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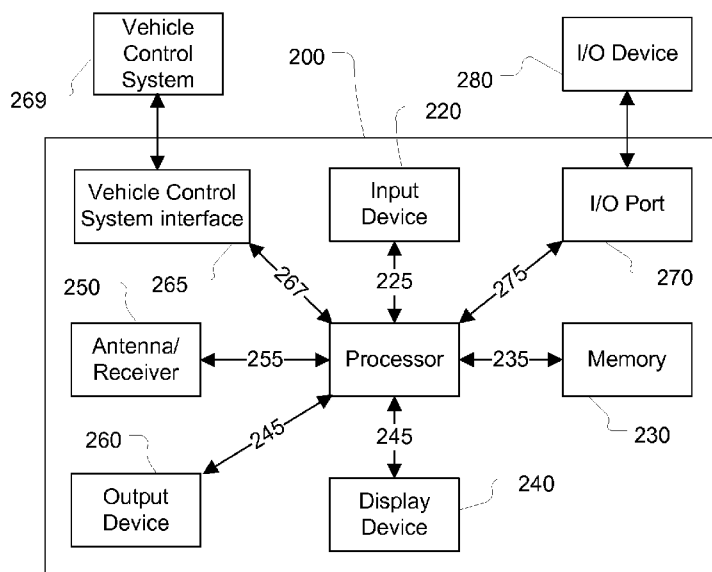
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(54) Title: NAVIGATION DEVICE RESPONSIVE TO VEHICLE STATUS SIGNALS AND ASSOCIATED METHOD

**FIG. 2**

(57) Abstract: This invention relates to a navigation device (200) that comprises: a processor (210) for generating, from map data, a digital map for display to a user; a store (230) for said map data and data defining the location of points of interest on said digital map; a display (240) for displaying said digital map to said user; characterised in that the navigation device (200) further comprises: a vehicle control system interface (265) for receiving status signals from a control system of a vehicle with which said navigation device is associated; and a vehicle status monitoring module (490) that is responsive to received status signals to select points of interest associated with a said received status signal for display on said digital map. A method is also disclosed.

NAVIGATION DEVICE RESPONSIVE TO VEHICLE STATUS SIGNALS AND ASSOCIATED METHOD

Field of the Invention

This invention relates to navigation devices. Illustrative embodiments of the invention relate to portable navigation devices (so-called PNDs), in particular PNDs that include Global Positioning System (GPS) signal reception and processing functionality. Other embodiments relate, to navigation devices that are built-into vehicles, and yet further embodiments relate to any type of processing device that is configured to execute navigation software so as to provide route planning, and preferably also navigation, functionality.

Background to the Invention

Portable navigation devices (PNDs) that include GPS (Global Positioning System) signal reception and processing functionality are well known and are widely employed as in-car or other vehicle navigation systems.

In general terms, a modern PND comprises a processor, memory (at least one of volatile (e.g. RAM) and non-volatile (e.g. ROM), and commonly both), and map data stored within said memory. The processor and memory cooperate to provide an execution environment in which a software operating system may be established, and additionally it is commonplace for one or more additional software programs to be provided to enable the functionality of the PND to be controlled, and to provide various other functions.

Typically these devices further comprise one or more input interfaces that allow a user to interact with and control the device, and one or more output interfaces by means of which information may be relayed to the user. Illustrative examples of output interfaces include a visual display and a speaker for audible output. Illustrative examples of input interfaces include one or more physical buttons and a microphone for detecting user speech. The buttons may be configured, for example, to power the PND on or off or to control operation or other features of the device and need not necessarily be on the PND itself but could be on a steering wheel or another part of the vehicle in circumstances where the device is built into a vehicle. In a particularly preferred arrangement the output interface display may be configured as a touch sensitive display (by means of a touch sensitive overlay or otherwise) to additionally provide an input interface by means of which a user can operate the device by touch.

Devices of this type will also often include one or more physical connector interfaces by means of which power and optionally data signals can be transmitted to

and received from the device, and optionally one or more wireless transmitters/receivers to allow communication over cellular telecommunications and other signal and data networks, for example Wi-Fi, Wi-Max GSM and the like. PND devices of this type also typically include a GPS antenna by means of which satellite-broadcast signals, including location data, can be received and subsequently processed to determine a current location of the device.

The PND device may also include electronic gyroscopes and accelerometers which produce signals that can be processed to determine the current angular and linear acceleration, and in turn, and in conjunction with location information derived from the GPS signal, velocity and relative displacement of the device and thus the vehicle in which it is mounted. Typically such features are most commonly provided in in-vehicle navigation systems, but may also be provided in PND devices if it is expedient to do so.

The utility of such PNDs is manifested primarily in their ability to determine a route between a first location (typically a start or current location) and a second location (typically a destination). These locations can be input by a user of the device, by any of a wide variety of different methods, for example by postcode, street name and house number, previously stored "well known" destinations (such as famous locations, municipal locations (such as sports grounds or swimming baths) or other points of interest), and favourite or recently visited destinations.

Typically, the PND is enabled by software for computing a "best" or "optimum" route between the start and destination address locations from the map data. A "best" or "optimum" route is determined on the basis of predetermined criteria and need not necessarily be the fastest or shortest route. The selection of the route along which to guide the driver can be very sophisticated, and the selected route may take into account existing, predicted and dynamically and/or wirelessly received traffic and road information, historical information about road speeds, and the driver's own preferences for the factors determining road choice (for example the driver may specify that the route should not include motorways or toll roads).

In addition, the device may continually monitor road and traffic conditions, and offer to or choose to change the route over which the remainder of the journey is to be made due to changed conditions. Real time traffic monitoring systems, based on various technologies (e.g. mobile phone data exchanges, fixed cameras, GPS fleet tracking) are being used to identify traffic delays and to feed the information into notification systems.

PNDs of this type may typically be mounted on the dashboard or windscreen of a vehicle. In addition, the functionality of PNDs may be embodied in a navigation device that is built into a vehicle, for example as part of an on-board computer of the vehicle

radio or indeed as part of the control system of the vehicle itself. The navigation device may also be part of a hand-held system, such as a PDA (Portable Digital Assistant) a media player, a mobile phone or the like, and in these cases, the normal functionality of the hand-held system is extended by means of the installation of software on the device
5 to perform both route calculation and navigation along a calculated route.

Route planning and navigation functionality may also be provided by a desktop or mobile computing resource running appropriate software. For example, the Royal Automobile Club (RAC) provides an on-line route planning and navigation facility at <http://www.rac.co.uk>, which facility allows a user to enter a start point and a destination
10 whereupon the server to which the user's PC is connected calculates a route (aspects of which may be user specified), generates a map, and generates a set of exhaustive navigation instructions for guiding the user from the selected start point to the selected destination. The facility also provides for pseudo three-dimensional rendering of a calculated route, and route preview functionality which simulates a user travelling along
15 the route and thereby provides the user with a preview of the calculated route.

In the context of a PND, once a route has been calculated, the user interacts with the navigation device to select the desired calculated route, optionally from a list of proposed routes. Optionally, the user may intervene in, or guide the route selection process, for example by specifying that certain routes, roads, locations or criteria are to
20 be avoided or are mandatory for a particular journey. The route calculation aspect of the PND forms one primary function, and navigation along such a route is another primary function.

During navigation along a calculated route, it is usual for such PNDs to provide visual and/or audible instructions to guide the user along a chosen route to the end of
25 that route, i.e. the desired destination. It is also usual for PNDs to display map information on-screen during the navigation, such information regularly being updated on-screen so that the map information displayed is representative of the current location of the device, and thus of the user or user's vehicle if the device is being used for in-vehicle navigation.

30 An icon displayed on-screen typically denotes the current device location on the map, and it is usual for the icon to be centred with on the map to provide a good view of roads in the vicinity of the current device location. Icons representing the location of other points of interest (such as petrol stations, airports, recreation facilities and such like) on the map may also be displayed. Additionally, navigation information may be
35 displayed, optionally in a status bar above, below or to one side of the displayed map information, examples of navigation information include a distance to the next

manoeuvre that a user is required to take to continue along a calculated route, the nature of that manoeuvre possibly being represented by a further icon suggestive of the particular type of manoeuvre, for example a left or right turn. The navigation function also determines the content, duration and timing of audible instructions by means of which the user can be guided along the route. As can be appreciated a simple instruction such as "turn left in 100 m" requires significant processing and analysis. As previously mentioned, user interaction with the device may be by a touch screen, or additionally or alternately by steering column mounted remote control, by voice activation or by any other suitable method.

A further important function provided by the device is automatic route re-calculation in the event that: a user should deviate from a previously calculated route during navigation (either by accident or intentionally); real-time traffic conditions dictate that an alternative route would be more expedient and the device is suitably enabled to recognize such conditions automatically, or if a user actively causes the device to perform route re-calculation for any reason.

It is also known to allow a route to be calculated with user defined criteria; for example, the user may prefer a scenic route to be calculated by the device, or may wish to avoid any roads on which traffic congestion is likely, expected or currently prevailing. The device software would then calculate various routes and weigh more favourably those that include along their route the highest number of points of interest (known as POIs) tagged as being for example of scenic beauty, or, using stored information indicative of prevailing traffic conditions on particular roads, order the calculated routes in terms of a level of likely congestion or delay on account thereof. Other POI-based and traffic information-based route calculation and navigation criteria are also possible.

Although the route calculation and navigation functions are fundamental to the overall utility of PNDs, it is possible to use the device purely for information display, or "free-driving", in which only map information relevant to the current device location is displayed, and in which no route has been calculated and no navigation is currently being performed by the device. Such a mode of operation is often applicable when the user already knows the route along which it is desired to travel and does not require navigation assistance.

Navigation devices such as the TomTom 720T model PND manufactured and supplied by TomTom International B.V., and the Carminat TomTom system that is available as a built-in component of Renault vehicles, each provide a reliable means for enabling users to navigate from one position to another, and can be of particular utility in emergency situations.

For example a user can control the aforementioned devices to display the longitude and latitude of their current position – which information may be of use to a third party in the event of a breakdown or other emergency. A user can also control these devices to calculate a route from a current position to a location where assistance
5 may be provided. For example, if a user should happen to run out of fuel, they can instruct their navigation device to compute a route from their current location to a location (for example a petrol station) where assistance can be provided,

Whilst this functionality is eminently useful, for a user to make the most of that functionality it is necessary for the user to understand warning signals presented to them
10 by the vehicle in which they are travelling. In circumstances where a user does not recognise the warning signal provided by the vehicle, perhaps because they are unfamiliar with that particular vehicle, the user may not recognise the problem and hence not know what action to take in response thereto and by association which location to choose for assistance.

Another related problem is that for a user to make the most of this functionality it is necessary for the user to know which actions are appropriate for responding to a given problem. For example, in the event of a flat tire or a more serious problem with a vehicle, it may well be the case that navigating to a dealer for that particular type of vehicle may be a much better option than navigating to a petrol station.

20 Notwithstanding the foregoing, it is also the case that some users can become flustered when something unusual, like the illumination of a warning light, occurs. For such users, the illumination of a warning light (for example) can act as a distraction that diverts their attention away from the road.

It is also the case that a significant minority of users will, in the event that an
25 emergency should occur, try to operate their navigation device whilst driving to instruct the device to navigate a route to a location where assistance may be sought. As will be appreciated, operating a navigation device whilst driving can be very dangerous indeed.

It will be apparent from the foregoing that it would be advantageous to address these drawbacks, for example by providing a means whereby users can more safely be
30 guided to a location where assistance can be provided.

Summary of the Invention

In pursuit of this aim, a presently preferred embodiment of the present invention provides a navigation device that comprises: a processor for generating, from map data,
35 a digital map for display to a user; a store for said map data and data defining the location of points of interest on said digital map; a display for displaying said digital map

to said user; characterised in that the navigation device further comprises: a vehicle control system interface for receiving status signals from a control system of a vehicle with which said navigation device is associated; and a vehicle status monitoring module that is responsive to received status signals to select points of interest associated with a
5 said received status signal for display on said digital map.

Another embodiment of the present invention relates to a method of providing assistance to a user of a navigation device, the method comprising: receiving, at said navigation device, a status signal from a control system of a vehicle with which said navigation device is associated; selecting points of interest associated with said received
10 status signal; and displaying said selected points of interest on a digital map of a local area in which said navigation device is located.

Yet another embodiment of the present invention relates to computer software comprising one or more software modules operable, when executed in an execution environment, to cause a processor of a navigation device to: select points of interest that
15 are associated with a status signal received at said navigation device from a control system of a vehicle with which said device is associated; and display said selected points of interest on a digital map of a local area in which said navigation device is located.

Advantages of these embodiments are set out hereafter, and further details and
20 features of each of these embodiments are defined in the accompanying dependent claims and elsewhere in the following detailed description.

Brief Description of the Drawings

Various aspects of the teachings of the present invention, and arrangements
25 embodying those teachings, will hereafter be described by way of illustrative example with reference to the accompanying drawings, in which:

Fig. 1 is a schematic illustration of a Global Positioning System (GPS);

Fig. 2 is a schematic illustration of electronic components arranged to provide a navigation device;

30 Fig. 3 is a schematic illustration of the manner in which a navigation device may receive information over a wireless communication channel;

Figs. 4A and 4B are illustrative perspective views of a navigation device;

Fig. 5 is a schematic representation of the software employed by the navigation device; and

35 Fig. 6 is an illustrative flow diagram depicting the steps of one method by which the teachings of the present invention may be implemented.

Detailed Description of Preferred Embodiments

Preferred embodiments of the present invention will now be described with particular reference to a navigation device that is permanently installed in a vehicle, such as the aforementioned Carminat TomTom system. It should be remembered, however, that the teachings of the present invention are not limited to such devices but are instead applicable to PNDs and any other type of processing device that is configured to execute navigation software so as to provide route planning and navigation functionality. It follows therefore that in the context of the present application, a navigation device is intended to include (without limitation) any type of route planning and navigation device, irrespective of whether that device is embodied as a PND, a navigation device built into a vehicle, or indeed a computing resource (such as a desktop or portable personal computer (PC), mobile telephone or portable digital assistant (PDA)) executing route planning and navigation software.

It will also be apparent from the following that the teachings of the present invention even have utility in circumstances where a user is not seeking instructions on how to navigate from one point to another, but merely wishes to be provided with a view of a given location. In such circumstances the "destination" location selected by the user need not have a corresponding start location from which the user wishes to start navigating, and as a consequence references herein to the "destination" location or indeed to a "destination" view should not be interpreted to mean that the generation of a route is essential, that travelling to the "destination" must occur, or indeed that the presence of a destination requires the designation of a corresponding start location.

With the above provisos in mind, Fig. 1 illustrates an example view of Global Positioning System (GPS), usable by navigation devices. Such systems are known and are used for a variety of purposes. In general, GPS is a satellite-radio based navigation system capable of determining continuous position, velocity, time, and in some instances direction information for an unlimited number of users. Formerly known as NAVSTAR, the GPS incorporates a plurality of satellites which orbit the earth in extremely precise orbits. Based on these precise orbits, GPS satellites can relay their location to any number of receiving units.

The GPS system is implemented when a device, specially equipped to receive GPS data, begins scanning radio frequencies for GPS satellite signals. Upon receiving a radio signal from a GPS satellite, the device determines the precise location of that satellite via one of a plurality of different conventional methods. The device will continue scanning, in most instances, for signals until it has acquired at least three different

satellite signals (noting that position is not normally, but can be determined, with only two signals using other triangulation techniques). Implementing geometric triangulation, the receiver utilizes the three known positions to determine its own two-dimensional position relative to the satellites. This can be done in a known manner. Additionally, 5 acquiring a fourth satellite signal will allow the receiving device to calculate its three dimensional position by the same geometrical calculation in a known manner. The position and velocity data can be updated in real time on a continuous basis by an unlimited number of users.

As shown in Figure 1, the GPS system is denoted generally by reference 10 numeral 100. A plurality of satellites 120 are in orbit about the earth 124. The orbit of each satellite 120 is not necessarily synchronous with the orbits of other satellites 120 and, in fact, is likely asynchronous. A GPS receiver 140 is shown receiving spread spectrum GPS satellite signals 160 from the various satellites 120.

The spread spectrum signals 160, continuously transmitted from each satellite 15 120, utilize a highly accurate frequency standard accomplished with an extremely accurate atomic clock. Each satellite 120, as part of its data signal transmission 160, transmits a data stream indicative of that particular satellite 120. It is appreciated by those skilled in the relevant art that the GPS receiver device 140 generally acquires spread spectrum GPS satellite signals 160 from at least three satellites 120 for the GPS 20 receiver device 140 to calculate its two-dimensional position by triangulation. Acquisition of an additional signal, resulting in signals 160 from a total of four satellites 120, permits the GPS receiver device 140 to calculate its three-dimensional position in a known manner.

Figure 2 is an illustrative representation of electronic components of a navigation 25 device 200 according to a preferred embodiment of the present invention, in block component format. It should be noted that the block diagram of the navigation device 200 is not inclusive of all components of the navigation device, but is only representative of many example components.

The navigation device 200 includes a processor 210 connected to an input 30 device 220 and a display screen 240. The input device 220 can include a keyboard device, voice input device, touch panel and/or any other input device that can be utilised to input information; and the display screen 240 can include any type of display screen such as an LCD display, for example. In a particularly preferred arrangement the input device 220 and display screen 240 are integrated into an integrated input and display 35 device, including a touchpad or touchscreen input so that a user need only touch a portion of the display screen 240 to select one of a plurality of display choices or to

activate one of a plurality of virtual buttons.

In another envisaged implementation the input device may comprise or include controls of the vehicle that may have functions other than those associated with the navigation device. For example, the input device could comprise buttons on the steering wheel of the vehicle that perform one function when the user is controlling the vehicle entertainment system – for example – and another function when the user is controlling the navigation device.

The navigation device may include an output device 260, for example an audible output device (e.g. a loudspeaker). As output device 260 can produce audible information for a user of the navigation device 200, it is should equally be understood that input device 240 can include a microphone for receiving input voice commands, and software for interpreting voice commands and converting them to machine comprehensible instructions.

In the navigation device 200, processor 210 is operatively connected to and set to receive input information from input device 220 via a connection 225, and operatively connected to at least one of display screen 240 and output device 260, via output connections 245, to output information thereto. Further, the processor 210 is operably coupled to a memory resource 230 via connection 235 and is further adapted to receive/send information from/to input/output (I/O) ports 270 via connection 275, wherein the I/O port 270 is connectible to an I/O device 280 external to the navigation device 200. The memory resource 230 comprises, for example, a volatile memory, such as a Random Access Memory (RAM) and a non-volatile memory, for example a digital memory, such as a flash memory. The external I/O device 280 may include, but is not limited to an external listening device such as an earpiece for example. The connection to I/O device 280 can further be a wired or wireless connection to any other external device such as a car stereo unit for hands-free operation and/or for voice activated operation for example, for connection to an ear piece or head phones, and/or for connection to a mobile phone for example, wherein the mobile phone connection may be used to establish a data connection between the navigation device 200 and the internet or any other network for example, and/or to establish a connection to a server via the internet or some other network for example.

Fig. 2 further illustrates an operative connection between the processor 210 and an antenna/receiver 250 via connection 255, wherein the antenna/receiver 250 can be a GPS antenna/receiver for example. It will be understood that the antenna and receiver designated by reference numeral 250 are combined schematically for illustration, but that the antenna and receiver may be separately located components, and that the

antenna may be a GPS patch antenna or helical antenna for example.

As will be understood by one of ordinary skill in the art, the electronic components shown in Fig. 2 are powered by power sources (not shown) in a conventional manner. As will be understood by one of ordinary skill in the art, different configurations of the components shown in Fig. 2 are considered to be within the scope of the present application. For example, the components shown in Fig. 2 may be in communication with one another via wired and/or wireless connections and the like.

In addition, the navigation device 200 of Fig. 2 when embodied as a portable device can be mounted or “docked” in a known manner in or on a vehicle such as a bicycle, a motorbike, a car or a boat for example. Such a navigation device 200 is then removable from the docked location for portable or handheld navigation use.

The navigation device of the present invention further comprises a vehicle control system interface 265 (the details of which will later be described) that is configured to be capable of interfacing with a vehicle control system 269, at least for the reception of status signals from that control system. The vehicle control system interface 265 is coupled to the processor by connection 267 for communication therewith. Such vehicle control systems are commonplace features of modern vehicles, and include sensing components (such as tyre pressure, fuel level or oil level sensors) as well a variety of other electronic components. In the context of a preferred embodiment of the present invention, status signals received from these components are associated with problematic events (such as a lack of fuel or oil or a drop in tyre pressure), but it will be appreciated that the teachings of the present invention are not solely applicable to status signals that are representative of potential problems.

Referring now to Fig. 3, the navigation device 200 may establish a “mobile” or telecommunications network connection with a server 302 via a mobile device (not shown) (such as a mobile phone, PDA, and/or any device with mobile phone technology) establishing a digital connection (such as a digital connection via known Bluetooth technology for example). Thereafter, through its network service provider, the mobile device can establish a network connection (through the internet for example) with a server 302. As such, a “mobile” network connection is established between the navigation device 200 (which can be, and often times is mobile as it travels alone and/or in a vehicle) and the server 302 to provide a “real-time” or at least very “up to date” gateway for information.

The establishing of the network connection between the mobile device (via a service provider) and another device such as the server 302, using an internet (such as the World Wide Web) for example, can be done in a known manner. This can include

use of TCP/IP layered protocol for example. The mobile device can utilize any number of communication standards such as CDMA, GSM, WAN, etc.

As such, an internet connection may be utilised which is achieved via data connection, via a mobile phone or mobile phone technology within the navigation device 200 for example. For this connection, an internet connection between the server 302 and the navigation device 200 is established. This can be done, for example, through a mobile phone or other mobile device and a GPRS (General Packet Radio Service)-connection (GPRS connection is a high-speed data connection for mobile devices provided by telecom operators; GPRS is a method to connect to the internet).

The navigation device 200 can further complete a data connection with the mobile device, and eventually with the internet and server 302, via existing Bluetooth technology for example, in a known manner, wherein the data protocol can utilize any number of standards, such as the GSRM, the Data Protocol Standard for the GSM standard, for example.

The navigation device 200 may include its own mobile phone technology within the navigation device 200 itself (including an antenna for example, or optionally using the internal antenna of the navigation device 200). The mobile phone technology within the navigation device 200 can include internal components as specified above, and/or can include an insertable card (e.g. Subscriber Identity Module or SIM card), complete with necessary mobile phone technology and/or an antenna for example. As such, mobile phone technology within the navigation device 200 can similarly establish a network connection between the navigation device 200 and the server 302, via the internet for example, in a manner similar to that of any mobile device.

For GRPS phone settings, a Bluetooth enabled navigation device may be used to correctly work with the ever changing spectrum of mobile phone models, manufacturers, etc., model/manufacture specific settings may be stored on the navigation device 200 for example. The data stored for this information can be updated.

In Fig. 3 the navigation device 200 is depicted as being in communication with the server 302 via a generic communications channel 318 that can be implemented by any of a number of different arrangements. The server 302 and a navigation device 200 can communicate when a connection via communications channel 318 is established between the server 302 and the navigation device 200 (noting that such a connection can be a data connection via mobile device, a direct connection via personal computer via the internet, etc.).

The server 302 includes, in addition to other components which may not be illustrated, a processor 304 operatively connected to a memory 306 and further

operatively connected, via a wired or wireless connection 314, to a mass data storage device 312. The processor 304 is further operatively connected to transmitter 308 and receiver 310, to transmit and send information to and from navigation device 200 via communications channel 318. The signals sent and received may include data, communication, and/or other propagated signals. The transmitter 308 and receiver 310 may be selected or designed according to the communications requirement and communication technology used in the communication design for the navigation system 200. Further, it should be noted that the functions of transmitter 308 and receiver 310 may be combined into a signal transceiver.

Server 302 is further connected to (or includes) a mass storage device 312, noting that the mass storage device 312 may be coupled to the server 302 via communication link 314. The mass storage device 312 contains a store of navigation data and map information, and can again be a separate device from the server 302 or can be incorporated into the server 302.

The navigation device 200 is adapted to communicate with the server 302 through communications channel 318, and includes processor, memory, etc. as previously described with regard to Fig. 2, as well as transmitter 320 and receiver 322 to send and receive signals and/or data through the communications channel 318, noting that these devices can further be used to communicate with devices other than server 302. Further, the transmitter 320 and receiver 322 are selected or designed according to communication requirements and communication technology used in the communication design for the navigation device 200 and the functions of the transmitter 320 and receiver 322 may be combined into a single transceiver.

Software stored in server memory 306 provides instructions for the processor 304 and allows the server 302 to provide services to the navigation device 200. One service provided by the server 302 involves processing requests from the navigation device 200 and transmitting navigation data from the mass data storage 312 to the navigation device 200. Another service provided by the server 302 includes processing the navigation data using various algorithms for a desired application and sending the results of these calculations to the navigation device 200.

The communication channel 318 generically represents the propagating medium or path that connects the navigation device 200 and the server 302. Both the server 302 and navigation device 200 include a transmitter for transmitting data through the communication channel and a receiver for receiving data that has been transmitted through the communication channel.

The communication channel 318 is not limited to a particular communication

technology. Additionally, the communication channel 318 is not limited to a single communication technology; that is, the channel 318 may include several communication links that use a variety of technology. For example, the communication channel 318 can be adapted to provide a path for electrical, optical, and/or electromagnetic communications, etc. As such, the communication channel 318 includes, but is not limited to, one or a combination of the following: electric circuits, electrical conductors such as wires and coaxial cables, fibre optic cables, converters, radio-frequency (RF) waves, the atmosphere, empty space, etc. Furthermore, the communication channel 318 can include intermediate devices such as routers, repeaters, buffers, transmitters, and receivers, for example.

In one illustrative arrangement, the communication channel 318 includes telephone and computer networks. Furthermore, the communication channel 318 may be capable of accommodating wireless communication such as radio frequency, microwave frequency, infrared communication, etc. Additionally, the communication channel 318 can accommodate satellite communication.

The communication signals transmitted through the communication channel 318 include, but are not limited to, signals as may be required or desired for given communication technology. For example, the signals may be adapted to be used in cellular communication technology such as Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Code Division Multiple Access (CDMA), Global System for Mobile Communications (GSM), etc. Both digital and analogue signals can be transmitted through the communication channel 318. These signals may be modulated, encrypted and/or compressed signals as may be desirable for the communication technology.

The server 302 includes a remote server accessible by the navigation device 200 via a wireless channel. The server 302 may include a network server located on a local area network (LAN), wide area network (WAN), virtual private network (VPN), etc.

The server 302 may include a personal computer such as a desktop or laptop computer, and the communication channel 318 may be a cable connected between the personal computer and the navigation device 200. Alternatively, a personal computer may be connected between the navigation device 200 and the server 302 to establish an internet connection between the server 302 and the navigation device 200. Alternatively, a mobile telephone or other handheld device may establish a wireless connection to the internet, for connecting the navigation device 200 to the server 302 via the internet.

The navigation device 200 may be provided with information from the server 302

via information downloads which may be periodically updated automatically or upon a user connecting navigation device 200 to the server 302 and/or may be more dynamic upon a more constant or frequent connection being made between the server 302 and navigation device 200 via a wireless mobile connection device and TCP/IP connection for example. For many dynamic calculations, the processor 304 in the server 302 may be used to handle the bulk of the processing needs, however, processor 210 of navigation device 200 can also handle much processing and calculation, oftentimes independent of a connection to a server 302.

As aforementioned in connection with Fig. 2, the navigation device 200 includes a processor 210, an input device 220, and a display screen 240. In a preferred arrangement the input device 220 and display screen 240 may be integrated into an integrated input and display device to enable both input of information (via direct input, menu selection, etc.) and display of information through a touch panel screen, for example. Such a screen may be a touch input LCD screen, for example, as is well known to those of ordinary skill in the art. Further, the navigation device 200 can also include any additional input device 220 and/or any additional output device 241, such as audio input/output devices for example.

Figs 4A and 4B are perspective views of a navigation device 200 that is embodied as a PND. As shown in Fig. 4A, the PND includes an integrated input and display device 290 (a touch panel screen for example) and the other components of fig. 2 (including but not limited to internal GPS receiver 250, microprocessor 210, a power supply, memory systems 230, etc.).

The PND 200 may sit on an arm 292, which itself may be secured to a vehicle dashboard/window/etc. using a suction cup 294. This arm 292 is one example of a docking station to which the PND 200 can be docked.

As shown in Fig. 4B, the PND 200 can be docked or otherwise connected to an arm 292 of the docking station by snap connecting the PND 292 to the arm 292 for example. The PND 200 may then be rotatable on the arm 292, as shown by the arrow of Fig. 4B. To release the connection between the PND 200 and the docking station, a button on the navigation device 200 may be pressed, for example. Other equally suitable arrangements for coupling and decoupling the navigation device to a docking station are well known to persons of ordinary skill in the art.

In this embodiment of the present invention, where the navigation device is embodied as a PND, the vehicle control system interface may be configured as a wireless interface. For example, a transmitter may be provided within the vehicle and be coupled to the vehicle control system, and a receiver may be provided within the PND

and be configured to receive signals from the vehicle transmitter. As will be appreciated, any suitable wireless transmission protocol may be adopted for communications between the PND and the vehicle control system.

In another envisaged arrangement the navigation device may again be configured as a PND, and the PND may be configured so that it can be plugged into a socket that is coupled to the vehicle control system. For example, the dashboard of the vehicle may include a socket into which a complementary connector on the PND may be plugged (or vice versa) to connect the PND to the control system of the vehicle. In another arrangement the PND may be coupled to the control system of the vehicle by means of a cable plugged into an appropriate socket outlet on the vehicle at one end and a connector interface on the PND at the other. In yet another arrangement the PND could be plugged into another component of the vehicle, such as a vehicle entertainment system.

In one envisaged embodiment the aforementioned socket into which the PND is plugged could form part of a data bus, such as the so-called CAN bus, that interconnects components of the vehicle control system. In another envisaged arrangement, the PND may be configured to interface with an on-board diagnostics (OBD) port of the vehicle.

In another arrangement, similar in appearance to the aforementioned Carminat TomTom system for Renault vehicles, the navigation device may be permanently installed in a vehicle. In such an arrangement the navigation device cannot be removed from the vehicle, and the device directly interfaces with the vehicle control system, for example via the aforementioned control system bus or vehicle diagnostic port.

It will be appreciated by persons skilled in the art, that coupling the navigation device to the vehicle allows the device to receive status signals from the control system of the vehicle, and in accordance with the teachings of the present invention the navigation device is configured to act on received signals and provide assistance to the user.

For example, if the level of fuel in a vehicle should drop below a predetermined level a fuel level sensor will generate a warning signal, and in a conventional vehicle a fuel level warning light on the vehicle dashboard would be illuminated to warn the driver that they are running low on fuel.

In an embodiment of this invention, the warning signal generated by the fuel level sensor is received by the navigation device, and in response to this signal the device attempts to provide assistance to the user of the vehicle. For example, in the case of a low fuel level warning signal, the device may control the display of the navigation device to display points of interest on the navigation map that correspond to locations (for

example, locations corresponding to petrol stations) where a user might be able to obtain assistance. The navigation device will also preferably compute a route from the vehicle's current position to the closest of these locations, and query the user (for example by means of a displayed or spoken question) whether they wish to follow the computed route to the closest of these locations. If the user should indicate that they do wish to follow the route, for example by operating a virtual button on-screen or by speech, the navigation device is configured to issue navigation instructions to guide the user from their current position to the closest point of interest where assistance may be provided.

In the preferred arrangement this functionality is implemented in software, illustrative components of which will now be described.

Referring now to Fig. 5 of the accompanying drawings, the memory resource 230 stores a boot loader program (not shown) that is executed by the processor 210 in order to load an operating system 470 from the memory resource 230 for execution by functional hardware components 460, which provides an environment in which application software 480 can run. The operating system 470 serves to control the functional hardware components 460 and resides between the application software 480 and the functional hardware components 460. The application software 480 provides an operational environment including the GUI that supports core functions of the navigation device 200, for example map viewing, route planning, navigation functions and any other functions associated therewith. In accordance with the preferred embodiment of the present invention, part of this functionality comprises a vehicle status monitoring module 490, the function of which will now be described in detail in connection with Fig. 6.

Fig. 6 is a schematic flow diagram illustrating steps of a method by which the teachings of the present invention, in particular the functionality of the aforementioned vehicle status monitoring module, may be implemented. The method will now be described with particular reference to a situation where a vehicle has run low on fuel. It will be apparent, however, that the following method may be used in a variety of different circumstances where the navigation device can provide assistance to a user in the event of a change to the status of the vehicle.

As shown in Fig. 10, in step 500 the navigation device listens for status signals received via the vehicle control system interface 265.

In the event that a status signal is received (for example a status signal indicating that the level of fuel stored in the vehicle has dropped), the navigation device then determines – in step 502 – the type of problematic event that the signal characterises and the point of interest type (in this instance, filling stations) where assistance with that

problem might best be provided. This step of the method may be implemented by determining on which pin of a connector interface the signal is received, or by retrieving a unique code from the signal and determining (for example from a look-up table in memory 230) the type of problematic event associated with that code, followed by
5 retrieving the appropriate point of interest type for that event.

The navigation device then interrogates a data store of points of interest in step 504 to find those points of interest where assistance may be provided that are in the vicinity of the vehicle.

The navigation device then displays those points of interest on the digital map in
10 step 506 and computes, in step 508, a route from the vehicles current position to the closest of the points of interest selected in step 504.

The navigation device then queries the user, in step 510, as to whether they wish to re-route the vehicle and follow the route computed in step 508. This may be accomplished by playing an audible message to the user and/or by displaying a
15 message on the display of the navigation device.

If the user should decide to re-route the vehicle, the navigation device provides navigation instructions to the user in step 512 to guide the user from the vehicles current position to the closest point of interest where assistance with the problematic event may best be provided. If the user decides not to re-route, the process terminates in step 514.
20 It will be apparent from the foregoing that the teachings of the present invention provide an effective means for assisting users in the event of problems occurring with their vehicles.

It will also be appreciated that whilst various aspects and embodiments of the present invention have heretofore been described, the scope of the present invention is
25 not limited to the particular arrangements set out herein and instead extends to encompass all arrangements, and modifications and alterations thereto, which fall within the scope of the appended claims.

For example, whilst embodiments described in the foregoing detailed description refer to GPS, it should be noted that the navigation device may utilise any kind of
30 position sensing technology as an alternative to (or indeed in addition to) GPS. For example the navigation device may utilise using other global navigation satellite systems such as the European Galileo system. Equally, it is not limited to satellite based but could readily function using ground based beacons or any other kind of system that enables the device to determine its geographic location.

35 In another modification, the navigation device may take factors in addition to distance into account when computing a route to a location where assistance might best

be provided. For example, the navigation device may – in the event of a problem occurring – determine the current time of day and select only those points of interest that are likely to be open for business. The navigation device may also or alternatively be configured, in the event that no points of interest of a preferred type are in the vicinity of
5 the vehicle's current position, to select a different point of interest type. For example, in the event of an oil leak and a lack of garages in the local area, the navigation device may opt to direct the user to a car park, for example, where a motoring organisation – such as the Automobile Association or Royal Automobile Club – may more easily provide assistance.

10 In another modification, the navigation device may be configured to provide the user with an explanation of the type of problematic event that has occurred. For example, in the event that the vehicle is running low on fuel, the navigation device may convey this information to the user so that the user does not need to know the meaning of any displayed warning signs.

15 It will also be well understood by persons of ordinary skill in the art that whilst the preferred embodiment implements certain functionality by means of software, that functionality could equally be implemented solely in hardware (for example by means of one or more ASICs (application specific integrated circuit)) or indeed by a mix of hardware and software. As such, the scope of the present invention should not be
20 interpreted as being limited only to being implemented in software.

Lastly, it should also be noted that whilst the accompanying claims set out particular combinations of features described herein, the scope of the present invention is not limited to the particular combinations hereafter claimed, but instead extends to encompass any combination of features or embodiments herein disclosed irrespective of
25 whether or not that particular combination has been specifically enumerated in the accompanying claims at this time.

CLAIMS

1. A navigation device (200) comprising:
 - 5 a processor (210) for generating, from map data, a digital map for display to a user;
 - a store (230) for said map data and data defining the location of points of interest on said digital map;
 - a display (240) for displaying said digital map to said user;
- 10 characterised in that the navigation device (200) further comprises:
 - a vehicle control system interface (265) for receiving status signals from a control system of a vehicle with which said navigation device is associated; and
 - a vehicle status monitoring module (490) that is responsive to received status signals to select points of interest associated with a said received status signal for
 - 15 display on said digital map.
2. A navigation device according to Claim 1, wherein the navigation device further comprises an antenna (250) and a receiver (250) for receiving data signals and said processor (210) is configured to determine from said received data signals a current
- 20 location of said navigation device (200).
3. A navigation device according to Claim 2, wherein the processor is operable to compute a route from the current location of the navigation device to a closest point of interest that is associated with said received status signal.
- 25 4. A navigation device according to Claim 3, wherein the processor is configured to generate navigation instructions for relaying to said user to guide said user along said route to said closest point of interest.
- 30 5. A navigation device according to any preceding claim, wherein said navigation device is permanently mounted in said vehicle.
6. A navigation device according to any of Claims 1 to 4, wherein said navigation device comprises a PND that is removable from said vehicle.
- 35 7. A navigation device according to any preceding claim, wherein said vehicle

control system interface is configured to couple said navigation device to a diagnostic port of said vehicle.

8. A navigation device according to any of claims 1 to 6, wherein vehicle control system interface is configured to couple said navigation device to a data bus of said vehicle control system.

9. A navigation device according to Claim 8, wherein said data bus comprises a controller area network bus (CAN bus).

10. A navigation device according to any preceding claim, wherein said status signal is indicative of a problem with the vehicle.

11. A navigation device according to Claim 10, wherein said selected points of interest comprise locations where assistance with addressing said problem may be obtained.

12. A method of providing assistance to a user of a navigation device, the method comprising:

receiving, at said navigation device, a status signal from a control system of a vehicle with which said navigation device is associated;

selecting points of interest associated with said received status signal; and

displaying said selected points of interest on a digital map of a local area in which said navigation device is located.

13. A method according to Claim 12, comprising the step of:

calculating a route from a current position of said vehicle in said local area to a point of interest that is associated with a received status signal and is closest to said current position.

14. A method according to Claim 13, comprising the step of:

generating navigation instructions for relaying to said user to guide said user along said route to said closest point of interest.

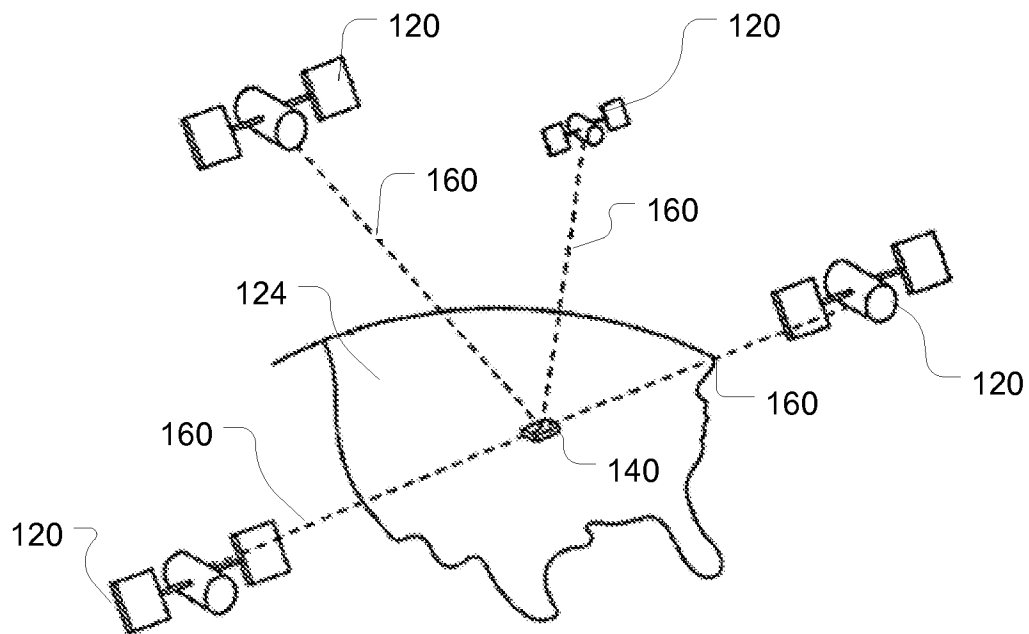
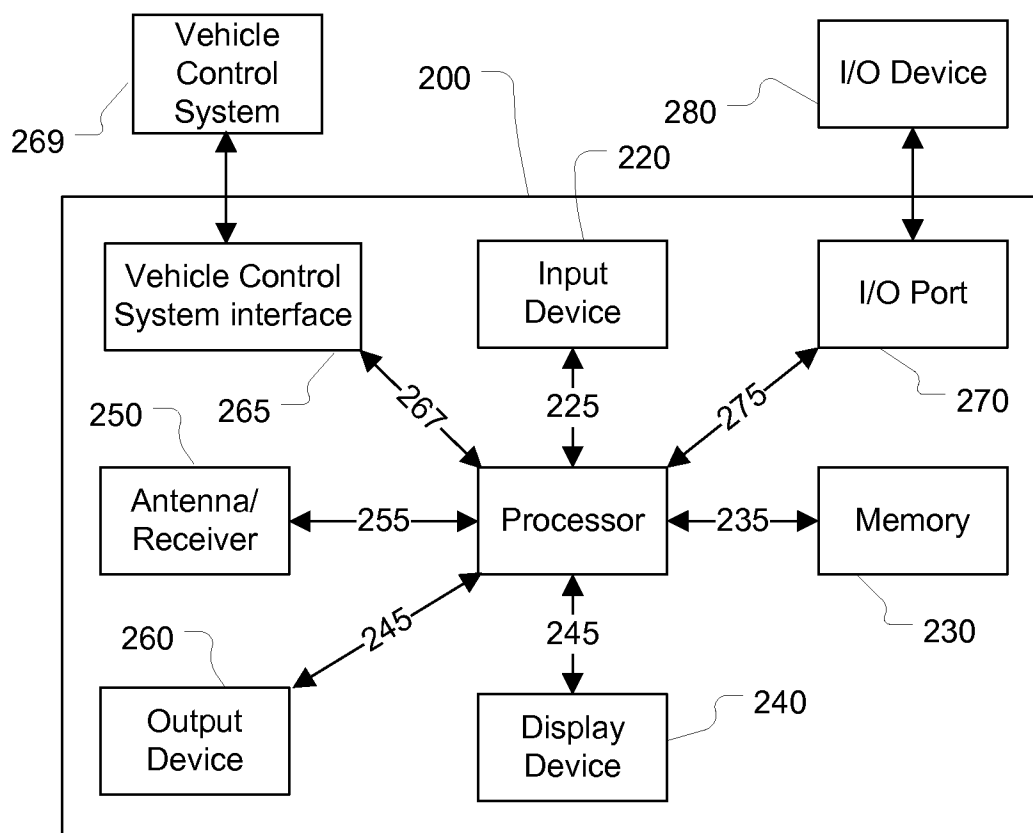
15. Computer software comprising one or more software modules operable, when executed in an execution environment, to cause a processor (210) of a navigation device

(200) to:

select points of interest that are associated with a status signal received at said navigation device from a control system of a vehicle with which said device is associated; and

- 5 display said selected points of interest on a digital map of a local area in which said navigation device is located.

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**FIG. 1****FIG. 2**

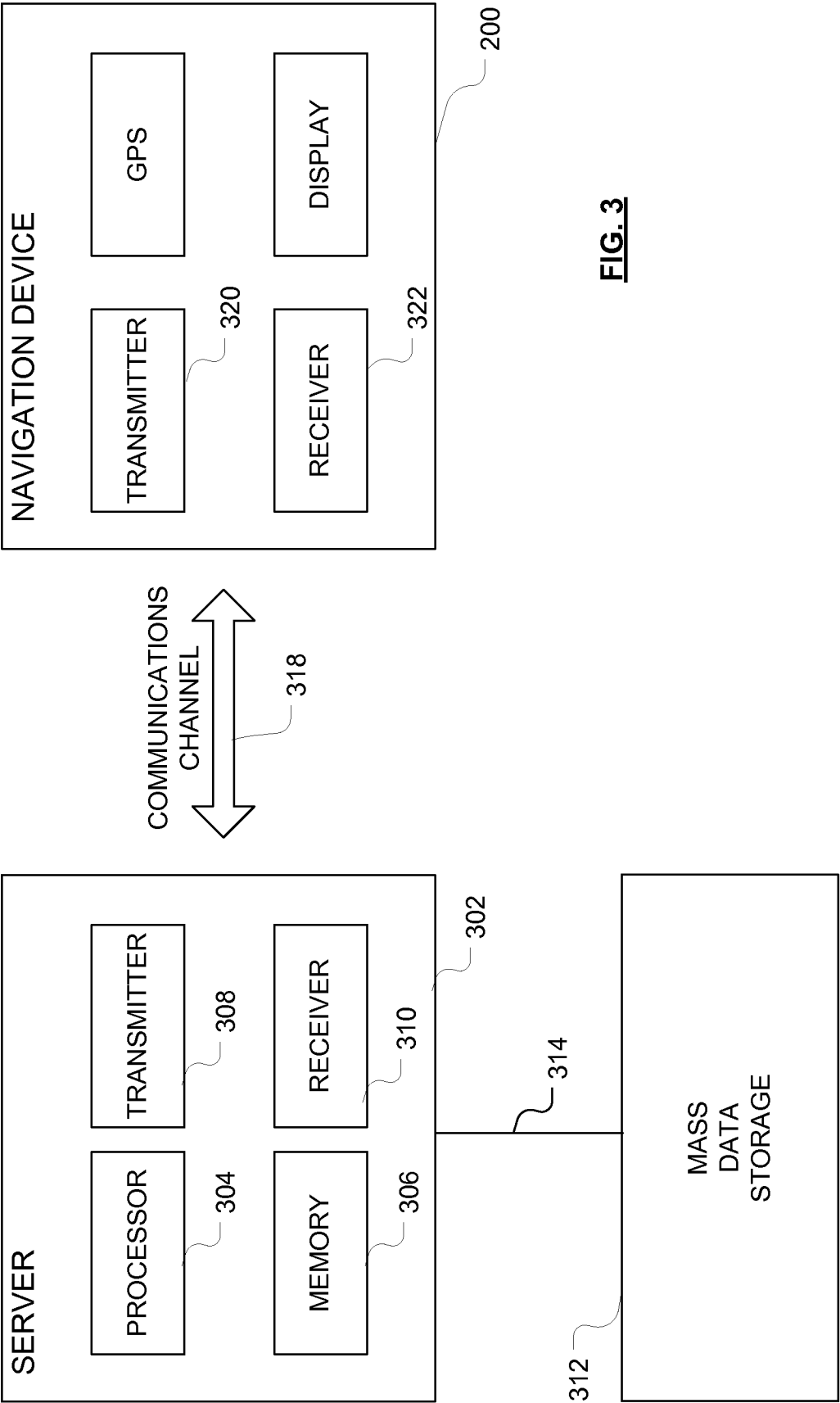


FIG. 3

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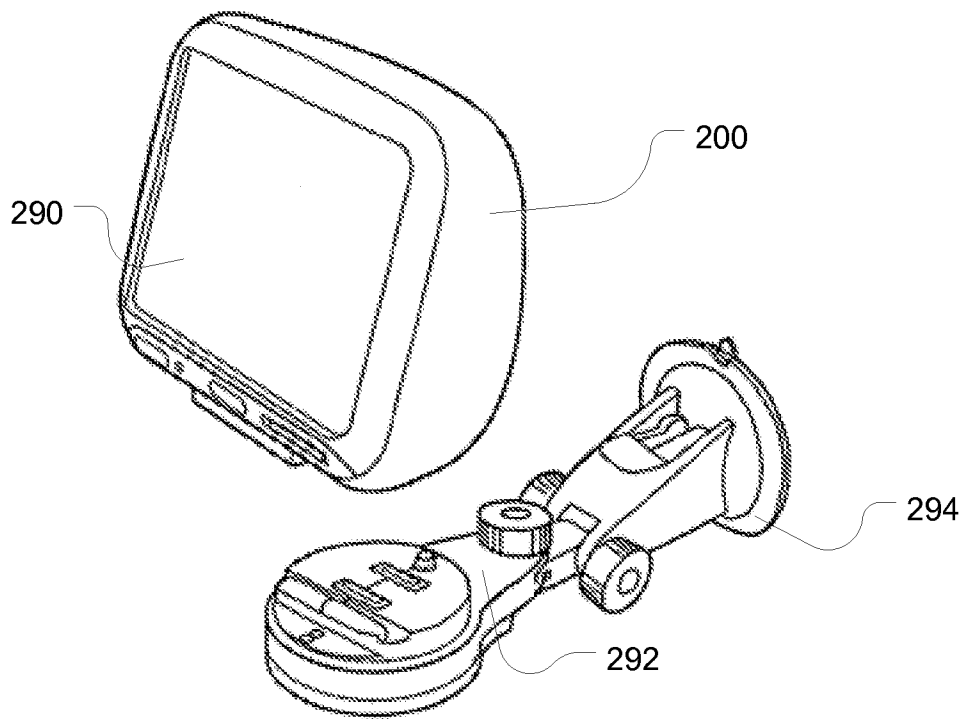


FIG. 4a

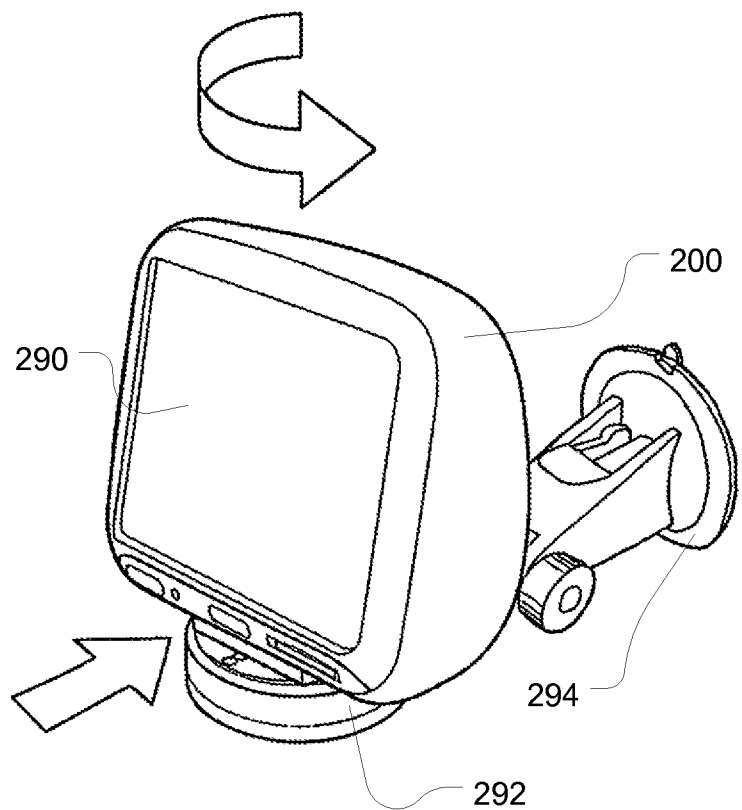
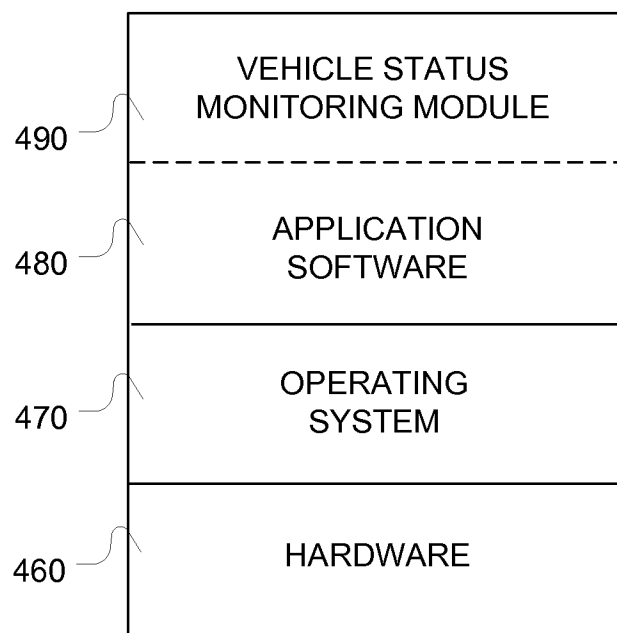
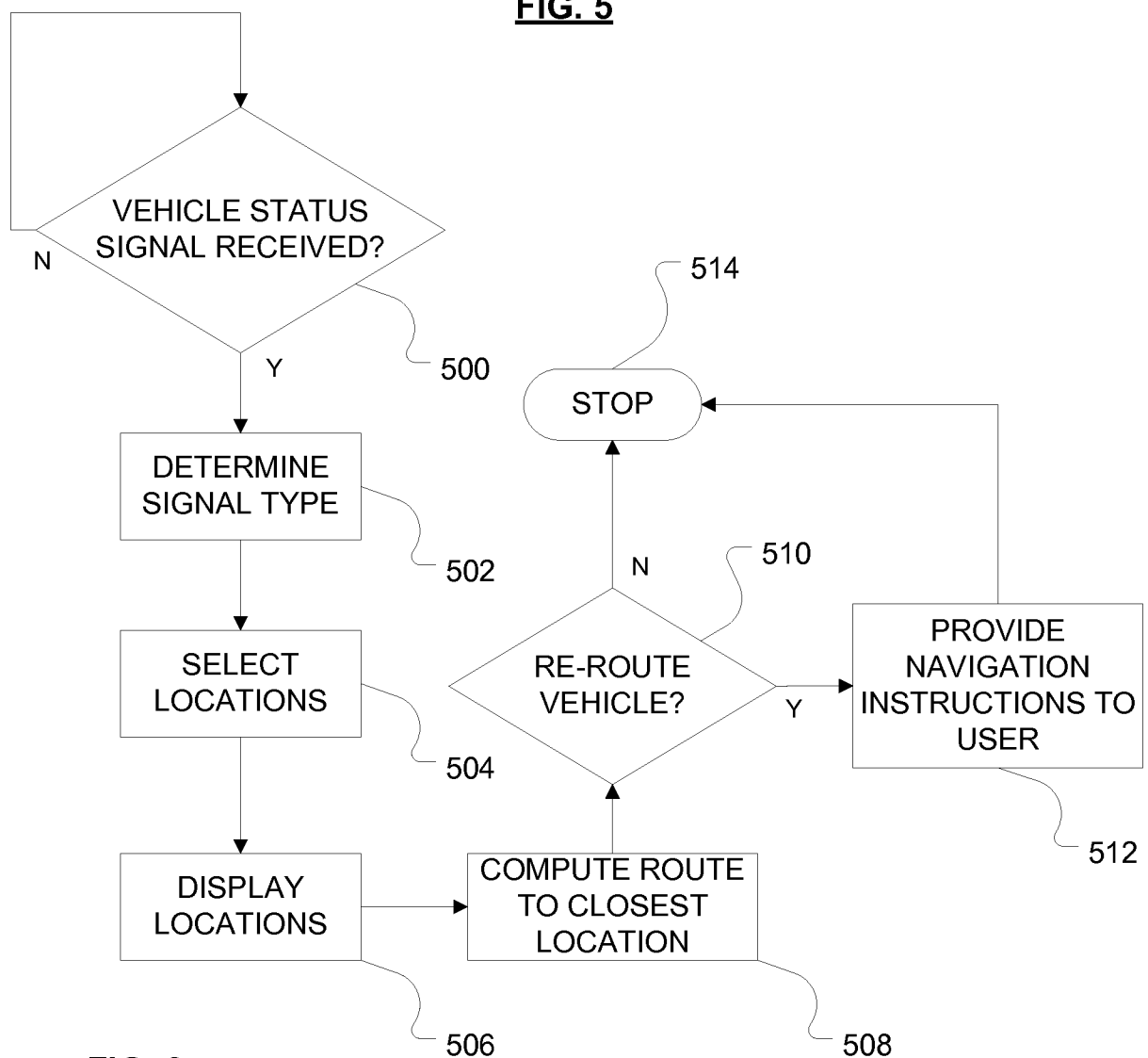


FIG. 4b

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**FIG. 5****FIG. 6**

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/058830

A. CLASSIFICATION OF SUBJECT MATTER

INV. G01C21/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 2006/200284 A1 (HWANG JUNG HYUN [KR]) 7 September 2006 (2006-09-07) abstract paragraphs [0002], [0008], [0017], [0021], [0022], [0024], [0026], [0028], [0029], [0039], [0041], [0044] figures 1,2	1-15
X	US 2009/076835 A1 (CARTER GARRY LYLE [US] ET AL) 19 March 2009 (2009-03-19) paragraphs [0001], [0062], [0063], [0064], [0065], [0066], [0067] ----- -/--	1-15

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/058830

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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