

DESCRIPTION

TITLE OF INVENTION: VEHICLE INFORMATION TERMINAL

5 CROSS-REFERENCE TO RELATED APPLICATIONS

[0001]

This application is based on Japanese Patent Application No. 2016-207043 filed on October 21, 2016, the disclosure of which is incorporated herein by reference.

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TECHNICAL FIELD

[0002]

The present disclosure relates to a vehicle information terminal including multiple antennas respectively corresponding to multiple kinds of communication systems.

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BACKGROUND

[0003]

Conventionally, a user or the like may attach an information process terminal to a car after shipment from a factory, in addition to a display and an input device. The information process terminal (also referred to as a vehicle information terminal) has a function of executing wireless communication with a predetermined communication device existing outside a vehicle. The vehicle information terminal corresponds to, for example, a portable type navigation apparatus (also referred to as a portable navigator).

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[0004]

As shown in Patent Literature 1, the portable navigator includes a display or the like. Additionally, the portable navigator includes a positioning function of a current position (also referred to as a GPS function) with a GPS antenna. The GPS antenna receives a navigation signal transmitted from a positioning satellite employed for GPS (global positioning system), and thereby the positioning of the current position is provided. The GPS function

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corresponds to a function executing communication with a communication station existing outside the vehicle compartment.

PRIOR ART LITERATURE

5 PATENT LITERATURE

[0005]

Patent Literature 1: JP 2011-209017 A

SUMMARY OF INVENTION

10 [0006]

In recent years, there is a demand for providing multiple communication functions such as DSRC (dedicated short range communications), Bluetooth (registered trademark) in order to improve a functionality of a vehicle information terminal.

15 [0007]

However, in order to install multiple communication functions in a vehicle information terminal, it may be necessary to arrange an antenna with respect to a carrier wave adopted in each communication system, so that directivity of the antenna is oriented in a direction where a communication counterpart exists.

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[0008]

For example, it may be necessary to arrange a DSRC antenna, the directivity of which being oriented to the outside of the vehicle (particularly, in a zenith direction) since a communication counterpart exists outside the vehicle.

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The communication counterpart for the DSRC antenna corresponds to a communication device arranged above the road (so-called roadside machine).

[0009]

As a method for communicating with a portable terminal brought inside the vehicle by a user, Bluetooth is introduced to the vehicle information terminal.

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When Bluetooth is introduced, it is necessary to arrange a Bluetooth antenna so that the directivity of the Bluetooth antenna is oriented to the inside of the vehicle.

[0010]

When both the antenna for executing the wireless communication with a vehicle compartment outside device such as the DSRC antenna and the antenna for executing the wireless communication with the communication device existing inside the vehicle compartment are introduced to the vehicle information terminal, each of the antennas may be oriented in a different direction from each other. Therefore, a housing may enlarge when each of the antennas is arranged so that the directivities are oriented in appropriate directions.

[0011]

It is an object of the present disclosure to provide a vehicle information terminal configured to execute both a wireless communication with a vehicle outside device and a wireless communication with a vehicle compartment inside device and also downsize.

[0012]

According to one aspect of the present disclosure, a vehicle information terminal includes: a display that includes a display surface configured to display information to an occupant sitting on a driver's seat of a vehicle; a first substrate that is arranged in a side opposite to the display surface of the display to face the display; a second substrate that is arranged in a side in which the display does not exist from the first substrate; at least one vehicle compartment outside antenna configured to communicate with an upper communication device corresponding to a communication device existing above the vehicle; and a vehicle compartment inside antenna configured to execute direct communication with a vehicle compartment inside device existing inside a vehicle compartment, the direct communication conforming to a predetermined communication standard. The second substrate is arranged in an orientation in which an angle formed between the second substrate and a plane perpendicular to a vertical direction of the display is equal to 45 degrees or less. The first substrate includes a protrusion area that does not overlap with the display in a depth direction from the display to the first substrate. The vehicle compartment inside antenna is placed in the protrusion area of a display facing

surface in the first substrate facing the display. The vehicle compartment outside antenna is placed on an upper side surface of two surfaces of the second substrate, the upper side surface facing above when the vehicle information terminal is attached to the vehicle in an orientation with respect to the vertical direction of the display.

[0013]

According to the vehicle information terminal, restrictions to an antenna arrangement for securing gain and isolation between antennas are eased. The vehicle information terminal can be downsized while executing the wireless communication with the vehicle compartment outside device and the narrow area communication with the vehicle compartment inside device.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

The above and other objects, features and advantages of the present disclosure will become more apparent from the following detailed description made with reference to the accompanying drawings. In the drawings:

FIG. 1 is a view illustrating an example of attachment of a portable navigator to a vehicle;

FIG. 2 is a diagram showing a schematic configuration of the portable navigator;

FIG. 3 is a cross-sectional view of the portable navigator viewed from a side;

FIG. 4 is a view explaining a positional relation among a display, a first substrate, and a BLE antenna;

FIG. 5 is a diagram showing an arrangement example of the antenna having a communication counterpart outside a vehicle compartment;

FIG. 6 is a view illustrating a positional relation between a main case and a holder case;

FIG. 7 is a view explaining an effect of the configuration illustrated in FIG. 6;

FIG. 8 is a view illustrating a modified example of the portable navigator used with attached to a windshield;

FIG. 9 is a view illustrating a modified example of the portable navigator used with attached to a windshield;

5 FIG. 10 is a view illustrating an example of attachment of the portable navigator to the vehicle;

FIG. 11 is a view illustrating a schematic configuration of the portable navigator used with attached to a dashboard;

10 FIG. 12 is a view illustrating a configuration of the portable navigator used by being attached to a bar-type handlebar;

FIG. 13 is a perspective view of a handlebar attachment portion; and

FIG. 14 is a side view of the handlebar attachment portion.

DESCRIPTION OF EMBODIMENTS

15 [0015]

As one example of an embodiment according to the present disclosure, a portable type navigation apparatus (also referred to as a portable navigator) 100 according to the present disclosure will be described with the drawings.

20 FIG. 1 is a view illustrating one example of an attachment state of the portable navigator 100 to a vehicle. The portable navigator 100 is used with attached to a windshield 200 of the vehicle or the like so that a display surface of a display 11 is oriented to a driver's seat.

[0016]

(Function of portable navigator)

25 Various functions of the portable navigator 100 will be schematically described before a configuration of the portable navigator 100 is described. The portable navigator 100 corresponds to a device having a function as a known navigation apparatus that executes route navigation or the like (also referred to as a navigation function). The portable navigator 100 has a function
30 of executing positioning of a current position (also referred to as a GNSS function) based on a navigation signal, as a subfunction to implement the navigation function. The navigation signal is transmitted from a positioning

satellite used in GNSS (global navigation satellite system). The GNSS corresponds to GPS (global positioning system), Galileo, GLONASS, or the like.

[0017]

5 The portable navigator 100 has a wide area communication function, a narrow area communication function, and a short distance communication function, in addition to the navigation function or the GNSS function. The wide area communication function executes a communication with a communication device (for example, a center) existing outside the vehicle compartment by wirelessly accessing to a wide area communication network such as a mobile
10 phone network. Conveniently, communication via the wide area communication network may be referred to as a wide area communication in order to distinguish from communication conforming to the other system. Any movable body communication system can be employed as a communication system implementing the wide area communication. As one example, the portable
15 navigator 100 executes the wide area communication conforming to a LTE (registered trade mark) standard.

[0018]

The narrow area communication function conforms to a predetermined communication system, and executes the wireless communication with a facility
20 arranged on a road (also referred to as a roadside machine) not via a wireless base station (that is, directly). As a communication system implementing the narrow area communication function, for example, the DSRC (dedicated short range communication) conforming to a wireless LAN technology, WAVE (wireless access in vehicular environment) standard disclosed in IEEE1609 or
25 the like can be employed. The portable navigator 100 is configured to communicate with the roadside machine or the like by the DSRC.

[0019]

The roadside machine is placed above the road (for example, a height of a position is 6 meters from a road surface) so as to broadcast information to
30 a limited area on the road. That is, the roadside machine corresponds to the communication device placed at a higher position than a roof portion of the vehicle. The information broadcasted by the roadside machine corresponds to,

for example, road traffic information such as congestion or accident, safe driving support information, or the like. The roadside machine may correspond to a communication facility configuring an automatic toll collection system. The automatic toll collection system is placed at a gate of a toll road, and executes an adjustment process of usage fee for the toll road.

[0020]

The narrow area communication function may execute the communication with the communication device that is installed in another vehicle and provides the narrow area communication function. That is, the narrow area communication function may provide a vehicle-to-vehicle communication. The GNSS satellite or the roadside machine corresponds to an upper communication device existing above the vehicle.

[0021]

The short distance communication function executes communication conforming to a predetermined short distance wireless communication standard (also referred to as a short distance communication). As the short distance wireless communication standard, for example, Bluetooth Low Energy (Bluetooth is the registered trademark), Wi-Fi (registered trademark) may be employed. As one example, the short distance communication is executed by Bluetooth Low Energy (also referred to as BLE). The short distance communication function is installed in the portable navigator 100 in order to communicate with the other communication terminal existing inside the vehicle compartment.

[0022]

The other communication terminal existing inside the vehicle compartment corresponds to a communication device that has a short distance communication function. The other communication terminal is other than the portable navigator 100 brought into the vehicle by the user. As the counterpart communicated by the short distance communication function of the portable navigator 100, for example, a smartphone, a tablet terminal, a wearable device, a portable audio player, a portable game machine, or the like is assumed. The counterpart communicated by the short distance communication function of the

portable navigator 100 corresponds to a communication terminal having the short distance communication function.

[0023]

(Configuration of portable navigator)

5 One example of a configuration of the portable navigator 100 to implement each kind of functions will be described. The portable navigator 100 includes two cases of a main case 1 and a holder case 2. An arm 3 connects the two cases, as shown FIG. 2 and FIG. 3. Conveniently, a direction from the main case 1 to the holder case 2 may be referred to as a depth direction. An
10 arrow of FIG. 3 indicates the depth direction. The main case 1 corresponds to a first housing. The holder case 2 corresponds to a second housing.

[0024]

 The main case 1 stores a display 11 and a first substrate 13. In the display 11, a touch panel 12 is stacked on a display surface 11A. The first
15 substrate 13 corresponds to a printed substrate where various electronic components are arranged. On the first substrate 13, a display controller 131, a touch panel controller 132, a BLE antenna 133, a BLE module 134, a main control portion 135, a power supply circuit 136, and a main side connector 137 are arranged. The BLE antenna 133 corresponds to a vehicle compartment
20 inside antenna.

[0025]

 A shape of the main case 1 may be appropriately designed. As one example, the main case 1 is formed in a flat rectangular parallelepiped shape. In the flat rectangular parallelepiped shape, a direction perpendicular to the first
25 substrate 13 corresponds to a thickness direction. A thickness of the main case 1 may be designed to a necessary and sufficient magnitude so that the main case 1 can accommodate predetermined accommodation targets such as the display 11, the touch panel 12, the first substrate 13, or the like. The thickness direction corresponds to the depth direction.

30 [0026]

 In a surface (also referred to as a main surface) 1A of surfaces perpendicular to the thickness direction of the main case 1, an opening portion

is placed in order to expose the display surface 11A of the display 11. A first end of the arm 3 is connected to a surface (also referred to as a main rear surface) 1B opposite to the main surface 1A in the main case 1. In a part of the main rear surface 1B is connected to the arm 3, a hole is formed in order to pass a flexible cable 4 therein. The arm 3 is a member in a cylindrical shape, and configured to internally pass the flexible cable 4. The flexible cable 4 corresponds to a cable 4.

[0027]

The portable navigator 100 is an apparatus used on a precondition that the display surface 11A of the display 11 is oriented to the driver's seat. In the main case 1, upper, lower, right and left are set so as to correspond to a display direction of the display 11. As one example, in the main case 1, the surface perpendicular to the thickness direction (in other words, the surface parallel with the first substrate 13) is formed in a rectangle shape. In the rectangle shape, a length in a lateral direction for the portable navigator 100 is shorter than a length in a vertical direction.

[0028]

The portable navigator 100 is attached to the vehicle on a precondition that the lateral direction of the main case 1 is parallel with a horizontal plane (also referred to as a vehicle horizontal plane) and also the vertical direction matches with the vehicle height direction. A state indicated by the match is not limited to a state by a perfect match. The state indicated as the match includes a state where the vertical direction is shifted from the height direction of the vehicle and a person sitting on the driver's seat can recognize a display content of the display 11 without feeling discomfort. The vehicle horizontal plane corresponds to a plane perpendicular to the vehicle height direction. For example, the vehicle horizontal plane is a plane parallel with a floor portion of the vehicle.

[0029]

The user may decide an attachment position of the portable navigator 100 on the windshield 200. The portable navigator 100 is arranged in a peripheral visual field in a state where a line of sight of an occupant in the

driver's seat is in a vehicle front direction, particularly, in an effective visual field. In the embodiment, the portable navigator 100 is used on a precondition that (or in a state where) a height of an eye level of the occupant of the driver's seat is similar to with a height of the portable navigator 100.

5 [0030]

The holder case 2 stores a second substrate 21 corresponding to a printed substrate on which various electronic components are mounted. Specifically, a GNSS antenna 211, a GNSS module 212, a DSRC antenna 213, a DSRC module 214, a LTE antenna 215, a LTE module 216, and a holder side
10 connector 217 are arranged on the second substrate 21. Each of the GNSS antenna 211, the DSRC antenna 213, and the LTE antenna 215 corresponds to one example of the vehicle compartment outside antenna. The first substrate 13 and the second substrate 21 are connected by the flexible cable 4.

[0031]

15 A shape of the holder case 2 may be appropriately designed. As one example, the holder case 2 is formed in the flat rectangular parallelepiped shape. In the flat rectangular parallelepiped shape, a direction perpendicular to the second substrate 21 corresponds to a thickness direction. A thickness of the holder case 2 may be necessary and sufficient when the holder case 2 can
20 accommodate the second substrate 21 where the various electronic components are mounted.

[0032]

The main case 1 can change orientation (in other words, an angle) to the holder case 2. In the embodiment, as one example, an angle adjuster 31 is
25 placed at a connection portion of the arm 3 and the main case 1. The angle adjuster 31 can be implemented by a configuration such as a ball joint, for example.

[0033]

As another aspect, the angle adjuster 31 may be placed at the
30 connection portion of the arm 3 and the holder case 2. The angle adjuster 31 may be placed at both the connection portion of the arm 3 and the holder case 2 and the connection portion of the arm 3 and the main case 1.

[0034]

A movable range of the angle adjuster 31 may be designed to be approximately 45 degrees. In the embodiment, the arm 3 is configured so that the main case 1 is perpendicular to the holder case 2 when an angle adjustment amount by the angle adjuster 31 is set to 0 degree. Therefore, in a side view, the angle (also referred to as a pitch angle) θ formed between the main case 1 and the holder case 2 can be reduced to 45 degrees.

[0035]

However, in the embodiment, a direction in which the pitch angle θ increases cannot be set to a predetermined angle (for example, 110 degrees) or more due to an interference (in other words, contact) between cases. FIG. 3 illustrates a state where the pitch angle θ is adjusted to approximately 60 degrees. In the embodiment, a configuration that enables to adjust the angle of the main case 1 to the holder case 2 is described. However, the present disclosure is not limited to the configuration. The angle adjuster 31 may not be provided. The arm 3 supports the orientation of the main case 1 to the holder case 2.

[0036]

A surface (also referred to as a holder upper surface) 2A of the holder case 2 is relatively oriented to an upper side when the main case 1 is arranged in a correct orientation. The holder upper surface 2A corresponds to a surface (also referred to as an attachment surface) for attaching the portable navigator 100 to the windshield 200. The holder upper surface 2A corresponds to a housing upper surface.

[0037]

The correct attachment orientation is an attachment orientation that is assumed when the portable navigator 100 is designed. The correct attachment orientation corresponds to an orientation at which the display direction of the display 11 is correct and the display surface 11A of the display 11 is oriented to the driver's seat. Adhesion between the attachment surface and the windshield 200 may be implemented by employing a double sided tape, a suction cup, or the like.

[0038]

A second end of the arm 3 is connected to a surface (also referred to as a holder lower surface) 2B opposite to the holder upper surface 2A in the holder case 2. At a part of the holder lower surface 2B is connected to the arm 3, a
5 hole to pass the flexible cable 4 is provided. The holder lower surface 2B corresponds to a housing lower surface.

[0039]

The display 11 corresponds to a display device having the display surface 11A displaying various information. The display surface 11A of the
10 display 11 is formed in a rectangular shape. Appearance shape of the display 11 is also in a flat rectangular parallelepiped shape. Conveniently, in the display 11, a surface opposite to the display surface 11A is referred to as a rear surface. In the main case 1, a portion where the display surface 11A of the display 11 is arranged corresponds to the opening portion, and the main case 1
15 stores the display 11 so that the display surface 11A can be seen from the outside. A state where the display surface 11A can be seen from the outside may include a state where the occupant sitting on the driver's seat can see the display surface 11A.

[0040]

20 As the display 11, a liquid crystal display, an organic EL display, or the like can be employed. As one example, the display 11 is implemented by employing an LCD (liquid crystal display) module. The display 11 is driven based on a control signal from a display controller, and displays a control signal image.

25 [0041]

The touch panel 12 corresponds to, for example, a capacitive touch panel, and is stacked on the display surface 11A of the display 11. The touch panel 12 sequentially outputs to a touch panel controller 132, a signal indicating whether the touch panel 12 is touched by the user. The touch panel 12
30 sequentially outputs a signal indicating a touch position (also referred to as a touch position signal) when being touched.

[0042]

The touch panel 12 may correspond to a touch panel that detects the touch position of the user by a method other than a capacitive method (for example, a pressure-sensitive type). The configuration in which the touch panel 12 is employed as the device (that is, the input device) for the user to input instructions for the portable navigator 100 is described. However, the present disclosure is not limited to the configuration. A device such as a hardware switch, a mouse, a haptic device can be employed as an input device.

[0043]

The first substrate 13 corresponds to the printed substrate where the display controller 131, the touch panel controller 132, the BLE antenna 133, the BLE module 134, the main control portion 135, the power supply circuit 136, and the main side connector 137 are arranged. The first substrate 13 is formed in a substantially rectangular shape.

[0044]

The main case 1 stores the first substrate 13 so as to face the rear surface of the display 11 and partly protrude to the upper side of the display 11. That is, the first substrate 13 is arranged so as to form an area not overlapping with the display 11 in the depth direction (also referred to as a protrusion area).

[0045]

Conveniently, of the two surfaces of the first substrate 13, one surface that faces the rear surface of the display 11 may be referred to as a display facing surface 13A, and a surface opposite to the display facing surface 13A may be referred to as a back side surface 13B. A direction from the first substrate 13 to the display 11 may be referred to as a first substrate perpendicular direction. The one-dot chain line in FIG. 3 indicates the first substrate perpendicular direction.

[0046]

The display facing surface 13A is oriented to the driver's seat occupant when the portable navigator 100 is attached to the vehicle in a correct attachment orientation. The first board perpendicular direction corresponds to the direction to the driver's seat occupant when the portable navigator 100 is attached to the vehicle in the correct attachment orientation.

[0047]

The display controller 131 corresponds to a configuration element controlling an operation of the display 11. The display controller 131 is connected to the display 11 so as to communicate with each other via a cable (not shown). The display controller 131 is also connected to the main control portion 135 so as to communicate with each other. The display controller 131 generates a control signal based on the display data that is input from the main control portion 135, outputs the control signal to the display 11, and displays an image corresponding to the display data.

[0048]

The touch panel controller 132 corresponds to a configuration element for controlling the operation of the touch panel 12. The touch panel controller 132 is connected to the touch panel 12 so as to communicate with each other via a cable (not shown). The touch panel controller 132 is also connected to the main control portion 135 so as to communicate with each other. The touch panel controller 132 converts the touch position signal output from the touch panel 12 into data in a format that can be recognized by the main control portion 135, and provides the data to the main control portion 135.

[0049]

The BLE antenna 133 transmits and receives electric wave of a frequency band (that is, 2.4 GHz band) employed as a carrier wave in BLE. The BLE antenna 133 is electrically connected to the BLE module 134.

[0050]

The BLE module 134 demodulates the signal received by the BLE antenna 133, and provides the demodulated signal to the main control portion 135. The BLE module 134 modulates the data input from the main control portion 135, outputs the modulated data to the BLE antenna 133, and radiates the output data as an electric wave.

[0051]

The main control portion 135 is configured as a computer including a CPU 1351 as a central processing device, a RAM 1352 as a volatile memory,

and a ROM 1353 as a nonvolatile memory. The ROM 1353 stores various program in order to function a normal computer as the main control portion 135.

[0052]

5 The main control portion 135 provides the navigation function by the CPU 1351 executing vehicle program stored in the ROM 1353. The main control portion 135 generates display data displayed in the display 11 based on the program and data input from the other module such as the touch panel controller 132 or the BLE module 134. The main control portion 135 outputs the display data to the display controller 131. The main control portion 135 controls
10 a power supply of the portable navigator 100 to turn on or off by cooperating with the power supply circuit 136.

[0053]

The power supply circuit 136 converts a power supply voltage supplied from a power supply (not shown) to an operation voltage suitable for the
15 operation of each portion of the portable navigator 100. The operation voltage generated by the power supply circuit 136 is supplied to each portion. The power supply may be a battery included in the portable navigator 100 or an onboard battery. When the onboard battery is employed as the power supply of the portable navigator 100, the portable navigator 100 is connected to the
20 onboard battery by a power supply cable (not shown).

[0054]

The main side connector 137 electrically connects the flexible cable 4 to the first substrate 13. That is, the first substrate 13 is connected to a first end of the flexible cable 4 via the main side connector 137. The second end of the
25 flexible cable 4 is electrically connected to the second substrate 21 via the holder side connector 217. When not distinguishing the main side connector 137 and the holder side connector 217, the main side connector 137 and the holder side connector 217 may be described as a connector.

[0055]

30 It may be appropriately designed that each of the display controller 131, the touch panel controller 132, the BLE module 134, the main control portion

135, the power supply circuit 136, and the main side connector 137 is arranged at any position on the first substrate 13.

[0056]

However, as shown in FIG. 3 and FIG. 4, the BLE antenna 133 is
5 arranged so that the center of the directivity matches with the first substrate perpendicular direction within the protrusion area of the display facing surface 13A. The match is not limited to the perfect match. The center of the directivity may be shifted from the first substrate perpendicular direction by approximately 45 degrees. The center of the directivity of the BLE antenna 133 is oriented in
10 the first substrate perpendicular direction.

[0057]

The second substrate 21 is formed in the substantially rectangular shape and housed in the holder case 2 so as to face the holder upper surface 2A. The second substrate 21 includes an upper side surface 21A relatively
15 oriented to the upper side and a lower side surface 21B relatively oriented to the lower side when the main case 1 is arranged in the correct orientation. The direction from the lower side surface 21B to the upper side surface 21A may be referred to as a second substrate perpendicular direction. The two-dot chain line in FIG. 3 indicates the second substrate perpendicular direction. The
20 second substrate perpendicular direction corresponds to a direction from the second substrate 21 to the holder upper surface 2A.

[0058]

The GNSS antenna 211 receives the navigation signal transmitted by a positioning satellite of the GNSS (also referred to as a GNSS satellite). For
25 example, the GNSS antenna 211 may receive a circular polarized wave of the 1.5 GHz band. The GNSS antenna 211 is electrically connected to the GNSS module 212, and outputs an electric signal corresponding to the received electric wave.

[0059]

30 The GNSS antenna 211 is arranged on the upper side surface 21A so that the center of the directivity is oriented in the second substrate perpendicular direction. The state where the center of the directivity is oriented

in the second substrate perpendicular direction is not limited to a state where the center of the directivity completely matches with the second substrate perpendicular direction. The center of the directivity may be shifted from the second substrate perpendicular direction by approximately 45 degrees. The
5 GNSS antenna 211 corresponds to a positioning antenna.

[0060]

The GNSS module 212 executes a calculation process such a positioning process of the current position based on the signal received by the GNSS antenna 211. The GNSS module 212 is connected to the holder side
10 connector 217. The GNSS module 212 is connected to the main control portion 135 via the holder side connector 217, the flexible cable 4, or the like so as to communicate with each other. A place where the GNSS module 212 is installed on the second substrate 21 may be designed appropriately. For example, on the lower side surface 21B, the GNSS module 212 may be arranged in
15 peripheral of a back side position corresponding to a position of the GNSS antenna 211. The GNSS antenna 211 and the GNSS module 212 correspond to a configuration in order to implement the GNSS function.

[0061]

The DSRC antenna 213 transmits and receives an electric wave of a
20 frequency band (for example, 5.8 GHz band) employed as a carrier wave in DSRC. The DSRC antenna 213 is placed on the upper side surface 21A so that the center of the directivity is oriented in the second substrate perpendicular direction. The DSRC antenna 213 is electrically connected to the DSRC module 214. The DSRC antenna corresponds to a narrow area
25 communication antenna.

[0062]

The DSRC module 214 is connected to the main control portion 135 via the holder side connector 217, the flexible cable 4, or the like. The DSRC module 214 demodulates the signal received by the DSRC antenna 213, and
30 provides demodulated signal to the main control portion 135. The DSRC module 214 demodulates the data input from the main control portion 135, outputs the demodulated data to the DSRC antenna 213, and radiates as the

electric wave. A place where the DSRC module 214 is installed on the second substrate 21 may be designed appropriately. For example, on the lower side surface 21B, the DSRC module 214 may be arranged in peripheral of a back side position corresponding to a position of the DSRC antenna 213. The DSRC antenna 213 and the DSRC module 214 correspond to a configuration in order to implement the narrow area communication function.

[0063]

The LTE antenna 215 transmits and receives the electric wave of a frequency band employed as a carrier wave in the LTE standard. The LTE antenna 215 is placed on the upper side surface 21A so that the center of the directivity is oriented in the second substrate perpendicular direction. In this embodiment, as shown in FIG. 5, the two LTE antennas 215 are placed on the upper side surface 21A for multiple-input and multiple-output (MIMO). The LTE antenna 215 is electrically connected to the LTE module 216.

[0064]

The LTE module 216 is connected to the main control portion 135 via the holder side connector 217, the flexible cable 4, or the like. The LTE module 216 demodulates the signal received by the LTE antenna 215, and provides demodulated signal to the main control portion 135. The LTE module 216 demodulates the data input from the main control portion 135, outputs the demodulated data to the LTE antenna 215, and radiates as the electric wave. A place where the LTE module 216 is installed on the second substrate 21 may be designed appropriately. For example, on the lower side surface 21B, the LTE module 216 may be arranged in peripheral of a back side position corresponding to a position of the LTE antenna 215.

[0065]

The holder side connector 217 electrically connects the flexible cable 4 with the second substrate 21. That is, the second substrate 21 is connected to the first end of the flexible cable 4 via the holder side connector 217. Thereby, the second substrate 21 and the first substrate 13 are electrically connected. The holder side connector 217 may be arranged in the peripheral of the

connection portion of the holder lower surface 2B and the arm 3 on the lower side surface 21B, for example.

[0066]

5 An arrangement aspect of each kind of the antennas on the upper side surface 21A shown in FIG. 5 is one example. A specific arrangement aspect may be appropriately designed so that interference between the antennas is difficult to occur. Each kind of the antennas may be planar antennas such as a patch antenna and a planar inverted-F antenna. Due to the configuration in the arrangement aspect, it may be possible to reduce the thickness of the holder
10 case 2.

[0067]

In the configuration, the inclination by the holder case 2 to the vehicle horizontal plane is 45 degrees or less when the portable navigator 100 is attached in the correct orientation. The angle formed between the second
15 substrate perpendicular direction and the zenith direction is also 45 degrees or less. A component obtained by projecting the second substrate perpendicular direction in the zenith direction is greater than a component obtained by projecting in the horizontal direction. The second substrate perpendicular direction can be oriented in the zenith direction rather than the horizontal
20 direction.

[0068]

The GNSS antenna 211 is arranged on the upper side surface 21A of the second substrate 21 so that the center of the directivity is oriented in the second substrate perpendicular direction. The directivity of the GNSS antenna
25 211 is oriented in the direction where the GNSS satellite corresponding to the communication counterpart with the GNSS antenna 211 exists. It may be possible to satisfactorily receive the electric wave from the GNSS satellite.

[0069]

The directivity of the DSRC antenna 213 and the LTE antenna 215 are
30 also oriented in the direction where the communication counterpart exists. It may be easy to receive the electric wave from the communication counterpart. The communication counterpart for the DSRC antenna 213 corresponds to the

roadside machine. The communication counterpart for the LTE antenna 215 corresponds to a wireless base station. In the configuration, it may be possible to improve a communication quality for the wireless communication with communication device existing outside the vehicle compartment such as the

5 GNSS satellite, the roadside machine, or the wireless base station.

[0070]

When the portable navigator 100 is attached in the correct orientation, the inclination by the main case 1 to the vehicle horizontal plane is 90 degrees, and the first substrate perpendicular direction is oriented to a vehicle

10 compartment inside space including the driver's seat. The BLE antenna 133 is placed on the display facing surface 13A so that the center of the directivity is oriented in the first substrate perpendicular direction.

[0071]

The directivity of the BLE antenna 133 is oriented to the vehicle

15 compartment inside space including the driver's seat when the portable navigator 100 is attached in the correct orientation. Generally, the display 11 may shield the electric wave. However, the BLE antenna 133 is placed in the protrusion area of the display facing surface 13A. It may be possible to satisfactorily receive the electric wave from the portable terminal existing in the

20 vehicle compartment inside space. In the configuration, it may be possible to improve the quality for the short distance wireless communication with the communication device existing inside the vehicle compartment such as the portable terminal carried by the user.

[0072]

25 There may be tendency that the housing may enlarge in order to secure the isolation between antennas, when multiple kinds of the wireless communication functions are installed in one information process terminal. In the embodiment, it may be possible to separately arrange the multiple kinds of the antennas in each of the main case 1 and the holder case 2. It may be

30 possible to ease the restrictions for the antenna arrangement for securing the isolation. It may be possible to easily downsize the vehicle information terminal.

[0073]

In the configuration, the vehicle information terminal can be downsized while providing both the wireless communication with the vehicle compartment outside device and also the narrow area communication with the vehicle compartment inside device. It may be easy to secure a clearance for each module providing the communication function. It may be possible to reduce the possibility that the signal of the communication module acts as the noise for the communication module.

[0074]

The configuration that orientation of the main case 1 to the holder case 2 is adjustable is described. The orientation of the main case 1 to the holder case 2 may not be adjustable. When the orientation of the main case 1 to the holder case 2 is not adjustable, the arm 3 or the like is configured so that the entire holder case 2 is positioned between the upper end and the lower end of the main case 1, as shown in FIG. 6. The one-dot chain line in FIG. 6 indicates the position of the upper end portion of the main case 1, and the two-dot chain line indicates the position of the lower end portion of the main case 1. The holder case 2 is positioned between the one-dot chain line and the two-dot chain line.

[0075]

When a part of the holder case 2 is arranged so as to protrude to the upper side from the one-dot chain line, a possibility of preventing the front view of the occupant sitting on the driver's seat may occur as shown in FIG. 7. Similarly, in a case where the orientation of the main case 1 to the holder case 2 is adjustable, it may be preferable that the portable navigation system 100 is attached so that the holder case 2 is hidden behind the main case 1 as seen from the occupant in the driver's seat. The angle adjuster 31 and the arm 3 are configured so that the user can install in such an orientation.

[0076]

In the vehicle information terminal, when the vertical direction of the display matches with the vehicle height direction and also the orientation in which the display surface faces the driver's seat (also referred to as the correct orientation), the inclination of the second substrate to the vehicle horizontal

plane is equal to 45 degrees or less. The vehicle horizontal plane corresponds to the plane perpendicular to the vehicle height direction.

[0077]

5 The vehicle height direction matches with the zenith direction when the vehicle exists on a horizontal road. The upper surface of the second substrate is oriented in the zenith direction when the vehicle exists on the horizontal road.

[0078]

10 In the vehicle information terminal, the vehicle compartment outside antenna is arranged on the upper surface of the second substrate. The directivity of the vehicle compartment outside antenna is oriented in the zenith direction when the vehicle information terminal is attached to the vehicle in the correct orientation. The vehicle compartment outside antenna can satisfactorily receive the electric wave from the upper communication device existing above the vehicle.

15 [0079]

The first substrate is arranged in the rear surface side of the display so as to face the display. The display facing surface of the first substrate is oriented to the driver's seat when the vehicle information terminal is attached to the vehicle in the correct orientation. The directivity of the vehicle compartment
20 inside antenna is oriented to the vehicle compartment inside driver's seat direction.

[0080]

25 The vehicle compartment inside antenna is placed in the protrusion area of the display facing surface. The vehicle compartment inside antenna can satisfactorily receive the electric wave from the vehicle compartment inside device brought inside the vehicle compartment by the user. It may be possible to reduce the possibility that the display shields the electric wave from the vehicle compartment inside device by placing the vehicle compartment inside antenna in the protrusion area. In the configuration, it may be possible to
30 provide both the wireless communication with the communication device existing above the vehicle and also the communication with the vehicle compartment inside device.

[0081]

There may be a tendency that the housing enlarges in order to secure the gain or the isolation between antennas when multiple kinds of the wireless communication functions are installed in one substrate. It may be possible to
5 separately arrange the multiple kinds of the antennas in each of the two substrates arranged in a different orientation.

[0082]

Members having the same functions as the members described in the above embodiment are described by the same reference numerals, and
10 description thereof is omitted. When only a part of the configuration is described, the configuration described in the above embodiment can be applied to the other part.

[0083]

(First modification)

15 Though the embodiment includes the configuration that the portable navigator 100 includes the two cases of the main case 1 and the holder case 2, the present disclosure is not limited to this. As shown in FIG. 8, the first substrate 13 and the second substrate 21 may be housed in one case 5.

[0084]

20 The case 5 of the first modification is formed so that the angle θ formed in the side view between a surface 5A oriented to the driver's seat (also referred to as the driver's seat side surface) and a surface 5B as the attachment surface is the predetermined angle within 45 to 90 degrees (for example, 60 degrees). The first substrate 13 is arranged so as to face the driver's seat side surface 5A
25 via the display 11. The second substrate 21 is arranged in the case 5 so as to face the surface 5B as the attachment surface. The first substrate 13 and the second substrate 21 are configured so that the angle θ formed in the side view is a predetermined angle within 45 to 90 degrees (for example, 60 degrees).

[0085]

30 Even in the configuration, it may be possible to improve the quality for the short distance wireless communication with the communication device

existing inside the vehicle compartment such as the portable terminal carried by the user, similarly to the other embodiments.

[0086]

The shape of the case 5 is not limited to the aspect shown in FIG. 8.

5 For example, the shape may be formed as shown in FIG. 9.

[0087]

(Second modification)

Though the configuration of the portable navigator 100 is used on a precondition that the portable navigator 100 is attached to the windshield 200,
10 the present disclosure is not limited to the configuration. As shown in FIG. 10, the portable navigator 100 may be mounted on the upper surface of a dashboard 300 to be used.

[0088]

FIG. 11 is a view illustrating one example of the configuration of the
15 portable navigator 100 on a precondition that the portable navigator 100 is used with arranged on the dashboard 300. In the portable navigator 100 on the precondition that the portable navigator 100 is arranged on the dashboard 300 to be used, the holder lower surface 2B functions as the attachment surface.

[0089]

20 (Third modification)

Though the configuration of the portable navigator 100 attached to a four-wheeled vehicle is disclosed, the portable navigator 100 may be attached to a two-wheeled vehicle. The portable navigator 100 for the two-wheeled vehicle may be attached to, for example, a handlebar. FIG. 12 shows a
25 configuration of the portable navigator 100 on a precondition that the portable navigator 100 is attached to a handlebar portion of the two-wheeled vehicle to be used.

[0090]

The portable navigator 100 for the two-wheeled vehicle may be
30 implemented, for example, by attaching a handlebar attachment portion 6 to the holder lower surface 2B of the portable navigator 100 shown in the second modification. The handlebar attachment portion 6 may be implemented by a

hinge structure as shown in FIG. 13 and FIG. 14, for example. A movable portion 61 for holding (or sandwiching) the handlebar of a two-wheeled vehicle is connected to a fixing portion 62 by a hinge portion 63. An end portion of the movable portion 61 on a side opposite to the hinge portion 63 is engaged with the fixing portion 62 by a screw 64.

[0091]

The portable navigator 100 shown in FIG. 12 may be attached to a handlebar of a three-wheeled vehicle and used. The handlebar attachment portion 6 and the holder lower surface 2B may be integrally formed.

[0092]

(Fourth modification)

Though the configuration of including the three kinds of the antennas of the GNSS antenna 211, the DSRC antenna 213, and the LTE antenna 215 is described as the vehicle compartment outside antenna, the portable navigator 100 may not necessarily include the all antennas. For example, the portable navigator 100 may include only the GNSS antenna 211 and the DSRC antenna 213 as the vehicle compartment outside antenna.

[0093]

The portable navigator 100 may include an antenna other than the described kind of the antenna as the vehicle compartment outside antenna. For example, the portable navigator 100 may include an antenna (also referred to as a radio antenna) for receiving radio broadcast wave as the vehicle compartment outside antenna. The communication counterpart for a radio reception antenna corresponds to a radio broadcast station. A kind of the antenna of the portable navigator 100 as the vehicle compartment outside antenna may be appropriately designed.

[0094]

The kind of the antenna of the portable navigator 100 is not limited to the antenna described above. For example, the portable navigator 100 may include a near field communication (NFC) antenna. The near field communication refers to communication by a communication method in which the communicationable distance is sufficiently smaller than a short distance

communication. For example, the near field communication refers to communication in which the communicable distance is approximately several centimeters to several tens centimeters. The near field communication conforms to standards such as ISO/IEC 14443 or ISO/IEC 18092.

5 [0095]

A near field communication antenna may be placed on the first substrate 13 or on the second substrate 21. The near field communication antenna may be placed on each of the first substrate 13 and the second substrate 21.

10 [0096]

(Fifth modification)

Though the aspect that the LTE antenna 215 or the radio antenna is employed as the antenna of which communication counterpart exists in the zenith direction of the vehicle is described, the present disclosure is not limited to the aspect. It can be regarded that the electric wave from the wireless base station or the radio broadcast station arrives from the horizontal direction of the vehicle outside.

[0097]

20 The LTE antenna 215 and the radio antenna may be arranged on the back side surface 13B of the first substrate 13. The LTE antenna 215 and the radio antenna may be arranged on each of the back side surface 13B and the upper side surface 21A as a diversity antenna.

[0098]

(Sixth modification)

25 Though the example of applying the vehicle information terminal according to the present disclosure to the portable type navigation apparatus is described, the present disclosure is not limited to the example. The vehicle information terminal may be applied to an information process terminal without including the navigation function. The vehicle information terminal can be applied to various information process terminals such as a car audio and a drive recorder having the communication function with an outside device. The

30

information process terminal refers to a communication terminal that displays information based on data received from the outside of the display.

[0099]

5 Though the present disclosure has been made in accordance with the
embodiments, it is understood that the present disclosure is not limited to such
embodiments and structures. The present disclosure covers various
modification examples and equivalent arrangements. In addition, while the
various elements are shown in various combinations and configurations, which
are exemplary, other combinations and configurations, including more, less or
10 only a single element, are also within the spirit and scope of the present
disclosure.

CLAIMS

1. A vehicle information terminal comprising:

a display (11) that includes a display surface configured to display information to an occupant sitting on a driver's seat of a vehicle;

5 a first substrate (13) that is arranged in a side opposite to the display surface of the display to face the display;

a second substrate (21) that is arranged in a side in which the display does not exist from the first substrate;

10 at least one vehicle compartment outside antenna (211, 213, 215) configured to communicate with an upper communication device corresponding to a communication device existing above the vehicle; and

a vehicle compartment inside antenna (133) configured to execute direct communication with a vehicle compartment inside device existing inside a vehicle compartment, the direct communication conforming to a predetermined communication standard,

15 wherein:

the second substrate is arranged in an orientation in which an angle formed between the second substrate and a plane perpendicular to a vertical direction of the display is equal to 45 degrees or less;

20 the first substrate includes a protrusion area that does not overlap with the display in a depth direction from the display to the first substrate;

the vehicle compartment inside antenna is placed in the protrusion area of a display facing surface (13A) in the first substrate facing the display; and

25 the vehicle compartment outside antenna is placed on an upper side surface (21A) of two surfaces of the second substrate, the upper side surface facing above when the vehicle information terminal is attached to the vehicle in an orientation with respect to the vertical direction of the display.

30 2. The vehicle information terminal according to claim 1, further comprising:

a first housing (1) that stores the display and the first substrate, wherein the display surface is seen from outside;

a second housing (2) that stores the second substrate; and
an arm (3) that connects the first housing and the second housing, and
supports an orientation of the first housing to the second housing,
wherein:

5 the second housing includes

a housing upper surface (2A) that faces the upper side surface and
a housing lower surface (2B) that faces a lower side surface being one
of the two surfaces of the second substrate and being other than the upper side
surface;

10 the arm has a cylindrical member;

the first substrate and the second substrate are electrically connected
by a cable that is arranged in the arm; and

the first housing is configured to adjust an angle of the first housing to
the second housing.

15

3. The vehicle information terminal according to claim 2, wherein:
the housing upper surface is attached to a windshield of the vehicle,
causing the vehicle information terminal to be used.

20

4. The vehicle information terminal according to claim 2, wherein:
the vehicle information terminal is mounted on a dashboard of the
vehicle, causing the housing lower surface to face the dashboard to be used.

25

5. The vehicle information terminal according to claim 2, wherein:
the housing lower surface includes a handlebar attachment portion (6)
configured to engage the vehicle information terminal with a handlebar of a two-
wheeled vehicle.

30

5, wherein:
the vehicle compartment inside antenna is arranged so that a center of
directivity of the vehicle compartment inside antenna matches with a first

substrate perpendicular direction that corresponds to a direction from the first substrate to the display.

5 7. The vehicle information terminal according to any one of claims 1 to 6, further comprising:

 a positioning antenna as the vehicle outside compartment antenna, configured to receive a signal from a positioning satellite,

 wherein:

10 the positioning antenna is arranged so that a center of directivity of the positioning antenna matches with a second substrate perpendicular direction that corresponds to a direction to the upper side surface from a lower side surface being one of the two surfaces of the second substrate and being other than the upper side surface.

15 8. The vehicle information terminal according to any one of claims 1 to 7, further comprising:

 a narrow area communication antenna as the vehicle compartment outside antenna, configured to execute the direct communication with a roadside machine placed on a road at a higher position than a roof portion of
20 the vehicle,

 wherein:

 the narrow area communication antenna is arranged so that a center of directivity of the narrow area communication antenna matches with a second substrate perpendicular direction which corresponds to a direction to the upper
25 side surface from the lower side surface being one of the two surfaces of the second substrate and being other than the upper side surface.