-Z planar angle 1 and a Y-Z planar angle 2 can be set as the setting information, said angles being substituted for the region A and the region B. In the settings of FIG. 18, θ_1 is recorded in association with the Y-Z planar angle 1 and θ_2 in association with the Y-Z planar angle 2. Also, α is recorded in association with the hysteresis angle for setting the undetermined region in the Y-Z plane. This setting information can be set arbitrarily by the user or an application program creator.

(0070)

Referring to FIG. 19, a storage region is provided in which the operation mode can be set as setting information when the orientation is associated with the region A or the region B in an expanded state. In the settings of FIG. 19, the normal mode is associated with the orientation belonging to the region A in an expanded state, and the power saving mode is associated with the orientation belonging to the region B in an expanded state. This setting information can be set arbitrarily by the user or an application program creator. Different power saving modes can be prepared for each orientation.

(0071)

The configuration of the embodiment has been described above, but the connection and configuration of the wireless communication system with the portable terminal apparatus 100, the base station and the like described in FIG. 17 have been omitted as they are well known to a person skilled in the art.

(0072)

Next, the operation of the portable terminal apparatus 100 in the present embodiment is described with reference to FIG. 20 and FIG. 21.

FIG. 20 is an explanatory view showing the Y-Z plane in the embodiment.

The state where the main display screen of the portable terminal apparatus 100 is placed horizontally is treated as $\theta x = 0^\circ$. The region A indicates the range from the set value $\theta 1$ to the set value $\theta 2$ ($-\theta 1 < \theta x < \theta 2$). The region B indicates the range from the set value $\theta 2$ to 180° and from -180° to the set value $-\theta 1$ ($\theta 2 < \theta x < 180^\circ$, $-180^\circ < \theta x < -\theta 1$). θx is a value from -180° to $+180^\circ$, and $\theta 1$ and $\theta 2$ are positive numbers.

(0073)

In the portable terminal apparatus 100 shown in FIG. 20, the region A indicates normal mode. A hysteresis α may be added at the change point between the region A and the region B. In that case, the change points from the region A to the region B are H1 and H4, and the change points from the region B to the region A are H2 and H3. There is a switch between the region A and the region B with just a slight movement at the change points set with $\theta 1$ and $\theta 2$, so if the user should carry out an operation or the like at a boundary region, there might be an unintentional switch to power saving mode when the region B is identified. Therefore the hysteresis α is set to make operation stable without an immediate switch to the power saving mode even when there is a change from the operation mode in the region A or the region B within the hysteresis α intervals.

If the setting information stored in the setting storage region 113 of the portable terminal apparatus 100 has the normal mode set in the region A and the power saving mode set in the region B, the power saving mode is set when there is a change in the state from the region A to the region B for the portable terminal apparatus 100 in such a state (refer to FIG. 18). If the setting information has the power saving mode set to the region A and the normal mode set to the region B due to the correction, a setting overwrite or the like, a change in the state from the region B to the region A will set the power saving mode.

(0074)

When the direction is reversed during use in the normal mode, the control unit 101 acquires information pertaining to orientation outputted by the orientation detection sensor 110, and switches to the prescribed power saving mode on the basis of the operation setting, which is stored in the setting information region 113, for the power saving mode when the direction of the portable terminal apparatus 100 is reversed during use in the normal mode.

(0075)

Once the portable terminal apparatus 100 enters the power saving mode as a result of a processing operation of the apparatus state monitoring unit 112, processing to hold the power saving mode is enabled even if the orientation of the portable terminal apparatus 100 returns back to the ordinary mode region. As a result, the operation mode does not return back from the power saving mode unintentionally.

(0076)

FIG. 21 is a flowchart showing an example of the overall operation of the portable terminal apparatus 100 relating to power saving control in the embodiment.

First the control unit 101 confirms whether or not the current operation mode is the normal mode. If not (NO), i.e., the current operation mode is the power saving mode, processing ends. At this time, processing of the apparatus state monitoring unit 112 adds a limitation on the power saving control on the basis of an output from the orientation detection sensor 110, and the power saving mode is maintained until there is an input from the operation unit 109 (step a1).

If the operation mode is normal mode (YES) in step a1, the control unit 101, in the next step, sets a prescribed time until switching to the power saving mode as a power saving timer. The value of this prescribed time may be set by the user or set arbitrarily in advance (step a2).

The control unit 101 confirms whether or not the power saving timer set in step a2 has elapsed (step a3).

When the time set for the power saving timer has passed, the control unit 101 operates the apparatus state monitoring unit 112 and switches to the power saving mode (step a4).

(0077)

If the power saving timer has not yet elapsed in step s3, the control unit 101 identifies whether or not there has been a key operation since the power setting timer was set in step a2 (step a5). If there has been a key operation, the processing returns to step a2 and the power saving timer until power saving mode is reset.

(0078)

If there is no key operation in step a5, the control unit 101 (apparatus state monitoring unit 112) reads the setting information (step a6).

(0079)

The apparatus state monitoring unit 112 acquires information pertaining to orientation from the orientation detection sensor 110 and makes a correction according to need (step a7). At this time, the orientation detection sensor 110 outputs information pertaining to orientation enabling recognition of the orientation in the XYZ axis directions with respect to the direction of gravity and recognition of the form (shape).

(0080)

The apparatus state monitoring unit 112 uses information pertaining to orientation and setting information and identifies the associated operation mode on the basis of information such as the orientation of the portable terminal apparatus 100 with respect to gravity (step a8). In further detail, the apparatus state monitoring unit 112 identifies which of the region A and the region B shown in the setting information shown in FIG. 19 the orientation belongs to in order to check whether the operation mode is the normal mode or the power saving mode. In other words, if the current orientation is the power saving mode orientation recorded in the setting information due to a change in the orientation which varies from time to time, a determination is made of whether to switch the operation mode to the power saving mode.

If it is determined in step a8 that there is no change for the operation mode, the processing returns to step a3. If it is determined in step a8 to switch to the power saving setting, the processing goes to step a4 and the portable terminal apparatus 100 operates in power saving mode.

(0081)

Separate from the operation described above, the control unit 101 constantly monitors inputs to the operation unit 109, and returns the operation mode from the power saving mode to the normal mode if there is a user key operation in the power saving mode. A switch is also made back from the power saving mode if there is a change in the incoming signal, shape or the like, and the normal mode is maintained until that event ends.

(0082)

By operating the control unit 101 and the apparatus state monitoring unit 112 as described above, it is possible to immediately switch to the power saving mode following the preset setting information when, as an example, the user places the portable terminal apparatus 100 so the orientation is opposite with respect to the direction of gravity.

Similarly, because the setting information can be set arbitrarily in advance by the user or an application program creator, it is possible to carry out power saving processing suitable to the use mode of the user and to the operation mode of the application program.

(0083)

Once the power saving mode is set, the portable terminal apparatus 100 can hold that state until the user carries out a key operation or the like, and therefore the phenomenon whereby there is continuous switching between the power saving mode and the normal mode can be prevented in the portable terminal apparatus 100, saving power.

(0084)

By adding other setting information as needed, the portable terminal apparatus 100 can be made so that power saving is easy and in accordance with the intention of the user or the like.

(0085)

In the embodiment described above, the portable terminal apparatus 100 is a sliding type, but naturally the present invention can be applied to other forms as well.

(EMBODIMENT 2)

(0086)

Next an embodiment 2 is presented to describe the present invention.

A portable terminal apparatus 200 in embodiment 2 of the present invention differs from the portable terminal apparatus 100 in embodiment 1 in that when there is a key operation in the operation unit, the output of the orientation detection sensor 110 is read and the portable terminal apparatus 200 automatically overwrites the operation mode recorded in the storage setting region 113.

(0087)

The configuration and operation of the portable terminal apparatus 200 are otherwise similar to that of the portable terminal apparatus 100 of embodiment 1, and therefore the description of the configuration and operation of the portable terminal apparatus 200 is simplified or abbreviated.

(0088)

Next, the operation of the portable terminal apparatus 200 of embodiment 2 is described with reference to FIG. 20.

(0089)

When the direction during use in the normal mode gradually changes from the region A to the region B, the portable terminal apparatus 200 changes its operation mode using the angle θ_2 as the threshold value. If the hysteresis α is added, the operation mode is changed at H4.

If the state of the setting information at this time is identical to FIG. 19, the operation mode is changed to the normal mode when the orientation belongs to the region A in an expanded state, and to the power saving mode when the orientation belongs to the region B in an expanded state. In other words, the control unit 101 switches the operation mode from the normal mode to the power saving mode with θ_2 (H4 if hysteresis α is added) as the boundary on the basis of the orientation described in the setting information.

(0090)

Next, a situation is described in which an input operation is made in the operation unit 103 with the orientation associated with the region B.

When an input operation is made with the orientation associated with the region B, the control unit 101 of the portable terminal apparatus 200 considers the orientation at that point based on an output from the orientation detection sensor 110 to be the orientation in use and overwrites the setting information so as to associate that orientation with the normal mode.

(0091)

That is, when the user makes a key operation in the operation unit 109 after association with the region B, the region B, as the region where the operation was made, is set as the normal mode and otherwise the setting information is overwritten to the power saving mode. The state of the power saving setting region after the overwrite is shown in FIG. 22.

(0092)

An operation was described above in which the setting information is overwritten when a key operation is carried out, but the operation may be incorporated in an operation that is ordinarily carried out may be incorporated as an operation based on the setting information. In this case, the storage setting region 113 is provided with a setting region pertaining to an input operation and the portable terminal apparatus 200 has, as setting information, an operation for overwriting the setting information so that the orientation at the time the input operation is carried out is set as the orientation for the normal mode.

That is, when the user makes a key operation in the operation unit 109 after association with the region B, the orientation when the operation was carried out is set as the normal mode on the basis of the setting information in the setting region of the processing operation for an input operation. At this time, the power saving setting region may be overwritten to set the orientation at the time the operation is carried out to the normal mode, or a timer may be set and the region of the orientation at the time the operation was carried out set to the normal mode for a prescribed period of time. Also, the region for setting the normal mode may be set centered on the angle of the orientation when the operation is carried out. This operation is shown below.

FIG. 23 is a flowchart showing the operation of the portable terminal apparatus 200 in embodiment 2.

The operation from steps b1 to b4 and from b6 to b8 is similar to b1 [sic: a1] to a4 and a6 to a8 in embodiment 1, and therefore the description of the operation is simplified or partially omitted.

The control unit 101 confirms the current operation mode (step b1) and sets the time until switching to the power saving mode in a power saving timer if the operation mode is the normal mode (step b2).

The control unit 101 checks whether the power saving timer has elapsed, and if it has not yet elapsed (NO in step b3), the control unit 101 stands by for a prescribed time after the power saving timer was set and checks during that time whether or not a key operation is carried out in the operation unit 109 (step b5).

If a key operation is carried out in step b5, the control unit 101 (apparatus state monitoring unit 112) reads the setting region of the processing operations for input operations in the setting storage region 113 (step b9).

The apparatus state monitoring unit 112 acquires information pertaining to orientation from the orientation detection sensor 110 and makes a correction as needed (step b10).

Then the control unit 101 operates on the basis of the setting information and overwrites the setting information so that the orientation at the time of the operation is the normal mode operation (step b11). The operation mode of the region in which the user carried out the key operation is thereby switched to being always normal mode. Then the processing returns to step b2 and a timer is set until the power saving mode.

If there is no key operation in step b5, the processing proceeds to steps b6, b7, and b8, and there is a switch to the operation mode based on the current orientation on the basis of the setting information.

(0093)

As described above, the control unit 101 and the apparatus state monitoring unit 112 operate so that the orientation of the portable terminal apparatus 200 of embodiment 2 is always automatically changed to the normal mode in response to an input operation.

(0094)

Even for a portable terminal apparatus which, for example, switches to the power saving mode when the orientation is in a use state where the display screen faces upward or downward, an input operation automatically results in the direction of the orientation being set to the normal mode, so it is easy to immediately track changes in the user's operation state. That is, as long as input operations in the operation unit 109 continue during a prescribed time interval, the ordinary mode is maintained regardless of the angle of the portable terminal apparatus 200.

(0095)

The changing orientation between one prescribed input operation and another input operation may also be taken into consideration along with the time for that orientation change. If such a setting is made, the normal mode can be maintained during a plurality of input operations even if the orientation change is slow. Also, if the orientation changes more than a certain amount in a short time, an ordinary processing operation can be carried out. Also, if a prescribed time period is set for each application used, effective power savings can be achieved.

(EMBODIMENT 3)

(0096)

Next an embodiment 3 is presented to describe the present invention.

In the description of the portable terminal apparatus 100 in embodiment 1, an operation originating in an orientation change with a vertical incline was described, and a processing operation corresponding to an orientation change with a horizontal incline is described below for a portable terminal apparatus 300 of embodiment 3.

(0097)

The portable terminal apparatus 300 in embodiment 3 has a function for displaying a display unit 108 horizontally. In contrast to an operation in which the portable terminal apparatus 100 detects the incline of the X axis in embodiment 1, the portable terminal apparatus 300 differs in using the output of the Y axis in addition to the X axis.

That is, the portable terminal apparatus 300 in embodiment 3 can respond with a power saving operation for a horizontal display as well as a vertical display.

FIG. 24 and FIG. 25 are explanatory views showing the setting information in embodiment 3.

The portable terminal apparatus 300 is provided with a setting region in which an orientation change in the Y axis can be detected in the storage setting region 113, and the setting of the operation mode for an orientation during horizontal use is stored as the setting information.

(0098)

The setting information stores, in addition to the vertical direction setting values θ_1 and θ_2 and hysteresis α , the horizontal direction angle setting values θ_3 and θ_4 and hysteresis β . In the description of embodiment 3, the respective regions are regions A and B in the vertical direction and regions C and D in the horizontal direction.

(0099)

The configuration and operation of the portable terminal apparatus 300 are otherwise similar to that of the portable terminal apparatus 100 of embodiment 1, and therefore the description of the configuration and operation of the portable terminal apparatus 300 is simplified or abbreviated.

(0100)

Next, the operation of the portable terminal apparatus of embodiment 3 is described with reference to FIG. 26. The operation in the horizontal direction is nearly identical to embodiment 1 if the reference plane is substituted, and therefore a detailed description is omitted.

(0101)

FIG. 26 is an explanatory view showing the X-Z plane in embodiment 3. The setting information set forth in FIG. 24 and FIG. 25 is values supposing the user's use in the right direction as viewed in FIG. 26.

The portable terminal apparatus 300 detects the direction of the screen displayed on the display unit 108 and uses that direction as part of the information pertaining to orientation. In further detail, when the screen direction of the portable terminal apparatus 300 is horizontal, information pertaining to orientation is used with Y axis rotation detection to carry out power saving processing.

(0102)

The state where the display screen of the portable terminal apparatus 300 shown in FIG. 26 is placed horizontally face upward is treated as $\theta_y = 0^\circ$. The region C indicates the range from the set value θ_3 to the set value θ_4 ($-\theta_3 < \theta_y < \theta_4$). The region D indicates the range from the set value θ_4 to 180° and from -180° to the set value $-\theta_3$ ($\theta_4 < \theta_y < 180^\circ$, $-180^\circ < \theta_y < -\theta_3$). θ_y is a value from -180° to $+180^\circ$, and θ_3 and θ_4 are positive numbers.

A hysteresis β may be added at the change points between the region C and the region D for the portable terminal apparatus 300. In that case, the change points from the region C to the region D are H7 and H8, and the change points from the region D to the region C are H5 and H6. By setting the hysteresis β , changes in operation mode are stable in the region C and the region D within this hysteresis β interval.

When there is a change in state from the region C to the region D with the portable terminal apparatus 300 in an expanded state, the power saving mode is set on the basis of the setting information stored in the setting storage region 113 of the portable terminal apparatus 300. Also, when there is a change in state from the region D to the region C, the power saving mode is set if the setting information has the power saving mode set to the region C and the normal mode set to the region D due to a correction, a setting overwrite or the like.

(0103)

In addition to the effects of the other embodiments, in the portable terminal apparatus 300, a power saving control can be carried out on the basis of an orientation that includes the X-axis and Y-axis rotation in addition to the direction of the screen displayed on the display 108 as described above. That is, the display direction of the screen, such as vertical style or horizontal style, is taken as the orientation and the use intention of the user is estimated to engage the power saving function so as to match the use mode.

(EMBODIMENT 4)

(0104)

Next an embodiment 4 is presented to describe the present invention.

A portable terminal apparatus 400 in embodiment 4 differs from the portable terminal apparatuses in the other embodiments in having a battery (secondary cell) and a fuel cell as power sources connected to the power source unit 104 and in operating with an association between the incline of the fuel cell and the power saving function.

(0105)

The configuration and operation of the portable terminal apparatus are otherwise similar to that of the portable terminal apparatuses in the other embodiments, and therefore the description is simplified or abbreviated. The setting information stored in the storage setting region 113 additionally stores information that associates the power generation quantity (power generation capacity) corresponding to the incline of the fuel cell and the orientation of the portable phone with the incline and fuel quantity of the fuel cell.

(0106)

The control unit 101 (apparatus state monitoring unit 112) of the portable terminal apparatus 400 estimates the power generation quantity of the fuel cell on the basis of the detected output of the orientation detection sensor 110 and the setting information recorded in the setting storage region 113, calculates the available power quantity, and controls the power saving function so as to stay within the calculated range.

(0107)

When the control unit 101 of the portable terminal apparatus 400 uses a fuel cell that can control the power generation quantity thereof, a control may be carried out to adjust the power generation quantity of the fuel cell in association with the power needed (power consumption) of the portable terminal apparatus 400 under power saving control.

(0108)

The portable terminal apparatus 400 may store setting information associating the orientation of the portable terminal apparatus 400 with the orientation of the fuel cell, setting information recording the estimated power consumption value when using a prescribed application program, and setting information recording the estimated use time. The estimated use time records past time intervals from full charge to time of fuel supply, application use time, and the like.

(0109)

If such setting information is used, when, for example, the display screen is displayed horizontally and a program is used that exhibits a television function, the control unit 101 uses the output value of the orientation detection sensor 110 to estimate the orientation of the fuel cell and identify the power generation capacity. The control unit 101 uses the identified value and the remaining battery quantity value to control the power savings of a function with low necessity. A control may be carried out according to need to adjust the power generation quantity of the fuel cell on the basis of the power generation quantity needed after the power saving control. By using the estimated use time in the setting information for this control, a portable terminal apparatus can be provided with which changes in the user's operation status and use status can be easily tracked.

(0110)

As described above with reference to modes and embodiments, the present invention can be applied to a portable information processing apparatus to achieve a superior power saving function using an orientation detection unit capable of detecting orientation. That is, according to the present invention, a portable information processing apparatus and a control method therefor can be provided that use an orientation detection unit capable of detecting orientation to achieve a superior power reduction function.

(0111)

In the modes and embodiments described above, control of each part of the portable information processing apparatus was described as hardware control, but such control can also be achieved with software. More specifically, a program for detecting orientation, a correction program, a program for controlling each power saving function or the like can be developed on the RAM as a program for monitoring the apparatus status. The control unit makes each unit described in the modes and embodiments function on the basis of various programs. The control unit also controls the power saving function on the basis of the setting information stored in the RAM or the like and on information pertaining to orientation.

(0112)

The specific configuration of the present invention is not limited to the modes described above, and the present invention includes modifications within a scope not deviating from the gist of the invention.

(INDUSTRIAL APPLICABILITY)

(0113)

The present invention is provided with an acceleration (gravity) sensor and is suitable for a portable type information processing apparatus having a power saving function. Specifically, the present invention may be used in a portable phone, a Personal Handy-phone, a personal digital assistant, a portable computer or the like that is a portable terminal apparatus.

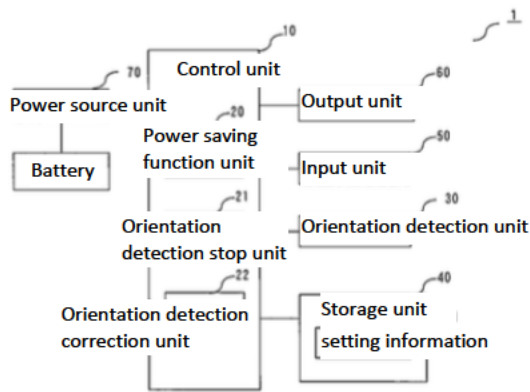
(DESCRIPTION OF THE REFERENTIAL CODES OR SYMBOLS)

(0114)

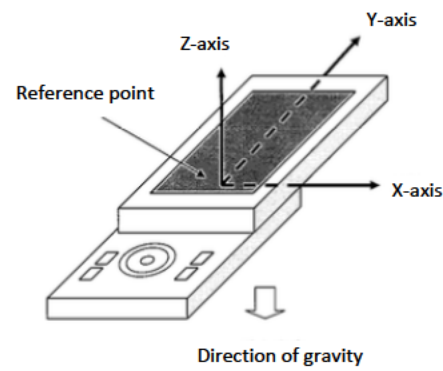
1	portable information processing apparatus
10	control unit
20	power saving function unit
21	orientation detection stop unit
22	orientation detection correction unit
30	orientation detection unit
40	storage unit
50	input unit
60	output unit

70 power source unit
 100 portable terminal apparatus
 101 control unit
 102 wireless unit
 103 antenna unit
 104 power source unit
 105 call transmission unit
 106 call receiving unit
 107 speaker
 108 display unit
 109 operation unit
 110 orientation detection sensor
 111 storage unit
 112 apparatus state monitoring unit
 113 setting storage region

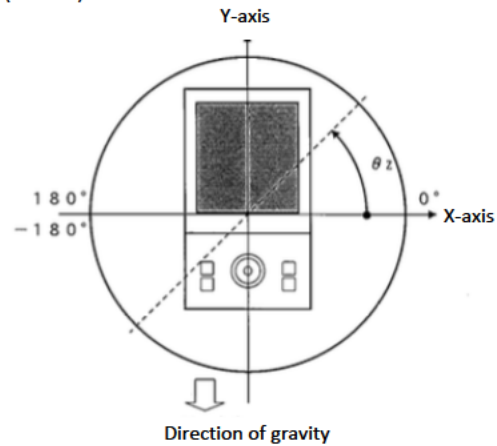
(FIG. 1)



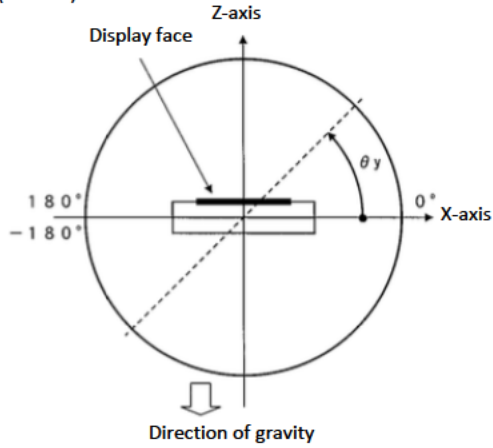
(FIG. 2)



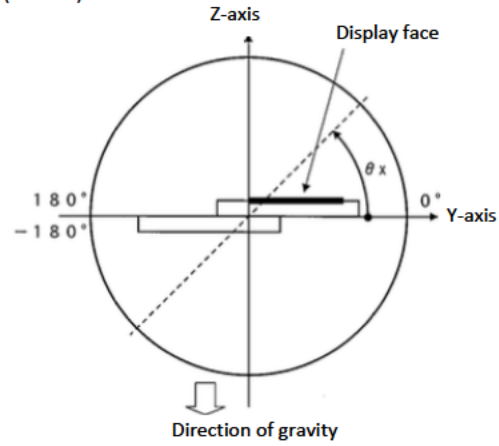
(FIG. 3)



(FIG. 4)



(FIG. 5)



(FIG. 6)

X-Y planar angles $\theta_z(^{\circ})$		X-Z planar angles $\theta_y(^{\circ})$	
$0 \sim \theta_1$	Z1	$0 \sim \theta_1$	Y1
$\theta_1 \sim \theta_2$	Z2	$\theta_1 \sim \theta_2$	Y2
$\theta_2 \sim 180$	Z3	$\theta_2 \sim 180$	Y3
$0 \sim -\theta_3$	Z4	$0 \sim -\theta_3$	Y4
$-\theta_3 \sim -\theta_4$	Z5	$-\theta_3 \sim -\theta_4$	Y5
$-\theta_4 \sim -180$	Z6	$-\theta_4 \sim -180$	Y6

(a)

(b)

Y-Z planar angles $\theta_x(^{\circ})$	
$0 \sim \theta_1$	X1
$\theta_1 \sim \theta_2$	X2
$\theta_2 \sim 180$	X3
$0 \sim -\theta_3$	X4
$-\theta_3 \sim -\theta_4$	X5
$-\theta_4 \sim -180$	X6

(c)

(FIG. 7)

Orientation setting regions		
X, Y, Z	Form (shape)	Orientation
X1, Y1, Z1	Form A	Orientation A
X1, Y1, Z2	Form A	Orientation B
X1, Y1, Z3	Form A	Orientation C
X1, Y1, Z4	Form A	Orientation D
X1, Y1, Z5	Form A	Orientation D
X1, Y1, Z6	Form A	Orientation D
X1, Y2, Z1	Form A	Orientation E
X1, Y2, Z2	Form A	Orientation F
*	*	*
*	*	*
*	*	*
X6, Y6, Z6	Form X	Orientation X

(FIG. 8)

Operation mode setting regions (power saving setting regions)	
Orientation A	Normal mode
Orientation B	Power saving mode A
Orientation C	Power saving mode B
Orientation D	Power saving mode B
*	*
*	*
*	*

(FIG. 9)

Hysteresis setting regions	
Region X1-X2 boundary	$\alpha 1$
Region X2-X3 boundary	$\alpha 2$
Region X3-X4 boundary	$\alpha 3$
*	*
*	*
*	*
Region Y1-Y2 boundary	$\beta 1$
*	*
*	*
*	*
Region Z1-Y2 boundary	$\gamma 1$
*	*
*	*
*	*
Region Z6-Y1 boundary	$\gamma 6$

(FIG. 9)

Hysteresis setting regions	
X-Y plane hysteresis angle	α
X-Z plane hysteresis angle	β
Y-Z plane hysteresis angle	γ

(FIG. 11)

Setting regions based on operation (change)	
Operation based on orientation	Processing operation
Change from stored form to use form	Normal mode hold time setting
Flipped from front to back at a prescribed position and kept horizontal	Forced switch to power saving mode B
Changed to stored form, moved downward, and then kept horizontal in a flipped state	Forced switch to power saving mode B
Tapped while kept horizontal in a flipped state	Forced switch to power saving mode B
Shaken in stored form	Clock display
Shaken in expanded form	Current state mode kept
*	*

(FIG. 13)

Hysteresis setting values for right-hand use	
X-Y plane hysteresis angle	$\alpha 1$
X-Z plane hysteresis angle	$\beta 1$
Y-Z plane hysteresis angle	$\gamma 1$
*	*
*	*
*	*

(a)

(FIG. 12)

Setting regions pertaining to input operation	
Input operation	Processing operation
Input quantity at least a prescribed value	Current mode held for a prescribed time
Input in a prescribed input program	Fixed in power saving mode C until program ends
Input pattern A	Forced mode switch in power saving mode D
Tenkey input operation	Angle of current orientation set as standard mode during prescribed period of time
Movement while keeping height (movement not accompanying movement in the direction of gravity)	Current mode standby for a prescribed time
*	*

Hysteresis setting values for left-hand use	
X-Y plane hysteresis angle	$\alpha 2$
X-Z plane hysteresis angle	$\beta 2$
Y-Z plane hysteresis angle	$\gamma 2$
*	*
*	*
*	*

(b)

(FIG. 14)

X-Y planar angle $\theta_z(^{\circ})$ for right-hand use

$0 \sim \theta_1 + R1$	Z1
$\theta_1 \sim \theta_2 + R1$	Z2
$\theta_2 \sim 180 + R1$	Z3
$0 \sim -\theta_1 + R1$	Z4
$-\theta_1 \sim -\theta_2 + R1$	Z5
$-\theta_2 \sim -180 + R1$	Z6

(a)

X-Z planar angle $\theta_Y(^{\circ})$ for right-hand use

$0 \sim \theta_1 + R2$	Y1
$\theta_1 \sim \theta_2 + R2$	Y2
$\theta_2 \sim 180 + R2$	Y3
$0 \sim -\theta_1 + R2$	Y4
$-\theta_1 \sim -\theta_2 + R2$	Y5
$-\theta_2 \sim -180 + R2$	Y6

(b)

(FIG. 15)

X-Y planar angle $\theta_z(^{\circ})$ for left-hand use

$0 \sim \theta_1 + L1$	Z1
$\theta_1 \sim \theta_2 + L1$	Z2
$\theta_2 \sim 180 + L1$	Z3
$0 \sim -\theta_1 + L1$	Z4
$-\theta_1 \sim -\theta_2 + L1$	Z5
$-\theta_2 \sim -180 + L1$	Z6

(a)

X-Z planar angle $\theta_Y(^{\circ})$ for left-hand use

$0 \sim \theta_1 + L2$	Y1
$\theta_1 \sim \theta_2 + L2$	Y2
$\theta_2 \sim 180 + L2$	Y3
$0 \sim -\theta_1 + L2$	Y4
$-\theta_1 \sim -\theta_2 + L2$	Y5
$-\theta_2 \sim -180 + L2$	Y6

(b)

Y-Z planar angle $\theta_x(^{\circ})$ for right-hand use

$0 \sim \theta_1 + R3$	X1
$\theta_1 \sim \theta_2 + R3$	X2
$\theta_2 \sim 180 + R3$	X3
$0 \sim -\theta_1 + R3$	X4
$-\theta_1 \sim -\theta_2 + R3$	X5
$-\theta_2 \sim -180 + R3$	X6

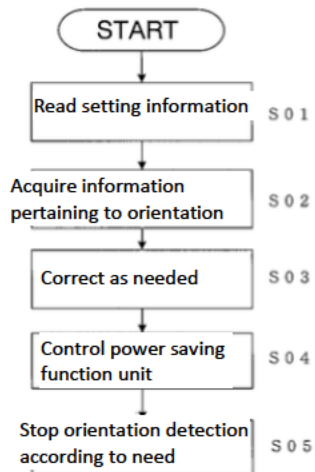
(c)

Y-Z planar angle $\theta_x(^{\circ})$ for left-hand use

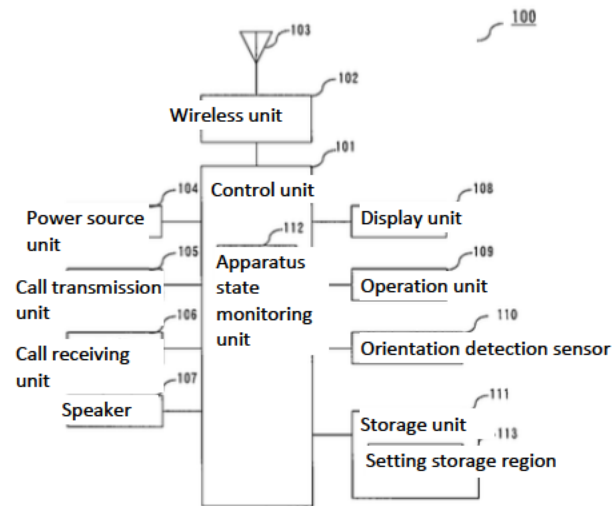
$0 \sim \theta_1 + L3$	X1
$\theta_1 \sim \theta_2 + L3$	X2
$\theta_2 \sim 180 + L3$	X3
$0 \sim -\theta_1 + L3$	X4
$-\theta_1 \sim -\theta_2 + L3$	X5
$-\theta_2 \sim -180 + L3$	X6

(c)

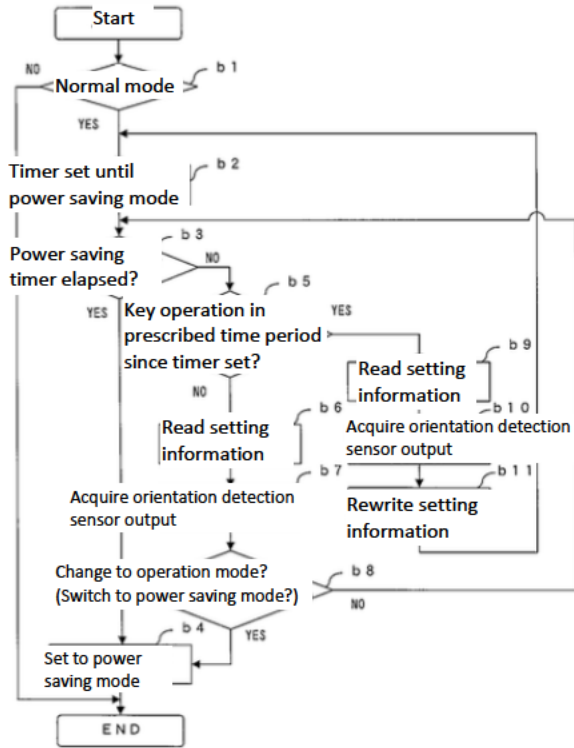
(FIG. 16)



(FIG. 17)



(FIG. 23)



(FIG. 24)

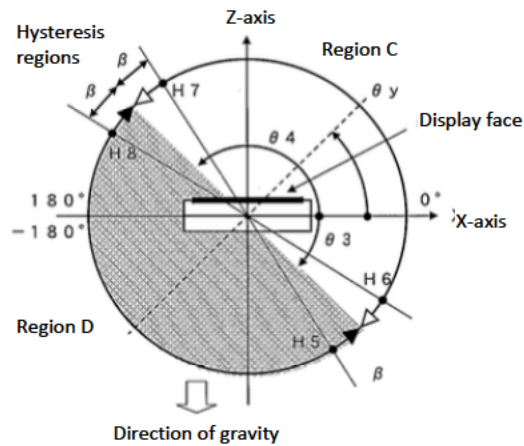
Angle setting regions (orientation setting regions)	
X-Z planar angle 1	$\theta 3$
X-Z planar angle 2	$\theta 4$
X-Z planar hysteresis angle	β

(FIG. 25)

Operation mode setting regions (power saving setting regions)	
Orientation	Operation mode
Belongs to region C in expanded state	Normal mode
Belongs to region D in expanded state	Power saving mode
*	*
*	*
*	*

(FIG. 26)

Illustration of when the portable terminal apparatus is placed horizontally



(FIG. 27)

Illustration of when the portable terminal apparatus is placed horizontally

