

DECLARATION OF ACCURACY

I, David Baldwin, declare the following:

1. I am over 18 years of age and competent to make this declaration.
2. I am a qualified Japanese to English translator.
3. I have translated the attached document identified as JPH09-311625.
4. I affirm that the translated text has been translated and edited to the best of my ability and knowledge to accurately reflect the content, meaning, and style of the original text and constitutes in every respect a correct and true translation of the original document.
5. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

I hereby certify under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Dated and signed on August 8, 2019.



(Translator's Signature)

David Baldwin

(Translator's Printed Name)

(12) Unexamined Patent Application Publication (A)

(19) Japan Patent Office (JP)

(11) Patent Application Publication No.

H9-311625

(43) Publication Date: Dec. 2, 1997 (Heisei 9)

(51) Int. Cl. ⁶	Ident. Code	Internal Ref. No.	FI	Technical Indication
G09B	29/00		G09B 29/00	A
G01C	21/00		G01C 21/00	B
G08G	1/0969		G08G 1/0969	

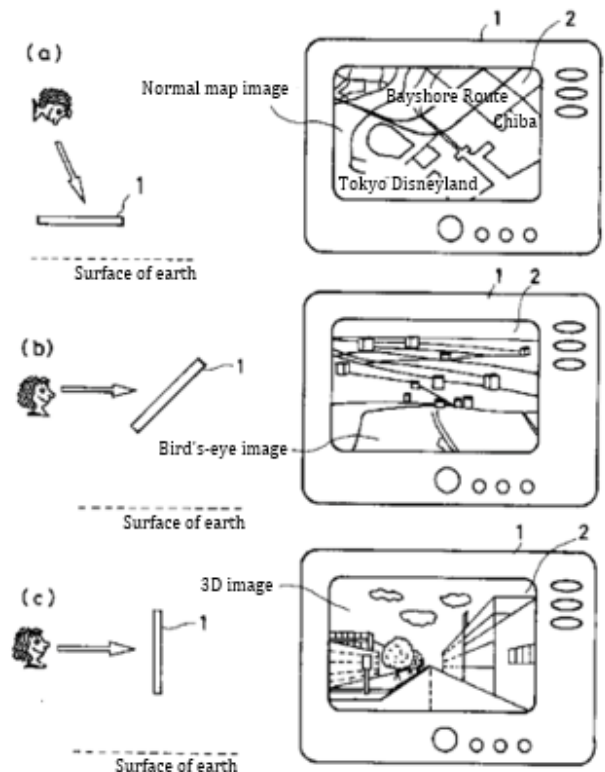
Examination Request: Not Made		No. of Claims: 13	FD	(16 Pages Total)
(21) Filing No.	H8-149740	(71) Applicant	000002185	
(22) Filing Date	May 22, 1996 (Heisei 8)		Sony Corp.	
		(72) Inventor	Kiyokazu Ikeda	
			c/o Sony Corp.	
			6-7-35 Kita Shinagawa,	
			Shinagawa-ku, Tokyo	
		(74) Agent	Atsuo Waki, Patent Attorney	
			(and One Other)	

(54) [Title] DISPLAY DEVICE, MAP DISPLAY DEVICE, DISPLAY METHOD, AND MAP DISPLAY METHOD

(57) [Abstract]

[Problem] To realize display that is easy to view and use for a user, display with a large information amount, and display that is interesting.

[Resolution Means] By detecting a posture and/or movement state of a main body of a display device and changing a display content to match conditions such as a posture or movement of the main body of the device, display matching an actual orientation, display according to a posture of the device, switching between three-dimensional display and flat display, and the like are realized.



[Scope of Patent Claims]

[Claim 1] A display device, comprising:
a state detection means of detecting a posture state and/or a movement state of a main body of the display device;
a display means; and
a display control means that can display a predetermined image on the display means and, based on detection information from the state detection means, change a display state of the displayed image.

[Claim 2] A display device, comprising:
a state detection means of detecting a posture state and/or a movement state of a main body of the map display device;
a map-information storage means of storing map information;
a display means; and
a display control means that can display a map image based on map information read from the map-information storage means on the display means and, based on detection information from the state detection means, change a display aspect or a map display region of the displayed map image.

[Claim 3] The map display device of claim 2, wherein the state detection means is provided with an incline sensor that detects an incline state of the main body of the map display device.

[Claim 4] The map display device of claim 2, wherein the state detection means is provided with an orientation sensor that detects an actual orientation.

[Claim 5] The map display device of claim 2, wherein the state detection means is provided with a movement-state sensor that detects a movement direction and/or a movement amount when the main body of the map display device is moved.

[Claim 6] The map display device of claim 2, wherein the map image displayed on the display means can be set with an absolute direction or a relative direction, and
the display control means changes a display state of the map image according to the posture state of the main body of the map display device detected by the state detection means so the set direction is substantially continually an upward direction in terms of gravity of the display means.

[Claim 7] The map display device of claim 2, wherein the display control means changes a display state of the map image according to an orientation state of the main body of the map display device detected by the state detection means so an orientation of the map image displayed on the display means substantially continually matches an actual orientation.

[Claim 8] The map display device of claim 2, wherein the display control means changes a display state of the map image according to the movement state of the main body of the map display device detected by the state detection means so the region displayed as the map image on the display means undergoes scrolling movement.

[Claim 9] The map display device of claim 2, wherein the

display control means changes a display state of the map image according to an incline state of the main body of the map display device detected by the state detection means so the map image displayed on the display means switches between a two-dimensional image and a three-dimensional image.

[Claim 10] The map display device of claim 2, further comprising: a current -position detection means; wherein the display control means is configured to be able to synthesize and display on the display means the map image based on the map information read from the map-information storage means and a position-presenting image based on current-position information detected by the current-position detection means and, based on the detection information from the state detection means, change the display aspect or the map display region of the displayed map image.

[Claim 11] A display method of detecting a posture state and/or a movement state of a main body of a device having a display unit and changing a display state of an image displayed on the display unit according to the detected posture state and/or movement state of the main body of the device.

[Claim 12] A map display method of detecting a posture state and/or a movement state of a main body of a device having a display unit and, when displaying a map image based on predetermined map information on the display unit, changing a display aspect or a map display region of the map image according to the detected posture state and/or movement state of the main body of the device.

[Claim 13] The map display method of claim 12, wherein an incline posture of the main body of the device having the display unit is detected and the map image displayed on the display unit is switched between a two-dimensional image and a three-dimensional image according to a detected incline state.

[Detailed Description of the Invention]

[0001]

[Field] The present invention relates to a display device and a display method that change a display state according to a state of a main body of the display device and particularly relates to a map-image display device and a map-image display method.

[0002]

[Conventional Art] In recent years, as are widespread in, for example, navigation systems, devices that display a map image on a display are known. Many of these store map information on a medium such as a CD-ROM; read map information of a required region, a vicinity of a current position, or the like from the CD-ROM; and display a map image based on this read map information.

[0003]

[Problem to be Solved by the Invention] Now, in such conventional electronic map display, the displayed map image itself is displayed with a specified direction of a screen as up, regardless of a posture or the like of a main body of this display device. As such, a user needs to view the map image by mentally aligning cardinal directions of the map image with actual cardinal directions.

Moreover, from a flat map image, it is difficult to visualize different regions, and realizing map display with higher added value is in demand.

[0004]

[Means for Solving the Problem] In view of such problems, the present invention has as an object to provide a display device, a display method, a map-display device, and a map-display method that can realize display that is easy to view and use for a user and display that can impart added value and is interesting.

[0005] As such, the display device is provided with a state detection means of detecting a posture state and/or a movement state of a main body of the display device; a display means; and a display control means that can display a predetermined image on the display means and, based on detection information from the state detection means, change a display state of the displayed image. The display method detects a posture state and/or a movement state of a main body of a device having a display unit and changes a display state of an image displayed on the display unit according to the detected posture state and/or movement state of the main body of the device.

[0006] Furthermore, the map display device is provided with a map-information storage means of storing map information, a display control means being able to display a map image based on map information read from the map-information storage means on a display means and, based on detection information from a state detection means, change a display aspect or a map display region of the displayed map image. The map display method detects a posture state and/or a movement state of a main body of a device having a display unit and, when displaying a map image based on predetermined map information on the display unit, changes a display aspect or a map display region of the map image according to the detected posture state and/or movement state of the main body of the device.

[0007] That is, in the present invention, by changing a display content to match conditions such as a posture or movement of the main body of the device, display matching an actual orientation, display according to a posture of the device, switching between three-dimensional display and flat display, and the like are realized.

[0008]

[Embodiments of the Invention] An embodiment of the present invention is described below by using as an example an electronic map device that displays a map image. The description is given in the following order.

1. Configuration of Electronic Map Device
2. Posture and Movement Detection by Sensors
3. Map Display Operations in Display-Orientation-Designated Mode
4. Map Display Operations in Actual-Orientation-Reflecting Mode
5. Map Display Operations in Vicinity-Map Display Mode
6. Map Display Operations in Virtual Display Mode
7. Map Display Operations in Navigation Display Mode
8. Composite Operation of Various Modes

[0009] 1. Configuration of Electronic Map Device

FIG. 1 illustrates a block diagram of the electronic map device of the present example, and FIG. 2 illustrates an appearance example of the electronic map device. As illustrated in FIG. 2, an electronic map device 1 is formed, for example, in a notebook shape of an extent that enables the display to be portable and has a display unit 2, which is a liquid-crystal display or the like, formed in an upper face. Moreover, used as a recording medium of electronic map data is, for example, a CD-ROM such as is used in a normal navigation system, and an insertion portion 3 for inserting this CD-ROM is provided.

[0010] Furthermore, various controllers 4 are formed for user control. As the controllers 4, it is sufficient to provide those of forms necessary for various controls, such as pressable keys and jog dials. Of course, these may be of other forms, such as slide switches or rotating knobs. Necessary controls include a power on/off control; a mode-setting control; an operation for selecting a map region to display; scrolling and zooming of screen display; a control of requesting, for example, presentation of various information; and the like, and any forms may be adopted as long as these controls can be performed. Moreover, a configuration may be such that control devices such as a mouse and a keyboard can be connected and used.

[0011] An internal configuration of the electronic map device 1 is as illustrated in FIG. 1, and a CPU 10 is provided as a part that performs overall operation control. Moreover, a RAM 11 is prepared as a work region used in operations such as control/computation by the CPU 10, and a ROM 12 is provided as a region for holding an operation program or the like.

[0012] A CD-ROM 20 inserted from the insertion portion 3 illustrated in FIG. 2 is loaded in a CD-ROM driver 14. The CD-ROM driver 14 is a part that performs a reproduction operation of the CD-ROM 20 based on CPU 10 control. The CD-ROM 20 loaded in the CD-ROM driver 14 is recorded with map information and additional information such as names of map locations and building height information. Information reproduced from the CD-ROM 20 by the CD-ROM driver 14 is taken in by the RAM 11 and subjected to necessary processing.

[0013] Furthermore, map-image information that is reproduced from the CD-ROM 20 and used for display is taken in by a map-image memory 15. The CPU 10 generates image data to display based on the map-image information and various additional information read from the CD-ROM 20 and deploys this to the map-image memory 15. A necessary portion of the image data held by the map-image memory 15 is then sent to a display driver 13, and map display of a certain region is executed on the display unit 2.

[0014] Furthermore, in the present example, the displayed map image is not limited to simply a normal map image recorded on the CD-ROM 20, and as described below, a bird's-eye image and a three-dimensional image (3D image) can be displayed. While image data of the bird's-eye image and the 3D image may of course be recorded in advance on the CD-ROM 20 and

a read bird's-eye image or 3D image be supplied as-is to the display driver 13 and displayed, to conserve a recording capacity of the CD-ROM 20, it is favorable to only record building heights, building and facility types, and the like as additional information for generating the bird's-eye image and the 3D image, using the map information and the additional information to generate the bird's-eye image and the 3D image by image synthesis processing. An image synthesis unit 16 is provided to perform this processing, and this unit can virtually generate bird's-eye images and 3D images of various regions (or images centered around various points on the map) based on CPU 10 control.

[0015] Furthermore, the present example has not only a map-display function but also a function similar to a navigation system. That is, map display centered around a current position is performed automatically to enable travel guidance to be executed. From this necessity for current-position detection, a GPS receiver 18 is provided. The GPS receiver 18 is a part for obtaining current-position information by a so-called GPS (global positioning system) and detects position information (latitude/longitude), absolute-orientation information, and velocity information based on a reception signal from a satellite. This information is supplied to the CPU 10.

[0016] A sensor unit 17 is provided with sensors necessary to detect a posture state and a movement state of a main body of the electronic map device 1. Detection information from the sensor unit 17 is supplied to the CPU 10. Data and control signals are transmitted between the above units via a bus 19. Moreover, various control information from the control unit 4 illustrated in FIG. 2 is input to the CPU 10.

[0017] Based on the mode-setting control and a display-region-designating control from the control unit 4, the detection information from the sensor unit 17, detection information from the GPS receiver 18, and the operation program stored in the ROM 12, the CPU 10 controls the reproduction operation by the CD-ROM driver 14, the synthesis processing by the image synthesis unit 16, write/read operations of the map-image memory 15, and a display operation by the display driver 13. By this, map display sought by the user is executed on the display unit 2.

[0018] 2. Posture and Movement Detection by Sensors

Here, posture and movement detection of the main body of the electronic map device 1 by the sensor unit 17 is described. The sensor unit 17 is provided with an incline sensor function of detecting an incline state of the main body, an orientation sensor function of detecting an absolute orientation (north, south, east, and west), and a movement sensor function of detecting movement of the main body (movement direction and movement amount) and is equipped with various sensors necessary for these functions.

[0019] In the description, first, as illustrated in FIG. 2, directions of up, down, left, and right relative to a screen of the display unit 1 of the main body of the electronic map device 1 are referred to as screen-up, screen-down, screen-right, and screen-left so as to be distinguished from up and down in terms of earth's gravity and left and right in terms of absolute orientation.

[0020] FIG. 3 illustrates incline-state examples of the main body of the electronic map device 1. (a), (b), and (c) in FIG. 3 illustrate the main body of the electronic map device 1 rotated in a screen-up/screen-down direction around an axis from screen-left to screen-right. That is, in (a) in FIG. 3, the electronic map device 1 is substantially horizontal, and (b) and (c) in FIG. 3 illustrate postures of a screen-up portion being lifted upward in terms of gravity. Although not illustrated, a posture of a screen-down portion being lifted upward in terms of gravity is of course also possible. Moreover, (a), (d), and (e) in FIG. 3 illustrate the main body of the electronic map device 1 rotated in a screen-left/screen-right direction around an axis from screen-up to screen-down. That is, (d) and (e) in FIG. 3 illustrate postures of a screen-left portion being lifted upward in terms of gravity from the horizontal state in (a) in FIG. 3. Although not illustrated, a posture of a screen-right portion being lifted upward in terms of gravity is also possible.

[0021] As the sensor that detects these incline states, it is favorable to biaxially form in the sensor unit 17 an incline sensor made using, for example, a mercury switch or equip in the sensor unit a gravity sensor that detects the direction of gravity. The posture changes arise according to how the user holds the electronic map device 1, how the user places the device (horizontally, on a desk or the like, or vertically, leaning up against something), and the like.

[0022] Next, FIG. 4 illustrates relationships between the main body of the electronic map device 1 and an absolute orientation. (a) in FIG. 4 is a state wherein the screen-up portion faces the absolute orientation north, (b) in FIG. 4 is a state wherein the screen-left portion faces north, and (c) in FIG. 4 is a state wherein a portion between the screen-down portion and the screen-left portion faces north. As in the above for example, the present example also detects an orientation posture of the electronic map device 1 in terms of absolute orientation. As such, the sensor unit 17 is equipped with an orientation sensor such as an electronic compass. Conceivable as an actual example is, for example, adopting a magnetic-field sensor. Moreover, orientation information of a travel direction obtained by the GPS receiver 18 may be used as the orientation sensor.

[0023] FIG. 5 illustrates movement conditions of the main body of the electronic map device 1. The arrow in (a) in FIG. 5 illustrates, for example, a state wherein the user holds the electronic map device 1 horizontally in their hand and moves the device in front of their body so as to draw a circle, and the arrows in (b) in FIG. 5 illustrates a state wherein the device is moved in a certain direction, screen-up, -down, -left, or -right. In the present example, when the electronic map device 1 is moved in this manner, the movement direction and the movement amount are detected in terms of screen-up, -down, -left, and -right. As such, the sensor unit 17 is equipped with at least one sensor that can detect movement such as an acceleration sensor, velocity sensors, or a magnetic-field sensor. Note that the movement conditions may include, in addition to the movement of (a) and (b) in FIG. 5 in a state of the electronic map device 1 being horizontal relative to the earth's surface, the movement of (a) and (b) in FIG. 5 in a state of the device being vertical or diagonal relative to the earth's surface.

[0024] In the present example,

the sensor unit 17 detects inclines, movements, and directions in terms of absolute orientation of the main body of the electronic map device such as those illustrated in FIG. 3, FIG. 4, and FIG. 5 above and is equipped with sensors necessary for such. Sensor types and a sensor count may be any that enable detection of these inclines/movements/orientations. Moreover, as described below, the CPU 10 executes predetermined display output processing based on detected incline/movement/orientation conditions.

[0025] Note that FIG. 6 illustrates an example of using the electronic map device 1 by installing the device on a predetermined stand 30. Here, the stand 30 is formed with a mounting portion 32 via a shank 31, and a mounting mechanism that is not illustrated on a back face of the electronic map device 1 is coupled to the mounting portion 32. Moreover, by the shank 31, the electronic map device 1 can incline/rotate in any direction in a state of being installed to the stand 30. With such a mechanism, it is also conceivable to provide a mechanical position sensor on a mounting-portion 32 and shank 31 side and detect posture conditions of the electronic map device 1 by operations thereof.

[0026] 3. Map Display Operations in Display-Orientation-Designated Mode

Display operations based on incline/movement/orientation detection of the electronic map device 1 are sequentially described below as display aspects in display operation modes. Note that a display-orientation-designated mode, an actual-orientation-reflecting mode, a vicinity-map display mode, a virtual display mode, and a navigation display mode can be set as the display operation modes of the present example, the operations in each mode described below being executed by the user selecting the mode by controlling the control unit 4.

[0027] First, map display operations in the display-orientation-designated mode is described using FIG. 7, FIG. 8, and FIG. 9. The display-orientation-designated mode is a display operation mode wherein a direction designated by the user is continually up in the map image regardless of the posture of the electronic map device 1 and is displayed matching an upward direction in terms of gravity of the electronic map device 1. Note that in the description, up, down, left, and right in the displayed map image, bird's-eye image, or 3D image are referred to as map-up, map-down, map-left, and map-right, which are distinct from screen-up, screen-down, screen-right, and screen-left described above; up and down in terms of the earth's gravity; and left and right in terms of absolute orientation.

[0028] That is, in the display-orientation-designated mode, the designated direction is made to be map-up regardless of the posture of the electronic map device 1 (regardless of whether screen-up, screen-down, screen-right, or screen-left is up in terms of gravity) and display is performed so map-up and up in terms of gravity match. Directions able to be designated by the user are made to be absolute orientations such as north, south, east, and west as well as a current travel direction, a direction the user is facing, and the like. Moreover, when setting is not performed by the user, automatic setting such as making, for example, north be map-up as a reference direction may be performed.

[0029] FIG. 7 illustrates control operations by the CPU 10 in the display-orientation-designated mode. Note that the user

designates a certain region as the map region to be displayed and map information and additional information of this region is read from the CD-ROM 20 and held in the map-image memory 15.

[0030] During this display-orientation-designated mode, at step F101, the CPU 10 continually monitors posture detection information (incline state) from the sensor unit 17. Then, at step F102, it is determined whether the posture of the electronic map device 1 is in a horizontal/vertical/diagonal state as illustrated in FIG. 3. When the vertical or diagonal state is determined—as in, for example, (b), (c), (d), or (e) in FIG. 3—the flow proceeds to step F103. Then, it is confirmed whether additional information whereby a bird's-eye image and a 3D image as viewed from a certain point in the region can be synthesized (or bird's-eye image data or 3D image data itself) is present as the map information of the region to currently display.

[0031] When no data necessary for the processing of synthesizing the bird's-eye image and the 3D image is prepared for this region (not recorded on the CD-ROM 20), the flow proceeds from step F104 to F105 to perform normal, flat map display. Then, according to the posture of the main body of the electronic map device 1 detected at step F101, display-image data is generated so the map image, wherein up (map-up) is the designated direction, matches up in terms of gravity. This display-image data is supplied to the display driver 13, and display on the display unit 2 is executed. FIG. 8 illustrates images of this situation.

[0032] It is supposed that the user designates, for example, south as the designated direction in the display-orientation-designated mode. (a) in FIG. 8 is when it is supposed that the user is holding the electronic map device 1 vertically with the screen-up portion up in terms of gravity at this time. Here, as the map image, an image of the certain region wherein south is map-up is displayed; because screen-up and up in terms of gravity match, as illustrated, an image is displayed wherein screen-up is map-up (that is, south).

[0033] Furthermore, (b) in FIG. 8 illustrates the screen-right portion being inclined downward in a state of the user holding the electronic map device 1 vertically. At this time, screen-up of the main body of the electronic map device 1 no longer matches up in terms of gravity. However, processing at step F105 generates the map image simply so map-up (= south) matches up in terms of gravity. Therefore, as illustrated, the displayed map image displays south as being up in terms of gravity such that a map image that is long from a south-east portion to a north-west portion of the map is displayed.

[0034] Furthermore, (c) in FIG. 8 is a state wherein the user holds the electronic map device 1 vertically with the screen-left portion being upward. At this time as well, the processing at step F105 generates the map image simply so map-up (= south) matches up in terms of gravity. Therefore, as illustrated, the displayed map image displays south as being up in terms of gravity such that a map image that is long in a north-south direction of the map is displayed.

[0035] As evident from comparing (a) to (c) in FIG. 8,

when the electronic map device 1 is held vertically in the display-orientation-designated mode, the map of the certain region is displayed simply according to the posture of the electronic map device 1 at this time so the designated direction is map-up in a direction that is up in terms of gravity among the screen-up, -down, -left, and -right directions. Therefore, as viewed by the user, the designated direction is displayed continually upward regardless of how the electronic map device 1 is rotated while being held vertically. In terms of a display control operation, the displayed map image changes orientation according to which direction up in terms of gravity is in terms of the screen-up, screen-down, screen-left, and screen-right directions. Note that this operation takes place not only in the vertical state but also when the diagonal state is detected.

[0036] Now, when it is determined at step F104 that a bird's-eye view or 3D display is possible, the flow proceeds to step F106, and three-dimensional image display from the certain point is performed. Then, here as well, regardless of the posture of the electronic map device 1, a vanishing point of the three-dimensional image (farthest point in a depth direction) becomes the designated direction, display being performed so this is up in terms of gravity. That is, up in the three-dimensional image is made to match up in terms of gravity. Note that the 3D image is displayed when a posture of an incline direction of the main body is vertical and the bird's-eye image is displayed when this is diagonal.

[0037] FIG. 9 illustrates an example of the electronic map device 1 being held vertically and the 3D image from the certain point being displayed. As the 3D image itself, an image viewing the designated direction (for example, south) from the certain point is generated. This is virtually synthesized by using additional information such as height information of buildings surrounding the specified point. Moreover, as evident from a comparison with (a), (b), and (c) in FIG. 8, regardless of which direction among the screen-up, screen-down, screen-left, and screen-right directions is up in terms of gravity in holding the electronic map device 1, in the displayed 3D image, map-up (that is, up in the 3D image) simply matches up in terms of gravity.

[0038] Note that although not illustrated, when the electronic map device 1 is held in a diagonally inclined state, bird's-eye display is executed in a similar aspect to FIG. 9. The bird's-eye image is an image such as that illustrated in (b) in FIG. 15.

[0039] Now, when the electronic map device 1 is horizontal, the processing flows from step F102 to F107. Here, at this point, there is no direction among two-dimensional directions of screen-up, screen-down, screen-left, and screen-right that corresponds to up in terms of gravity. Therefore, at step F107, a posture immediately before the posture becomes horizontal is determined, and at step F108, display is performed so a direction deemed to be upward immediately before is considered to be up in terms of gravity. For example, when, as in (c) in FIG. 8, the electronic map device 1 is placed horizontally immediately after screen-left is deemed to be up in terms of gravity, display of the map image wherein screen-left is the designated direction (here, south) is executed.

[0040] Note that as above, in the display-orientation-

designated mode, display is performed so the designated direction simply matches up in terms of gravity at a given time; it is needless to say that a detection precision and number of detection stages of the screen-up, -down, -left, and -right directions and a detection precision and number of detection stages of an incline can be set in various ways. For example, if the number of detection stages is increased, nearly continuous display-image changing when the main body is rotated is possible so map-up is continually up in terms of gravity. Moreover, if the number of stages is decreased to every 45° or 90° or the like, a display operation is performed of switching display directions upon rotating by an angle of a certain extent.

[0041] Furthermore, because in this display-orientation-designated mode the map is displayed so a direction desired by the user continually matches up in terms of gravity, regardless of how the device is held or placed, from the user's perspective, it is sufficient to continually deem up (up in terms of gravity) to be the designated direction such that there is no need to think about a reading orientation that depends on the posture of the electronic map device 1.

[0042] Note that this description concerning detection precision and number of detection stages also applies to the actual-orientation-reflecting mode, the vicinity-map reflecting mode, and the virtual display mode described below, and a display-change aspect can be set in various ways according to settings of detection precision and number of detection stages for posture and movement.

[0043] 4. Map Display Operations in Actual-Orientation-Reflecting Mode

Next, map display operations in the actual-orientation-reflecting mode are described using FIG. 10 and FIG. 11. The actual-orientation-reflecting mode is a display operation mode that displays the map simply matching an actual orientation regardless of the posture of the electronic map device 1.

[0044] FIG. 10 illustrates control operations by the CPU 10 in the actual-orientation-reflecting mode. Note that here as well, the user designates a certain region as the map region to be displayed and the map information and the additional information of this region is read from the CD-ROM 20 and held in the map-image memory 15.

[0045] During this actual-orientation-reflecting mode as well, at step F201, the CPU 10 continually monitors the posture detection information (incline state) from the sensor unit 17. Then, at step F202, it is determined whether the posture of the electronic map device 1 is in the horizontal/vertical/diagonal state as illustrated in FIG. 3.

[0046] When the electronic map device 1 is horizontal, the flow proceeds to step F203. Then, it is determined with which screen two-dimensional direction among screen-up, screen-down, screen-left, and screen-right an absolute direction confirmed by the orientation sensor in the sensor unit 17 corresponds, and display is performed so north, south, east, and west in the map image match actual north, south, east, and west.

[0047] FIG. 11 illustrates images of this. (a) in FIG. 11 is a state wherein the electronic map device 1 is horizontal and the screen-up portion is facing north.

At this time, the map image is displayed so the north direction matches actual north. As such, image display is performed so, as illustrated, screen-up is north on the map.

[0048] Furthermore, (b) in FIG. 11 is a state wherein the screen-up portion of the electronic map device 1 is facing north-east. At this time, as illustrated, by performing image display so screen-up is north-east in terms of the map, displayed is a map image, matching the actual orientation, that is long from north-west to south-east. Furthermore, (c) in FIG. 11 is a state wherein the screen-up portion of the electronic map device is facing east. At this time, as illustrated, by performing image display so screen-up is east in terms of the map, displayed is a map image, matching the actual orientation, that is long in a north-south direction.

[0049] As evident from comparing (a) to (c) in FIG. 11, when the electronic map device 1 is horizontal in the actual-orientation-reflecting mode, the map of the certain region is displayed simply matching the actual orientation at this time. Therefore, from the user's perspective, a map reflecting actual cardinal directions can be viewed regardless of which direction the user faces while holding the electronic map device 1 horizontally, making reading the map while mentally matching the actual cardinal directions and cardinal directions of the map image. Moreover, this also eliminates misreading map directions.

[0050] When the posture is determined to be vertical or diagonal at step F202, the flow proceeds to step F204. Then, it is confirmed whether the additional information whereby the bird's-eye image and the 3D image as viewed from the certain point in the region can be synthesized (or the bird's-eye image data or the 3D image data itself) is present as the map information of the region to currently display.

[0051] When no data necessary for the processing of synthesizing the bird's-eye image and the 3D image is prepared for this region (not recorded on the CD-ROM 20), the flow proceeds from step F205 to F207 to perform normal, flat map display. When the posture is deemed to be vertical or diagonal, in this state, the screen two-dimensional directions of screen-up, screen-down, screen-left, and screen-right and the actual cardinal directions cannot be matched. As such, here, it is detected which among screen-up, -down, -left, and -right corresponds to up in terms of gravity of the main body of the electronic map device.

[0052] Then, at step F208, the map image is displayed so screen-up, -down, -left, or -right detected as up in terms of gravity matches a direction viewed through the main body of the electronic map device 1. For example, it is supposed that the user is holding the electronic map device 1 in their hand while facing north and that the electronic map device 1 is being held diagonally or vertically with screen-up being up in terms of gravity. Here, the direction viewed through the main body of the electronic map device 1 is in other words the cardinal direction the user is facing—that is, north. Therefore, displayed is a map image such as (a) in FIG. 11 wherein screen-up is north. As such,

from the user's perspective, for example, even if the electronic map device 1 is diagonal or vertical, displayed is a map that feels like it matches the actual cardinal directions.

[0053] For example, if the user turns to face east while still holding the device vertically, a display image changes to a map image wherein screen-up is east. That is, even if the electronic map device 1 is vertical or diagonal, a map continually reflecting the actual cardinal directions can be viewed.

[0054] Now, when it is determined at step F205 that the bird's-eye view or 3D display is possible, the flow proceeds to step F206, and three-dimensional image display from the certain point is performed. Then, here as well, display is performed so the vanishing point of the three-dimensional image (farthest point in the depth direction) matches an actual direction. That is, the 3D image or the bird's-eye image viewed from the certain point is generated as an image wherein the depth direction of the three-dimensional image corresponds to the direction the user is actually facing (direction viewed through the main body of the electronic map device 1) and up in the image (map-up) is made to match up in terms of gravity.

[0055] Therefore, when the 3D image is displayed with reference to a certain intersection, if the user sequentially changes orientation from east to south, west, and north while holding the electronic map device 1, the displayed 3D image changes from an image of the east to an image of the south, an image of the west, and an image of the north as viewed from the intersection being displayed at this time. Of course, the 3D image is not limited to a synthesized image and may use photographed image data. Note that the 3D image is displayed when the posture of the incline direction of the main body is vertical and the bird's-eye image is displayed when this is diagonal.

[0056] As above, in the actual-orientation-reflecting mode, regardless of how the electronic map device 1 is oriented, the displayed map image matches the actual orientation. This enables a map with very easy-to-understand directionality to be provided. Note that the display example of FIG. 11 displays an image of a compass on the map image; this provides a map whereby orientation is easily confirmed.

[0057] 5. Map Display Operations in Vicinity-Map Display Mode

Map display operations in the vicinity-map display mode are described using FIG. 12 and FIG. 13. The vicinity-map display mode is a display operation mode wherein when the map image of the certain region is being displayed and the user moves the main body of the electronic map device 1, the displayed map is scrolled in a manner corresponding to the direction and the amount of this movement.

[0058] FIG. 12 illustrates control operations by the CPU 10 in the vicinity-map display mode. Note that here, map-image information of the displayed region and a surrounding region thereof is read from the CD-ROM 20 and held in the map-image memory 15. Then, a portion of the region map-image information is supplied from the map-image memory 15 to the display driver 13 and the map of the certain region is displayed. Here, by shifting the map-image information read from the map-image memory 15,

scrolling display whereby the displayed region shifts can be realized.

[0059] During this vicinity-map display mode, at step F301, the CPU 10 first confirms whether a scroll button is pushed. The scroll button is one button in the control unit 4 of the electronic map device 1, and the user can push the scroll button at any point in time. When the scroll button is not pushed, the processing of the CPU 10 proceeds to step F305, and the map image being displayed at this time continues to be displayed in fixed display.

[0060] When the user desires to scroll the displayed map image, the user moves the main body of the electronic map device 1 in any direction (direction wherein the user desires to scroll the map) while pushing the scroll button. This control is, for example, as illustrated in FIG. 5, holding the electronic map device 1 and swinging it forward, backward, leftward, or rightward or moving it so as to draw a circle.

[0061] For CPU 10 processing of a period wherein the scroll button is being pushed, the flow proceeds to step F302, and the information from the sensor unit 17 is monitored to detect the movement direction and movement amount of the main body of the electronic map device 1. When the user is not imparting a moving operation to the electronic map device 1 even though the scroll button is being pushed—that is, when zero movement is detected at step F302 and a stopped state is determined—at step F305, map display is fixed as the display at this time. However, when a moving state is detected, the flow proceeds to step F304 and the displayed map image is scrolled according to the movement direction and the movement amount.

[0062] FIG. 13 illustrates an image of the display operations of the vicinity-map display mode. FIG. 13 illustrates the map of the region currently displayed on the display unit 2 of the electronic map device 1 together with a map image of the surroundings thereof. By the user moving the main body of the electronic map device 1 in various directions as illustrated by the arrows in the diagram while pushing the scroll button as the control unit 4, the display image is scrolled so map images of the illustrated surrounding regions are displayed on the display unit 2.

[0063] For example, by performing an operation of moving the electronic map device 1 upward in the diagram (an operation of the user pushing the electronic map device forward), the map scrolls to a vicinity of a region labeled as “Edogawa, Tokyo.” Moving the device so as to draw a circle as in (a) in FIG. 5 enables a wide surrounding region to be confirmed.

[0064] By matching a scrolling direction to the movement directions illustrated by the arrows and making a scroll amount an amount corresponding to a movement amount of this movement control, the user can confirm a map of a desired region simply by moving the electronic map device 1 in a desired direction, and a control method that is very easy to understand and has an excellent user interface can be realized. Of course,

because the map image is not scrolled while the scroll button is not pushed, the user does not need to worry about not moving the electronic map device while viewing the map currently being displayed.

[0065] 6. Map Display Operations in Virtual Display Mode Next, map-display operations in the virtual display mode are described using FIG. 14 and FIG. 15. The virtual display mode performs the 3D display and the bird’s-eye display of the examples above, and

[0066] FIG. 14 illustrates control operations by the CPU 10 in the virtual display mode. Here, when the map image of the certain region is displayed, at step F401, the CPU 10 is continually monitoring the posture detection information (incline state) from the sensor unit 17. Then, at step F402, it is determined whether the posture of the electronic map device 1 is in the horizontal/vertical/diagonal state as illustrated in FIG. 3.

[0067] When the electronic map device 1 is horizontal, the flow proceeds to step F403. (a) in FIG. 15 illustrates an image of this situation; the user is looking down at the display unit 2 from above, and here, the CPU 10 performs, as illustrated, normal, two-dimensional map-image display.

[0068] When the diagonal state is determined at step F402, the flow proceeds to step F404. An image at this time is as in (b) in FIG. 15; the user is in an angled state of viewing the display unit 2 from diagonally above. In conjunction therewith, at step F404, the CPU 10 synthesizes a bird’s-eye image such as is illustrated by the image synthesis unit 16 and at step F405 displays this bird’s-eye image on the display unit 2.

[0069] Furthermore, when the vertical state is determined at step F402, the flow proceeds to step F406. An image at this time is as in (c) in FIG. 15; the user is in a state of viewing the display unit 2 from the front. In conjunction therewith, at step F406, the CPU 10 synthesizes a 3D image such as is illustrated by the image synthesis unit 16 and at step F405 displays this bird’s-eye image on the display unit 2.

[0070] By the above virtual display mode, the electronic map device can be made to realize not only simply two-dimensional map display but also display of a three-dimensional image that is rich with visual information for the user and is interesting. Moreover, because switching between normal display, bird’s-eye display, and 3D display is performed automatically according to the posture of the main body of the electronic map device 1, the user can intuitively display a sought image and does not confuse controls.

[0071] 7. Map Display Operations in Navigation Display Mode

In the present example, because the GPS receiver 18 is provided and the current position (latitude/longitude) of the electronic map device 1 itself can be detected, navigation display is also possible by overlaying current-position display on the map image. That is,

by the CPU 10, based on the current-position information obtained by the GPS receiver 18, reading map-image data matching this current position from the CD-ROM 20; displaying this map image on the display unit 2; and displaying a pointer or the like at a point corresponding to the current position in this display, the user can confirm the current position and a surrounding region.

[0072] 8. Composite Operation of Various Modes

By compositely executing the operations of the various modes described above, a greater variety of map display can be realized. For example, it is conceivable to composite the operations of the display-orientation-designated mode and the vicinity-map display mode. Here, the designated direction is continually displayed as up in terms of gravity, and in this state, by moving the main body of the electronic map device 1 while pushing the scroll button, the map of the surrounding region is scrolled. Note that the example described using FIG. 7 additionally executes the operations of the virtual display mode of 3D display and bird's-eye display, but even during such display, the screen may be switched by moving the device while pushing the scroll button. Here, a three-dimensional scene is scrolled according to the movement direction.

[0073] Furthermore, it is also useful to composite the operations of the current-orientation-reflecting mode and the vicinity-map display mode. That is, by performing map display in a directional state simply matching the actual orientation and moving the main body of the electronic map device 1 while pushing the scroll button, the map of the surrounding region is displayed while being scrolled.

[0074] Furthermore, in the navigation display mode, by compositely carrying out the operations of the display-orientation-designated mode, the actual-orientation-reflecting mode, and the vicinity-map display mode, a more convenient navigation function for the user is realized. Moreover, executing virtual display during the navigation function enables matching with an actual scene, which is more favorable. Not being limited to the above, a variety of display operations can be realized by composite operations of the various modes.

[0075] Now, although the present example describes the present invention applied as an electronic map display device, the present invention can be applied to display devices in general. That is, by changing a display content according to a posture state or movement conditions of a main body of a display device, display of a variety of display contents can be realized with control with an excellent user interface. For example, when a portion of a certain image is displayed enlarged, confirming a surrounding image is facilitated by scrolling according to movement as in the surrounding-map display mode above. Moreover, by switching from a flat image to a three-dimensional image according to an angle state as in the virtual display mode above, a large amount of information can be provided to a user concerning a certain image.

[0076]

[Effect of the Invention] As described above, the present

invention can detect a posture state and/or a movement state of a main body of a display device and, based on this detection information, change a display state of an image being displayed. That is, by changing a display content to match conditions such as a posture or movement of the main body of the device, in, for example, map display, a variety of display changes can be realized such as display matching an actual orientation, display wherein a designated direction is made to be a constant direction from a user's perspective regardless of posture, display of scrolling a display area according to movement, and switching between three-dimensional display and flat display. Moreover, there are the effects of a displayable information amount being large and display being able to be realized that is easy to understand for a user, has favorable controllability, and matches user requests of any given time, and a very favorable information-providing function can be exhibited.

[Brief Description of Drawings]

[FIG. 1] A block diagram of an electronic map device of an embodiment of the present invention.

[FIG. 2] An appearance view of the electronic map device of the embodiment.

[FIG. 3] An explanatory diagram of posture change of the electronic map device of the embodiment.

[FIG. 4] An explanatory diagram of orientation change of the electronic map device of the embodiment.

[FIG. 5] An explanatory diagram of movement conditions of the electronic map device of the embodiment.

[FIG. 6] An explanatory diagram of installing the electronic map device of the embodiment to a stand.

[FIG. 7] A flowchart of processing of a display-orientation-designated mode of the embodiment.

[FIG. 8] An explanatory diagram of display operations of the display-orientation-designated mode of the embodiment.

[FIG. 9] An explanatory diagram of the display operations of the display-orientation-designated mode of the embodiment.

[FIG. 10] A flowchart of processing of an actual-orientation-reflecting mode of the embodiment.

[FIG. 11] An explanatory diagram of display operations of the actual-orientation-reflecting mode of the embodiment.

[FIG. 12] A flowchart of processing of a vicinity-map display mode of the embodiment.

[FIG. 13] An explanatory diagram of display operations of the vicinity-map display mode of the embodiment.

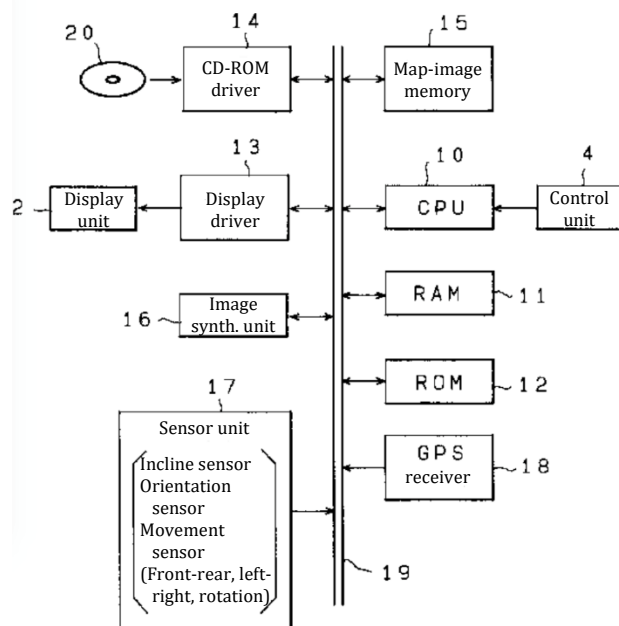
[FIG. 14] A flowchart of processing of a virtual display mode of the embodiment.

[FIG. 15] An explanatory diagram of display operations of the virtual display mode of the embodiment.

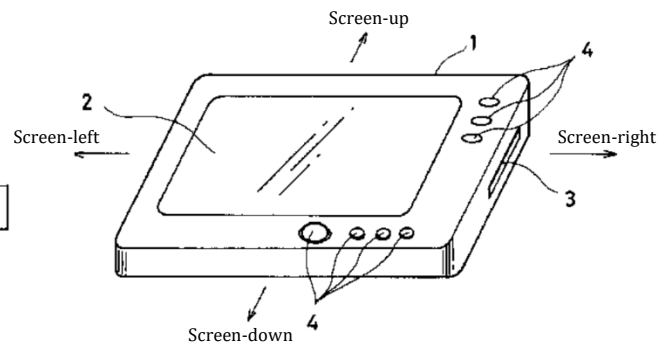
[Description of Reference Numerals]

1 electronic map device, 2 display unit, 3 insertion portion, 4 control unit, 10 CPU, 11 RAM, 12 ROM, 13 display driver, 14 CD-ROM driver, 15 map-image memory, 16 image synthesis unit, 17 sensor unit, 18 GPS receiver, 20 CD-ROM

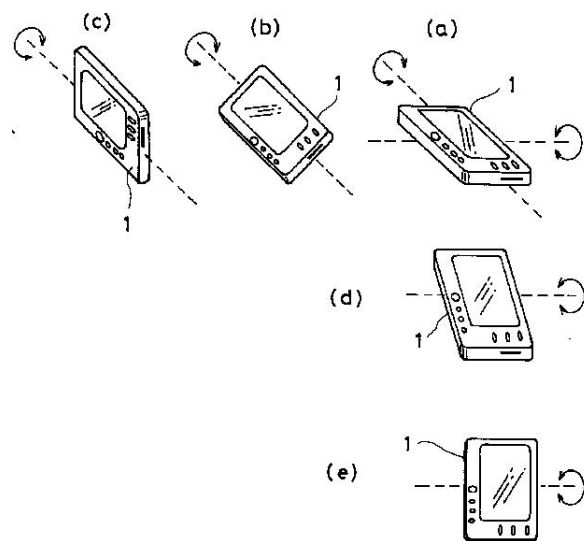
[FIG. 1]



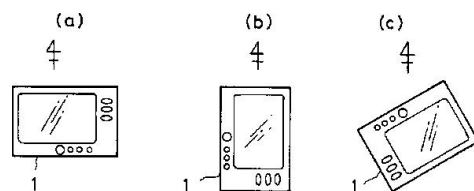
[FIG. 2]



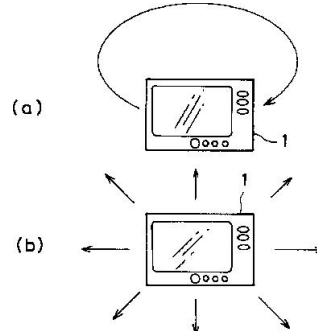
[FIG. 3]



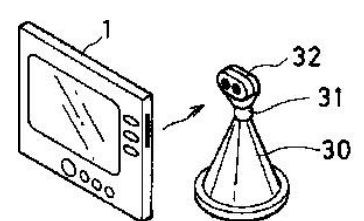
[FIG. 4]



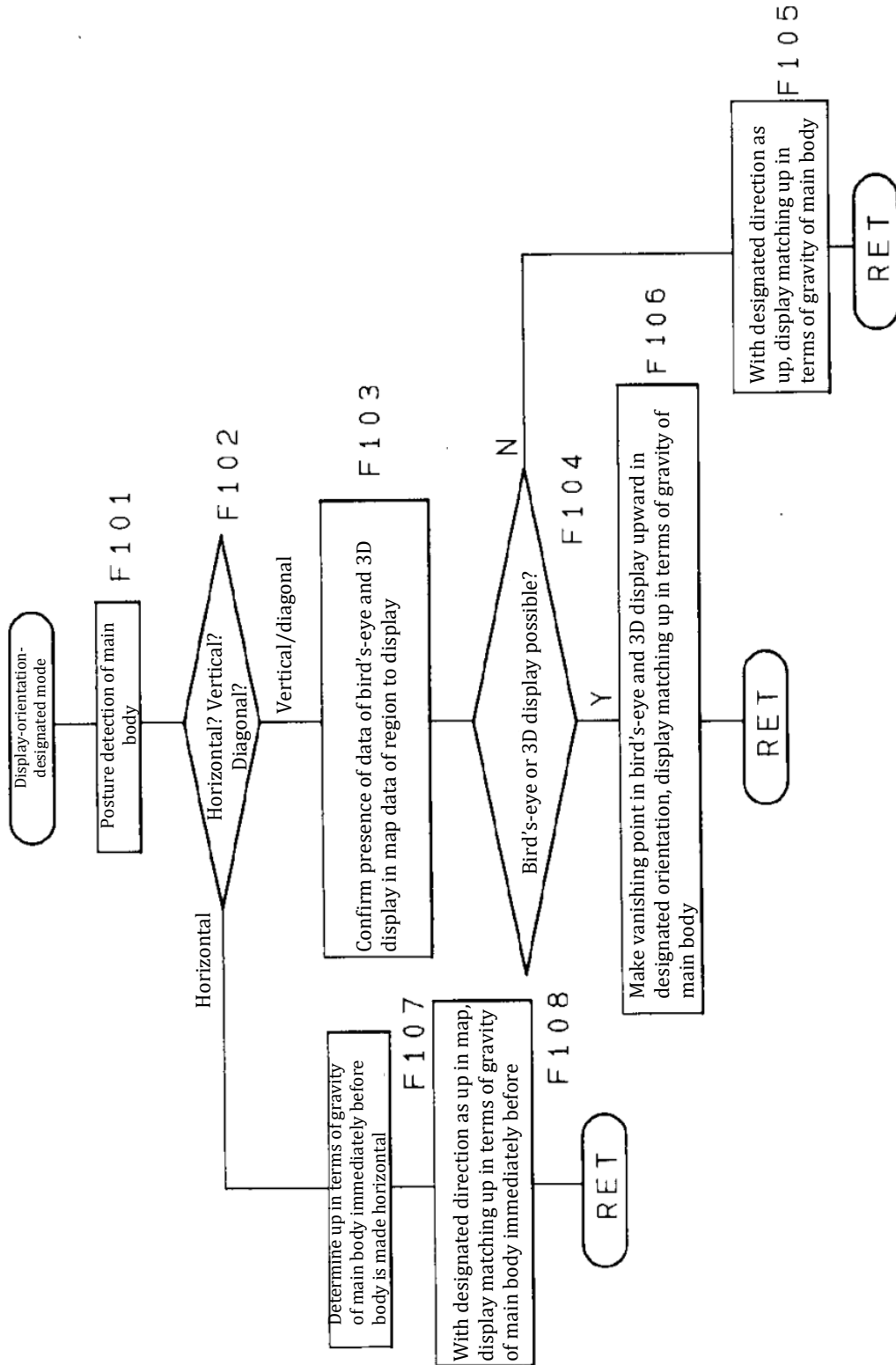
[FIG. 5]



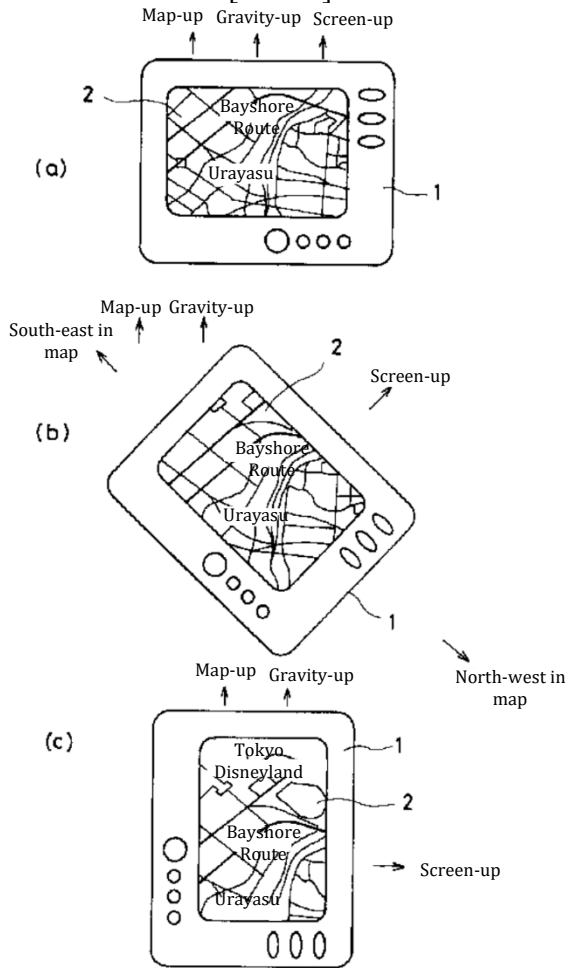
[FIG. 6]



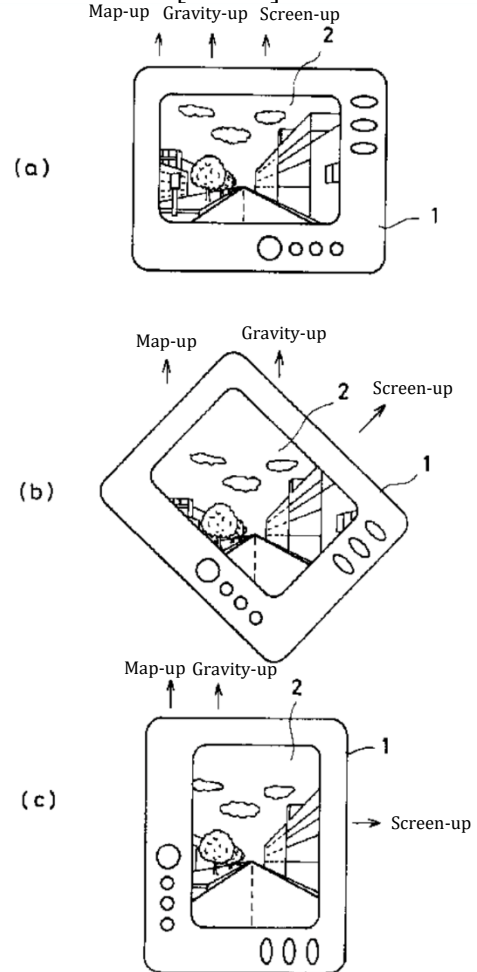
[FIG. 7]



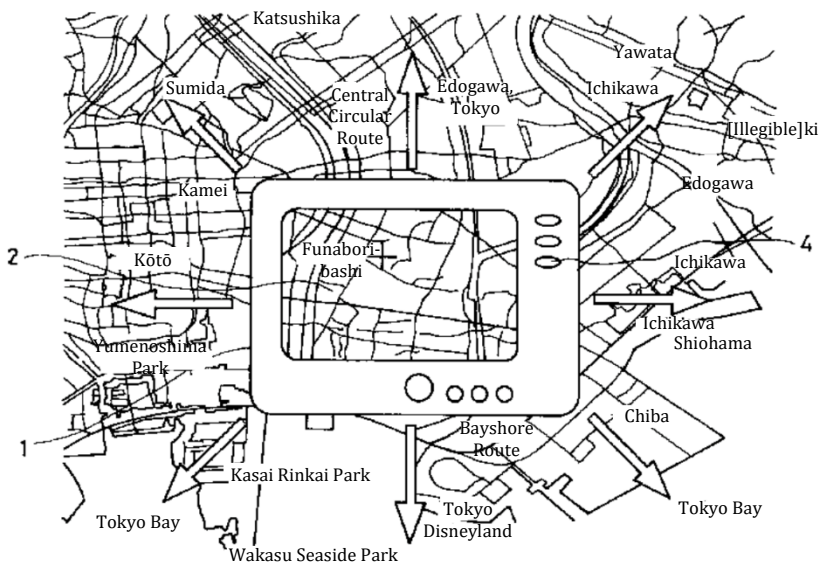
[FIG. 8]



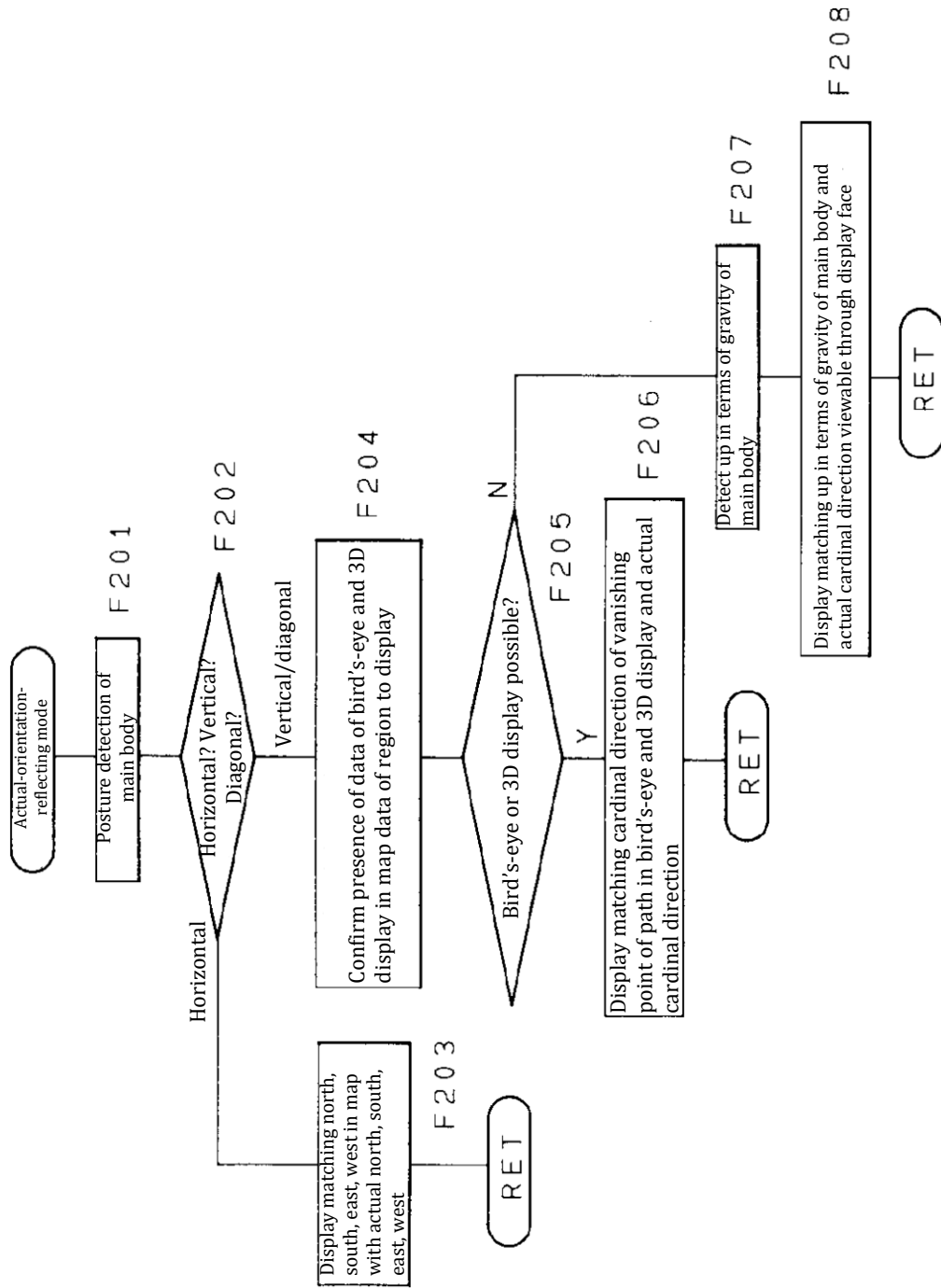
[FIG. 9]

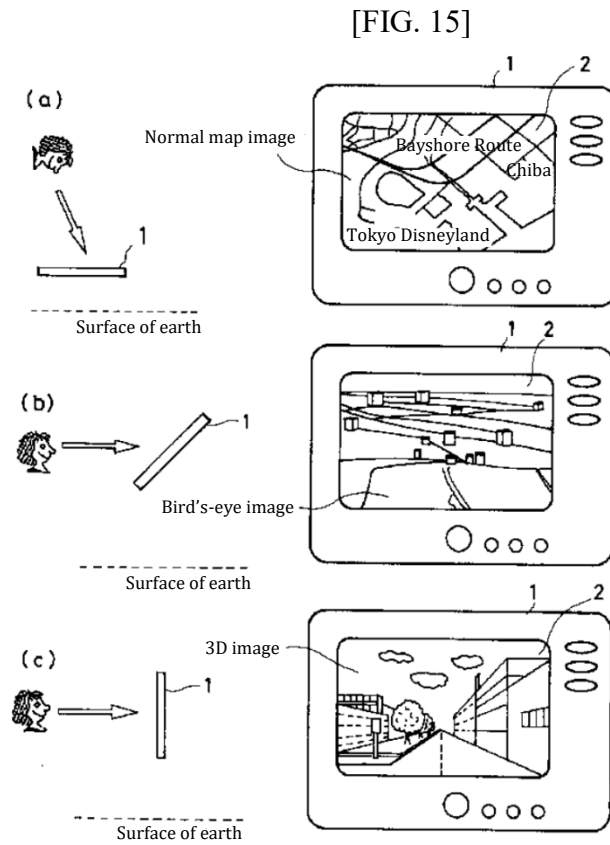
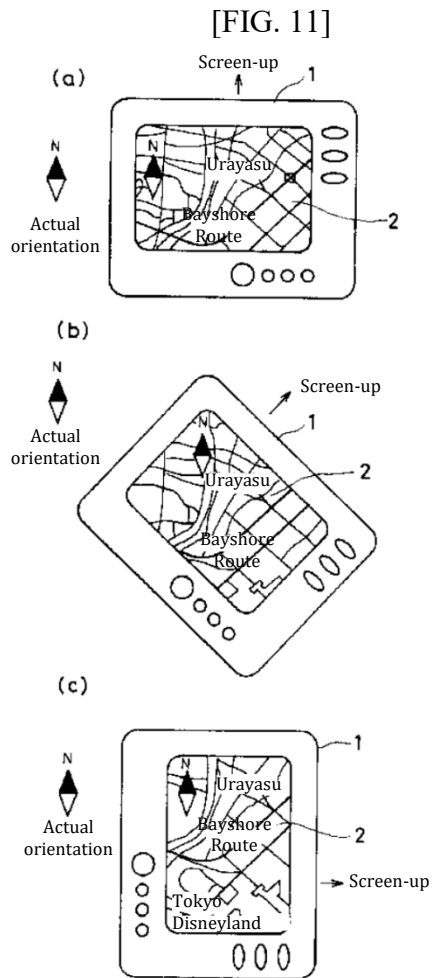


[FIG. 13]

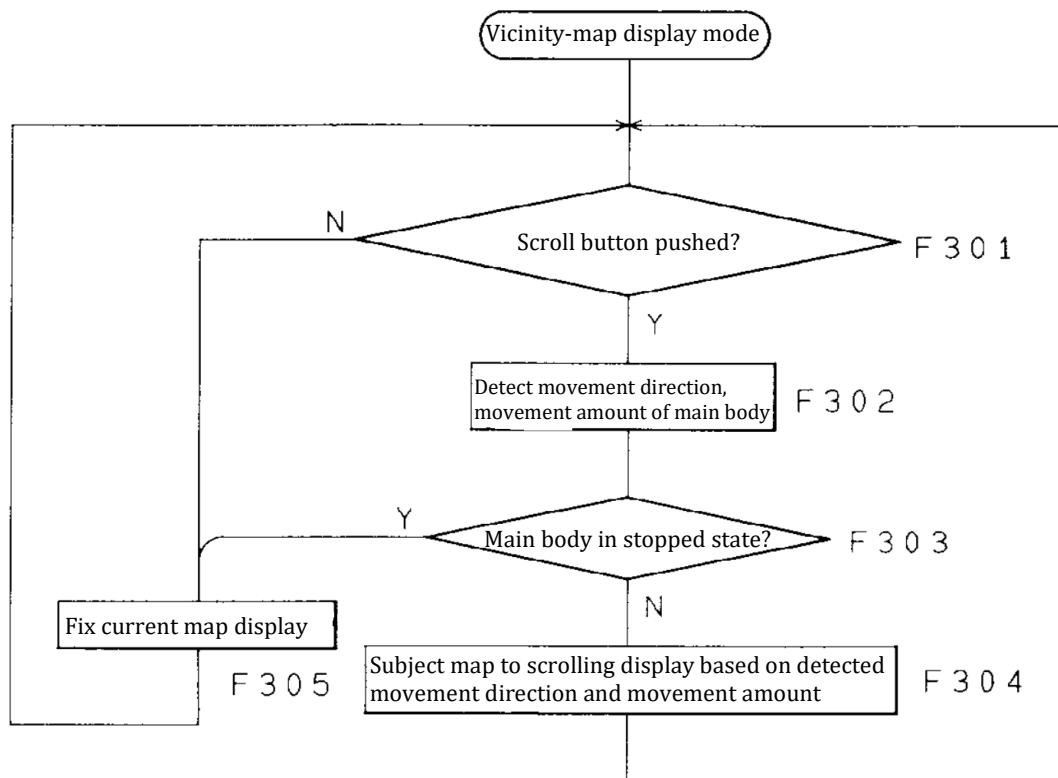


[FIG. 10]





[FIG. 12]



[FIG. 14]

