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Certification

Welocalize Translations

TRANSLATORS' DECLARATION:

We, Travis Huntsman, Lorelle Knowles, and Eric Vance hereby declare:

That we possess advanced knowledge of the Japanese and English languages. The attached Japanese into English translation has been translated by us and to the best of our knowledge and belief it is a true, correct and complete translation of: JPH10-221091A, JPH08-110230A and JP2007017351A. We hereby certify under penalty of perjury that the foregoing is true and correct.

A handwritten signature in black ink, appearing to read "Travis Huntsman".

Travis Huntsman

Project Number: [Project # SUMI_2403_P0004] (JP2007017351A_Original_document_20240313113257)

A handwritten signature in black ink, appearing to read "Lorelle Knowles".

Lorelle Knowles

Project Number: [Project # SUMI_2403_P0004] (L11031_04-6_JPH10-221091A)

A handwritten signature in black ink, appearing to read "Eric Vance".

Eric Vance

Project Number: [Project # SUMI_2403_P0004] (L11031_04-7_JPH08-110230A)

15 W. 37th Street 4th Floor
New York, NY 10018
212.581.8870

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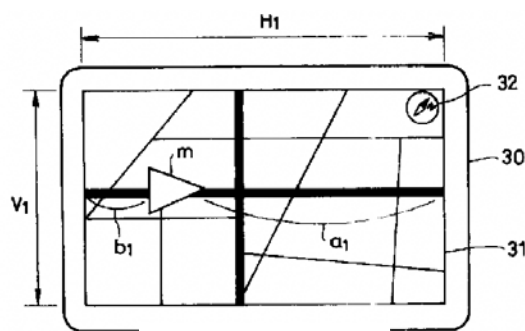
(21) Application No.	JP H9-25338	(71) Applicant	000002185 Sony Corporation 6-7-35 Kitashinagawa, Shinagawa-ku, Tokyo
(22) Date of Filing	February 7, 1997 (Heisei 9)	(72) Inventor	Katsuhiko Nunokawa c/o Sony Corporation 6-7-35 Kitashinagawa, Shinagawa-ku, Tokyo
		(72) Inventor	Koji Hasegawa c/o Sony Corporation 6-7-35 Kitashinagawa, Shinagawa-ku, Tokyo
		(74) Agent	Hidemori Matsukuma, Patent Attorney

(54) [Title of Invention] **DISPLAY METHOD, NAVIGATION DEVICE AND VEHICLE**

(57) [Abstract]

[Problem] To provide an efficient display that effectively utilizes a screen displayed when displaying a map.

[Resolution Means] A position of a mobile body is detected, and when a map in a vicinity of the detected position is displayed, a traveling direction of the mobile body is detected, and the detected traveling direction is made to substantially match a longitudinal direction or a diagonal direction of the map displayed.



Display example

[Scope of Patent Claims]

[Claim 1] A display method for detecting a position of a mobile body and displaying a map in a vicinity of the detected position, wherein a traveling direction of the mobile body is detected, and the detected traveling direction is made to substantially match a longitudinal direction or a diagonal direction of the map displayed.

[Claim 2] The display method according to claim 1, wherein a detected traveling direction side is displayed in a wide manner along the longitudinal direction or the diagonal direction of the map from a display position indicating the position of the detected mobile body.

[Claim 3] The display method according to claim 1, wherein the range in which the map is displayed is limited to one portion of the display screen, and the longitudinal direction or diagonal direction of the limited map display range is made to substantially match the traveling direction.

[Claim 4] A navigation device, comprising: positioning means for a current position; orientation detection means for detecting a travelling orientation; storage means for map data; and map control means for reading map data in a vicinity of the current position detected by the positioning means from the storage means and using this as a map display signal, and, when generating this map display signal, performing processing to cause the orientation detected by the orientation detection to substantially match a longitudinal direction or a diagonal direction of a map displayed by the map display signal.

[Claim 5] The navigation device according to claim 4, wherein when the display control means generates the map display signal, the map display is such that the detected traveling orientation side is displayed in a wide manner along the longitudinal direction or the diagonal direction of the map from the display position of the detected current position.

[Claim 6] The navigation device according to claim 4, wherein the map display signal generated by the display control means is a signal that limits a range in which the map is displayed to one portion of the display screen and displays information other than the map in a remaining portion, and the longitudinal direction or the diagonal direction of the limited map display range is made to substantially match the traveling direction.

[Claim 7] A vehicle, comprising: positioning means for a current position of the vehicle; orientation detection means for detecting an orientation in which the vehicle is traveling; storage means for map data; display means; and control means for reading map data in a vicinity of the current position detected by the positioning means from the storage means to generate a map display signal and supply the same to the display means for display, and when generating this map display signal, performing processing to cause the orientation detected by the orientation detection means to substantially match the longitudinal direction or the diagonal direction of the display means.

[Claim 8] The vehicle according to claim 7, wherein the detected traveling orientation side is displayed in a wide manner along the longitudinal direction or the diagonal direction of the map from the display position of the detected current position as the map displayed by the display means based on the map display signal.

[Claim 9] The vehicle according to claim 7, wherein a range in which the map is displayed by the display means based on the map display signal is limited to one portion of a display screen of the display means, information other than the map is displayed in a remaining portion, and the longitudinal direction or the diagonal direction of the limited map display range is made to substantially match the traveling direction.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention] The present invention relates to a display method that is mounted

on a mobile body such as an automobile, detects a current position thereof, and displays a map in a vicinity of the detected position, a navigation device to which this display method is applied, and a vehicle to which this navigation device is mounted.

[0002]

[Conventional Art] Conventionally, various navigation devices to be mounted on a mobile body such as an automobile have been developed. This navigation device is constituted by large-capacity data storage means, such as a CD-ROM on which road map data is stored, detection means for a current position, and a display device that displays a road map in a vicinity of the detected current position based on data read from the data storage means. In this case, the detection means for the current position may use a positioning system called GPS (Global Positioning System) that uses signals transmitted from positioning satellites (hereinafter simply referred to as GPS), or an autonomous navigation method (independent navigation) that tracks changes in the current position from a starting point based on information such as travel direction, travel speed, or the like of the vehicle, and carries out positioning of the current position.

[0003] Then, data of the road map in the vicinity of the current position detected by the detection means for the current position is read from large-capacity data storage means such as a CD-ROM, generates a video signal for displaying the road map, and supplies the video signal to a display device (often using a liquid crystal display panel) to display the road map in the vicinity of the current position.

[0004]

[Problem to Be Solved by Invention] When displaying a road map using such a navigation device, in some cases, the map is displayed so that north or south is at a top of a screen, and in other cases, the map is displayed in such a way that the traveling direction of the vehicle is always at the top of the screen. Here, when displaying a map where the traveling direction of the vehicle is at the top of the screen, there is an advantage in that a correspondence between an orientation on the displayed map and the traveling direction is easy to understand.

[0005] On the other hand, since the map display is used to provide guidance on a road on which the vehicle will be traveling, it is preferable that the road on which the vehicle will be traveling is displayed in an easy-to-understand format; however, in reality, a display device used by a navigation device often uses the same display unit as a display device used in a television receiver, so the aspect ratio of the display screen is 3:4 or 9:16 in landscape orientation, and thus the map is displayed on a horizontal screen and it cannot be argued that the map is always displayed in a favorable manner. For example, when a map is displayed having the top of the screen as the traveling direction and a current position set substantially at a center of the displayed map, the road ahead of the traveling direction will be displayed in approximately the top half of the screen; however, a distance from the current position on the screen to the top of the screen is displayed for a relatively short period of time, and thus it cannot be argued that the road ahead of the traveling direction is being displayed in a favorable manner.

[0006] In light of this problem, an object of the present invention is to provide an efficient display that effectively utilizes the screen displayed when displaying a map.

[0007]

[Means for Solving Problem] In order to solve the foregoing problem, the present invention detects a position of a mobile body, and when a map in a vicinity of the detected position is displayed, a traveling direction of the mobile body is detected, and the detected traveling direction is made to substantially match a longitudinal direction or a diagonal direction of the map displayed.

[0008] By displaying in this manner, map information ahead of the traveling direction is displayed in

the longitudinal direction or the diagonal direction of the screen whereon the map is displayed, and it is thus possible to display a map in a favorable manner by taking advantage of the screen shape of the prepared display means.

[0009]

[Embodiment of Invention] One embodiment of the present invention will be described below with reference to drawings.

[0010] In the present embodiment, the present invention is applied to a navigation device mounted on a vehicle, which is a mobile body (in this case, an automobile), and the overall configuration thereof is illustrated in FIG. 1.

[0011] The configuration of the navigation device of the present example will be described below with reference to FIG. 1; a GPS antenna 11 is connected to a navigation device 10, and a signal received by the antenna 11 is supplied to a GPS signal processing unit 12. The GPS signal processing unit 12 performs reception processing for a positioning system called a GPS (Global Positioning System). That is, a GPS positioning signal transmitted from a plurality of positioning satellites is received, data contained in the signal are analyzed, and data on the current position (latitude, longitude, altitude) are obtained. Data on a current position obtained by the GPS signal processing unit 12 are supplied to a system controller 13.

[0012] The system controller 13 is a controller that performs control to display a road map in a vicinity of the measured current position, and, when positioning data of a position is obtained from the GPS signal processing unit 12, sends a command to a CD-ROM control unit 14 to read the road map in the vicinity of the corresponding position. The CD-ROM control unit 14 controls reading of map data from a CD-ROM (here, this is a map disk on which road map data is recorded) 16 installed on a CD-ROM driver 15, and the map data that has been read is stored in a memory 17 connected to the system controller 13. Note that the system controller 13 also determines a traveling direction of the vehicle based on, for example, a detected change in the current position or information from an autonomous navigation unit 20, which will be described later.

[0013] The road map data stored on the map disk 16 is constituted by, for example, data on the coordinate positions of a start point and an end point of each road, and vector data connecting the start point and the end point. Furthermore, affiliated data necessary when displaying the road map is also stored on the map disk 16.

[0014] When the map data read from the map disk 16 is transferred to the memory 17, the system controller 13 performs processing to render a road map of a predetermined range in the map data and use it as a map display signal. Next, the road map data that has been rendered into a predetermined map display signal is supplied to the video processing unit 19, a video signal is supplied as a video signal in a predetermined format for display (for example, an RGB signal) to a display device 30 connected to the navigation device 10, and the road map is displayed on the display device 30. Here, a screen of the display device 30 has an aspect ratio of 9:16 in landscape orientation, and a liquid crystal display panel is used therefor.

[0015] Note that a key 18, which is an operation input unit of the navigation device, is connected to the system controller 13, and a road map based on a mode set by operating the key 18 is displayed. For example, a display range, a display scale, a display direction, and the like of the map may be set by key input.

[0016] Furthermore, the autonomous navigation unit 20 is connected to the navigation device 10 of the present embodiment so that positioning can be performed even if a GPS positioning signal from a man-made satellite cannot be received for some reason. That is, the autonomous navigation unit 20 is provided with a vehicle speed sensor 21 that counts vehicle speed pulses proportional to a speed of

the vehicle output from an automobile engine control computer, an angular velocity sensor 22 as an orientation sensor, and an autonomous navigation control unit 23 that performs positioning of the current position based on an output from both sensors 21 and 22, and is configured to perform positioning of the current position. The positioning result is supplied to the system controller 13 of the navigation device 10.

[0017] Here, one example of a state in which the navigation device 10 of the present embodiment is installed in an automobile will be described with reference to FIG. 2; as illustrated in FIG. 2, the navigation device 10 or the autonomous navigation unit 20 is fixed to a predetermined space, such as a trunk of an automobile 50, and the display device 30 constituted by a liquid crystal display device is disposed on a dashboard next to a steering wheel 51 in front of a driver's seat 52. Here, the key 18 is attached to a side of the steering wheel 51. Furthermore, the vehicle speed sensor 21 of the autonomous navigation unit 20 is attached to an engine control computer (not illustrated) in an engine compartment.

[0018] Next, a process when displaying a map in the vicinity of the current position using the navigation device of the present embodiment will be described. The process under the control of the system controller 13 when performing the map display process of the present embodiment will be described according to the flowchart in FIG. 3; first, based on information from the GPS signal processing unit 12 or the autonomous navigation unit 20, the orientation of the vehicle in the traveling direction is calculated (step 101), and the current position of the vehicle is calculated (step 102). Then, processing is performed to set the calculated orientation of the traveling direction to a direction that substantially matches a longitudinal direction of the screen displayed as a map, and to set display coordinates of the map (step 103). In the case of the present embodiment, the screen of the connected display device 30 has an aspect ratio of 9:16 in landscape orientation; therefore, the orientation of the traveling direction is set to a lateral direction (horizontal direction) of the screen.

[0019] When the display coordinates are set, a map display range is set based on the set display coordinates and the calculated current position, and the road map data of the map display range is read from the memory 17 (when there is no road map data for the corresponding range in the memory 17, data is read from the map disk 16 and transferred) and processed as a map display signal for rendering a map (step 104). In the present embodiment, when setting the map display range, the current position of the vehicle on the map is shifted from the center of the screen to the direction opposite to the traveling direction.

[0020] The map display signal thus created by the system controller 13 is supplied to the video processing unit 19, whereby it is converted into a video signal in a predetermined format, and a road map is displayed on the display device 30.

[0021] Here, the relationship between the traveling direction of the vehicle and the display direction on the map is illustrated in FIG. 4; in FIG. 4, the vertical axis X is a vertical direction (perpendicular direction) of the screen and the horizontal axis Y is a horizontal direction (lateral direction) of the screen, and when an angle between the traveling direction on the screen and the X axis is α and an angle between the actual traveling direction and the X axis is θ , the traveling direction on the screen may be performed according to $\theta - \alpha$. Note that here, the angle α between the traveling direction on the screen and the X axis is set to 90° , and the axis indicating the traveling direction on the screen and the horizontal axis Y match (both axes have been shifted in FIG. 4 to facilitate understanding of the description.)

[0022] The road map data stored in the map disk 16 is, for example, map data based on vector data where the vertical axis X represents the north-south direction and the horizontal axis Y represents the east-west direction, and the display coordinates indicated by the vertical axis X' and the horizontal

axis Y' of the map in the direction actually displayed corresponding to the traveling direction of the vehicle are set according to the following determinant [Equation 1].

[0023]

[Equation 1]

$$\begin{bmatrix} X' \\ Y' \end{bmatrix} = \begin{bmatrix} \cos(\theta - \alpha) & \sin(\theta - \alpha) \\ -\sin(\theta - \alpha) & \cos(\theta - \alpha) \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix}$$

[0024] FIG. 5 illustrates an example in which the display range of the map is set in this manner. FIG. 5 is an example in which a road map in the vicinity of the current position is displayed on the display device 30 that is provided with a screen 31 in landscape orientation, where a ratio of a vertical V₁ and a horizontal H₁ of the screen 31 is set to 9:16 and an orientation display 32 is displayed at a corner of the screen 31 (here, north is indicated in the upper right). As for the road map displayed on the screen 31, the traveling direction is indicated by a vertex serving as the most acute angle at a mark m on a triangle shape indicating the position of the vehicle, the traveling direction matches the lateral direction (horizontal direction) of the screen 31, and here the right side is set to the front. In this case, a distance a₁ at which the map ahead of the traveling direction is displayed when viewed from the mark m indicating the position of the vehicle is set to be significantly longer than a distance b₁ at which the map on the opposite side to the traveling direction is displayed.

[0025] Displaying the road map in this manner results in the road map ahead of the traveling direction to be displayed in a wide area, thereby making it possible to easily confirm the route on which the vehicle will travel. For example, when the aspect ratio of the screen on which the map is displayed is 9:16 and the center of the screen is set as the current position, as in the present embodiment, the map is displayed having the longitudinal direction (here, the lateral direction) of the screen set to the traveling direction, which results in the amount of information being displayed ahead of the traveling direction to be increased by approximately 1.8 times in comparison to a conventional navigation device where the map is always displayed having the traveling direction set to the top of the screen. Moreover, in the present embodiment, since the distance at which the road ahead of the traveling direction is displayed is set to be substantially longer than the distance at which the road on the opposite side to the traveling direction is displayed, the amount of information on the map ahead of the traveling direction is further increased. Note that even when the display device has a screen aspect ratio of 3:4, the map is displayed having the longitudinal direction (lateral direction) of the screen set to the traveling direction, which results in the amount of information being displayed ahead of the traveling direction to be increased by approximately 1.3 times in comparison to when the traveling direction is always set to the top of the screen.

[0026] Increasing the amount of information displayed ahead of the traveling direction makes it possible to easily confirm the next road to proceed on from the displayed screen. Furthermore, increasing the amount of information displayed ahead of the traveling direction to more than is conventional reduces the frequency of performing a scroll operation to change the range of the displayed map or an operation to change the scale of the map to see the upcoming road in comparison to what is conventional, and the operability of the navigation device is also improved.

[0027] Note that in the display example in FIG. 5, the map is displayed having the right side of the screen set to the traveling direction, but the map may be displayed having the left side set to the same. Furthermore, a user may be able to set which side in the longitudinal direction of the screen (here, the right or the left) is ahead of the traveling direction by setting the mode via operating the key 18 or the like.

[0028] In the above description, a case where the longitudinal direction of the screen of the display device 30 is set to a lateral direction was described; however, the display device 30 may be installed

having the vertical direction as the longitudinal direction, and the map may be displayed having the longitudinal direction (perpendicular direction) of the display device 30 as the traveling direction. FIG. 6 illustrates a display example in this case, where the installation direction of the display device 30 is changed by 90 degrees from the case illustrated in FIG. 5, and the ratio of a vertical V_2 to a horizontal H_2 of the screen 31 is 16:9; therefore, the longitudinal direction of the screen is the perpendicular direction of the screen 31, and the traveling direction of the vehicle is set in the perpendicular direction (vertical direction) of the screen. Furthermore, in the case of FIG. 6, a distance a_2 at which the map ahead of the traveling direction is displayed when viewed from the mark m indicating the position of the vehicle is set to be significantly longer than a distance b_2 at which the map on the opposite side to the traveling direction is displayed. Note that in the example in FIG. 6, the upper side of the perpendicular direction, which is the longitudinal direction, is the traveling direction, but the map may be displayed having the lower side of the screen as that ahead of the traveling direction.

[0029] Furthermore, the present invention may also be applied to a case where the map is not displayed on the entire screen 31 of the display device 30 and the display range of the map is limited to, for example, half of the screen 31. For example, as illustrated in FIG. 7, when a left half 31a of the screen 31 set to landscape orientation serves as the map display range and a right half 31b is set as another information display range, based on the ratio of a vertical V_3 to a horizontal H_3 of a map display range 31a (here, 9:8), processing is performed so that the map is displayed where the vertical direction (perpendicular direction) becomes the longitudinal direction and the vertical direction is set as the traveling direction. In this case, a distance a_3 at which the map ahead of the traveling direction is displayed when viewed from the mark m indicating the position of the vehicle is set to be significantly longer than a distance b_3 at which the map on the opposite side to the traveling direction is displayed.

[0030] It is conceivable to perform various types of traffic guidance by displaying the information displayed on the right half 31b of the screen 31, such as traffic information (including, for example, information on congested areas and parking space availability information) obtained by receiving FM multiplex broadcast signals and receiving infrared signals and radio waves from optical beacons, radio beacons, and the like. Alternatively, information not directly related to road guidance may be displayed on the right half 31b of the screen 31. Processing for achieving such a display mode is performed under the control of the system controller 13. Note that although the example here indicates that the screen is divided in half to display the map, the range in which the map is displayed may be set in a different state.

[0031] Furthermore, the map may be displayed having the traveling direction of the vehicle set to a direction that substantially matches the direction of a diagonal line displayed on the screen. For example, as illustrated in FIG. 8, the mark m indicating the current position of the vehicle is positioned on a diagonal line from a lower left corner 31c to an upper right corner 31d of the display screen 31 of the display device 30, and the current traveling direction of the vehicle is set from its current position to point toward the upper right corner 31d. Furthermore, in this case, a distance a_4 on a diagonal line at which the map ahead of the traveling direction is displayed when viewed from the mark m at the current position of the vehicle is set to be significantly longer than a distance b_4 on a diagonal line at which the map on the opposite side to the traveling direction is displayed.

[0032] Displaying a map in which the traveling direction matches the direction of the diagonal line in this manner makes it possible to further increase the amount of information displayed ahead of the traveling direction than when displaying a map having the longitudinal direction of the screen as the traveling direction. It is possible to display approximately twice as much information ahead of the

traveling direction compared to the case where the aspect ratio of the screen is 9:16 and the map is displayed having the top of the screen as the traveling direction.

[0033] In the example in FIG. 8, the traveling direction is set on a diagonal line from the bottom left to the top right of the screen, but the map may be displayed having the traveling direction set on a diagonal line from the bottom right to the top left of the screen. Moreover, the direction in which the vehicle proceeds may be set in any direction on the diagonal line. The user may also be able to select these display directions by operating keys on the navigation device. Furthermore, when displaying a map where the range displayed is limited to a portion of the screen (for example, when displaying as a split screen as in the example in FIG. 7), the traveling direction may be set on the diagonal line of the displayed map.

[0034] Note that in the foregoing embodiment, the present invention is applied to a case where a navigation device installed in an automobile detects the current position and displays a road map in the vicinity of that position; however, naturally, the present invention may also be applied to a navigation device for another mobile body.

[0035]

[Effect of Invention] According to the present invention, map information ahead of the traveling direction is displayed in the longitudinal direction or the diagonal direction of the screen whereon the map is displayed; therefore, the map ahead of the traveling direction is displayed in a wide manner on the screen, and a map having favorable navigation by taking advantage of the screen shape of the prepared display means is displayed.

[0036] In this case, displaying the detected traveling direction side in a wide manner along the longitudinal direction or the diagonal direction of the map from the display position indicating the position of the detected mobile body makes it possible to display the map ahead of the traveling direction in a wider manner on the screen and to obtain even more favorable navigation.

[0037] Furthermore, in the case described above, limiting the range in which the map is displayed to one portion of the display screen and making the longitudinal direction or diagonal direction of the limited map display range substantially match the traveling direction results in the map ahead of the traveling direction being displayed in a wider manner on the screen and to obtain even more favorable navigation, even when various other types of information are displayed on the screen at the same time.

[Brief Description of Drawings]

[FIG. 1] A block diagram illustrating a configuration of a device to which a first embodiment of the present invention is applied.

[FIG. 2] A perspective view illustrating a state in which a device to which the first embodiment is applied is attached to an automobile.

[FIG. 3] A flowchart showing map display processing according to the first embodiment.

[FIG. 4] A descriptive diagram illustrating the relationship between a traveling direction and a display direction when displaying a map according to the first embodiment.

[FIG. 5] A descriptive diagram illustrating a map display example (example of a screen in landscape orientation) according to the first embodiment.

[FIG. 6] A descriptive diagram illustrating a map display example (example of a screen in portrait orientation) according to the first embodiment.

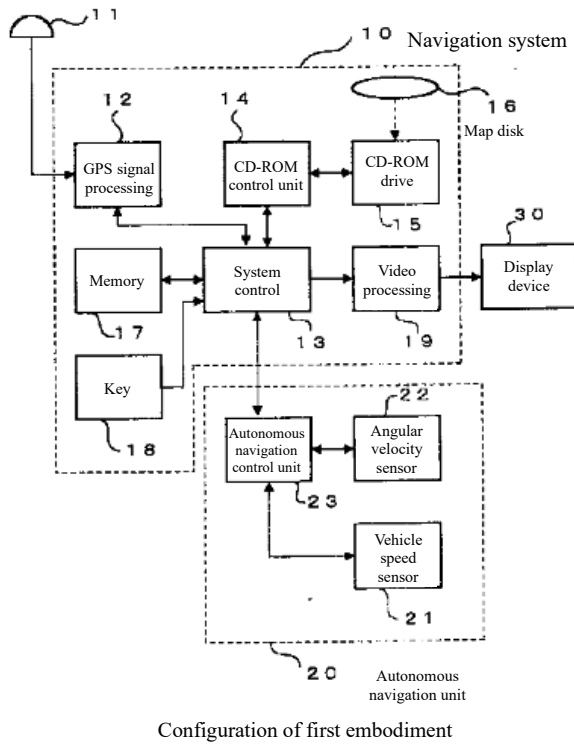
[FIG. 7] A descriptive diagram illustrating a map display example (example of a split display screen) according to the first embodiment.

[FIG. 8] A descriptive diagram illustrating a map display example (where the traveling direction is set to a diagonal direction) according to another embodiment of the present invention.

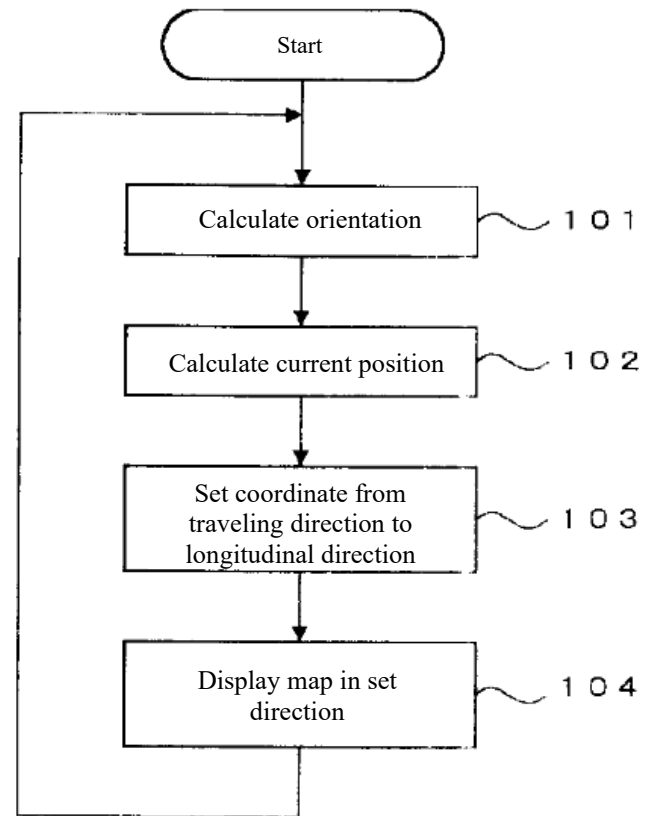
[Description of Reference Numerals]

10 Navigation device, 12 GPS signal processing unit, 13 system controller, 14 CD-ROM control unit, 15 CD-ROM driver, 16 map disk, 17 memory, 18 key, 19 video processing unit, 20 autonomous navigation unit, 21 vehicle speed sensor, 22 angular velocity sensor, 23 autonomous navigation control unit, 30 display device

[FIG. 1]

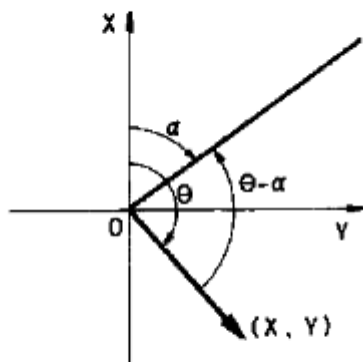


[FIG. 3]



Map display processing

[FIG. 4]



The relationship between the traveling direction α and the screen display direction θ

[FIG. 2]

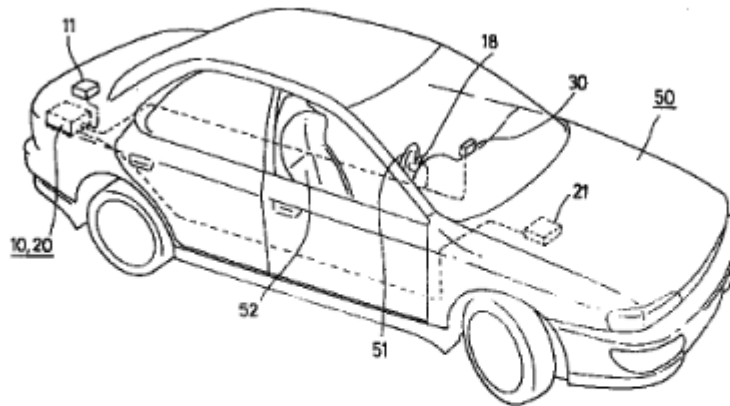
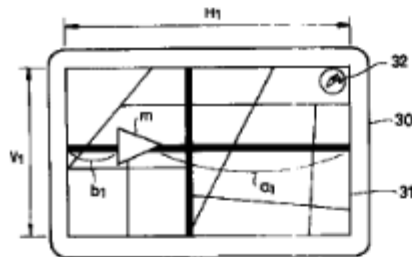


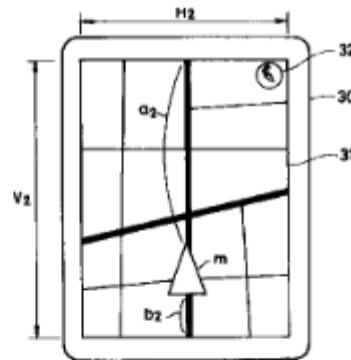
Diagram illustrating the example installed in a vehicle

[FIG. 5]



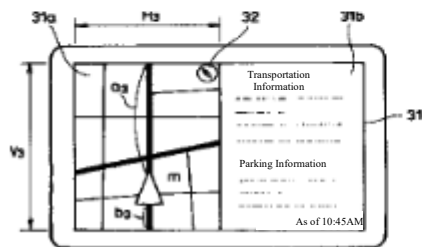
Display example

[FIG. 6]



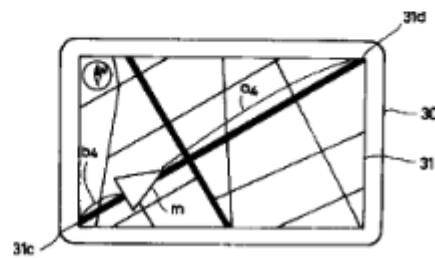
Display example

[FIG. 7]



Display example

[FIG. 8]



Display example