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(54) **Title**: NAVIGATION SYSTEM WITH MEANS FOR INDICATING THE LATERAL POSITION

(57) **Abstract**: A navigation apparatus (200) comprises a processing resource (202) that is couplable to a data store (214) which stores data representing an area through which the device can guide a user, means for selecting a desired destination and calculating a route from the position of the device to the selected destination, and means for indication to the user the lateral position of the device with respect to its longitudinal direction of travel.

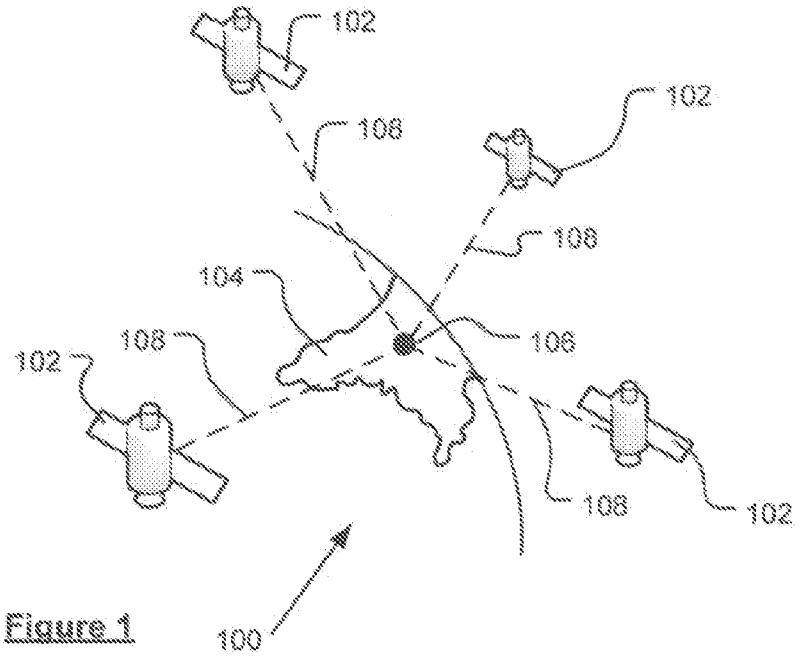

Figure 1

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NAVIGATION SYSTEM WITH MEANS FOR INDICATING THE LATERAL POSITION

Field of the Invention

The present invention relates to a navigation apparatus of the type that for example provides an indication to a user of the location of a an object which may be the navigation apparatus itself or a vehicle associated with the object.

Background to the Invention

Portable computing devices, for example 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 and non-volatile, 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 to control on/off operation or other features of the device (which buttons need not necessarily be on the device itself but could be on a steering wheel if the device is built into a vehicle), and a microphone for detecting user speech. In one particular arrangement, the output interface display may be configured as a touch sensitive display (by means of a touch sensitive overlay or otherwise) additionally to 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 Bluetooth, Wi-Fi, Wi-Max, GSM, UMTS and the like.

PNDs of this type also 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 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 PNDs if it is expedient to do so.

Such PNDs are primarily used 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).

PNDs of this type may typically be mounted on the dashboard or windscreen of a vehicle, but may also be formed 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 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

whereupon the server with which the user's computing resource is communicating 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 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 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 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.

An icon displayed on-screen typically denotes the current device location, and is centred with the map information of current and surrounding roads in the vicinity of the current device location and other map features also being displayed. Additionally, navigation information may be 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 deviation from the current road required to be taken by the user, the nature of that deviation possibly being represented by a further icon suggestive of the particular type of deviation, 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.

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.

Devices of the type described above, for example the 920T model manufactured and supplied by TomTom International B.V., provide a reliable means for enabling users to navigate from one position to another.

As mentioned above, the memory of the PND stores map data used by the PND not only to calculate routes and provide necessary navigation instructions to users, but also to provide visual information to users through the visual display of the PND.

It will be appreciated that such DPS systems can give quite accurate indications of location along a stored pathway such as a road or track. In particular current navigation systems often include what are known as "dead-reckoning sensors" such as accelerometers or gyroscopes or wheel-rotation counting devices to improve location accuracy as determined by the GPS system alone. However none of these systems are capable of giving accurate indications of lateral positioning , that is positioning transverse to the direction of movement. Thus such systems cannot determine which lane the driver of a car is using. In addition the system may calculate an incorrect position when there is a parallel road near to the road that the driver is driving on. This can be a real problem where driver visibility is limited by , for example, smoke or fog.

Summary of the Invention

According to a first aspect of the present invention, there is provided a Navigation device comprising: a processing resource couplable to a data store comprising data relating to an area through which the device can guide a user to a selected destination; an input for enabling a user to select a desired location, a location determination unit operably coupled to the processing resource and capable of determining the location of the device in respect of the area; a display device operably coupled to the processing resource for displaying an area surrounding the determined location of the device and an icon representing the device, and wherein the processsing resource is adapted to cooperate with a sensor resource for generating data from an indicator or an array of indicators positioned along a selected route being followed by device by receiving position data generated by the sensor resource from such an indicator or array of

indicators and to generate an indication for the user of the lateral position of the apparatus in respect of its longitudinal direction of travel.

According to a feature of the invention the device may include an optical resource for scanning markings associated with the route along which the device is moving. Preferably the sensor resource is operative to scan road lane markings. However it will be appreciated that the sensor resource may be operative to detect indicators along a route using non-optical means.

According to a second aspect of the present invention there is provided a method of generating a view to be displayed by a navigation device, the method comprising determining a location associated with the navigation device;

displaying an icon representing the actual location of the navigation device on the display of a route leading to the determined location;

detecting by one or more sensors an indicator or an array of indicators associated with the route along which the navigation device is travelling so as to generate data;

processing the data generated by the or each sensor to determine the position of the navigation device in relation to the indicator or or indicator array,

and generating an indication of the position of the device with respect to its position lateral to the direction of its movement along the route.

Brief Description of the Drawings

At least one embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic illustration of an exemplary part of a Global Positioning System (GPS) usable by a navigation device;

Figure 2 is a schematic diagram of a communications system for communication between a navigation device and a server;

Figure 3 is a schematic illustration of electronic components of one embodiment of the navigation device of Figure 2;

Figure 4 is a schematic diagram of an arrangement of mounting and/or docking a navigation device;

Figure 5 is a schematic representation of an architectural stack employed by the navigation device of Figure 3;

Figure 6 is a schematic illustration of entities supported by a processor of the navigation device of Figure 3;

Figure 7 is a perspective view of a situation in which the present invention is

applicable;

Figure 8 illustrates an embodiment of the present invention ;

Figure 9 is a flow diagram illustrating processing steps carried out by the embodiment of the invention of Figure 3; and

Figures 10 to 19 are screen shots from the navigation device.

Detailed Description of Preferred Embodiments

Throughout the following description identical reference numerals will be used to identify like parts.

Embodiments of the present invention will now be described with particular reference to a PND. It should be remembered, however, that the teachings of the present invention are not limited to PNDs but are instead universally applicable to any type of processing device that is configured to execute navigation software in a portable manner 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 vehicle such as an automobile, or indeed a portable computing resource, for example a portable personal computer (PC), a mobile telephone or a Personal 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, the Global Positioning System (GPS) of Figure 1 and the like are used for a variety of purposes. In general, the 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, acquiring a fourth satellite signal allows 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 100 comprises a plurality of satellites 102 orbiting about the earth 104. A GPS receiver 106 receives spread spectrum GPS satellite data signals 108 from a number of the plurality of satellites 102. The spread spectrum data signals 108 are continuously transmitted from each satellite 102, the spread spectrum data signals 108 transmitted each comprise a data stream including information identifying a particular satellite 102 from which the data stream originates. The GPS receiver 106 generally requires spread spectrum data signals 108 from at least three satellites 102 in order to be able to calculate a two-dimensional position. Receipt of a fourth spread spectrum data signal enables the GPS receiver 106 to calculate, using a known technique, a three-dimensional position.

Turning to Figure 2, a navigation device 200 comprising or coupled to the GPS receiver device 106, is capable of establishing a data session, if required, with network hardware of a “mobile” or telecommunications network via a mobile device (not shown), for example a mobile telephone, PDA, and/or any device with mobile telephone technology, in order to establish a digital connection, for example a digital connection via known Bluetooth technology. Thereafter, through its network service provider, the mobile device can establish a network connection (through the Internet for example) with a server 150. As such, a “mobile” network connection can be established between the navigation device 200 (which can be, and often is, mobile as it travels alone and/or in a vehicle) and the server 150 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 150, using the Internet for example, can be done in a known manner. In this respect, any number of appropriate data communications protocols can be employed, for example the TCP/IP layered protocol. Furthermore, the mobile device can utilize any number of communication standards such as CDMA2000, GSM, IEEE 802.11 a/b/c/g/n, etc.

Hence, it can be seen that the internet connection may be utilised, which can be achieved via data connection, via a mobile phone or mobile phone technology within the navigation device 200 for ex.

Although not shown, the navigation device 200 may, of course, include its own mobile telephone 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, and/or can include an insertable card (e.g. Subscriber Identity Module (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 150, via the Internet for example, in a manner similar to that of any mobile device.

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

In Figure 2, the navigation device 200 is depicted as being in communication with the server 150 via a generic communications channel 152 that can be implemented by any of a number of different arrangements. The communication channel 152 generically represents the propagating medium or path that connects the navigation device 200 and the server 150. The server 150 and the navigation device 200 can communicate when a connection via the communications channel 152 is established between the server 150 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 communication channel 152 is not limited to a particular communication technology. Additionally, the communication channel 152 is not limited to a single communication technology; that is, the channel 152 may include several communication links that use a variety of technology. For example, the communication channel 152 can

be adapted to provide a path for electrical, optical, and/or electromagnetic communications, etc. As such, the communication channel 152 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, free space, etc. Furthermore, the communication channel 152 can include intermediate devices such as routers, repeaters, buffers, transmitters, and receivers, for example.

In one illustrative arrangement, the communication channel 152 includes telephone and computer networks. Furthermore, the communication channel 152 may be capable of accommodating wireless communication, for example, infrared communications, radio frequency communications, such as microwave frequency communications, etc. Additionally, the communication channel 152 can accommodate satellite communication.

The communication signals transmitted through the communication channel 152 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 152. These signals may be modulated, encrypted and/or compressed signals as may be desirable for the communication technology.

The server 150 includes, in addition to other components which may not be illustrated, a processor 154 operatively connected to a memory 156 and further operatively connected, via a wired or wireless connection 158, to a mass data storage device 160. The mass storage device 160 contains a store of navigation data and map information, and can again be a separate device from the server 150 or can be incorporated into the server 150. The processor 154 is further operatively connected to transmitter 162 and receiver 164, to transmit and receive information to and from navigation device 200 via communications channel 152. The signals sent and received may include data, communication, and/or other propagated signals. The transmitter 162 and receiver 164 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 162 and receiver 164 may be combined into a single transceiver.

As mentioned above, the navigation device 200 can be arranged to communicate with the server 150 through communications channel 152, using transmitter 166 and receiver 168 to send and receive signals and/or data through the communications channel 152, noting that these devices can further be used to communicate with devices other than server 150. Further, the transmitter 166 and receiver 168 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 166 and receiver 168 may be combined into a single transceiver as described above in relation to Figure 2. Of course, the navigation device 200 comprises other hardware and/or functional parts, which will be described later herein in further detail.

Software stored in server memory 156 provides instructions for the processor 154 and allows the server 150 to provide services to the navigation device 200. One service provided by the server 150 involves processing requests from the navigation device 200 and transmitting navigation data from the mass data storage 160 to the navigation device 200. Another service that can be provided by the server 150 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 server 150 constitutes a remote source of data accessible by the navigation device 200 via a wireless channel. The server 150 may include a network server located on a local area network (LAN), wide area network (WAN), virtual private network (VPN), etc.

The server 150 may include a personal computer such as a desktop or laptop computer, and the communication channel 152 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 150 to establish an internet connection between the server 150 and the navigation device 200.

The navigation device 200 may be provided with information from the server 150 via information downloads which may be periodically updated automatically or upon a user connecting the navigation device 200 to the server 150 and/or may be more dynamic upon a more constant or frequent connection being made between the server 150 and navigation device 200 via a wireless mobile connection device and TCP/IP connection for example. For many dynamic calculations, the processor 154 in the server 150 may be used to handle the bulk of processing needs, however, a processor (not shown in Figure 2) of the navigation device 200 can also handle much processing and

calculation, independently of a connection to a server 150.

Referring to Figure 3, 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 is located within a housing (not shown). The navigation device 200 includes a processing resource comprising, for example, the processor 202 mentioned above, the processor 202 being coupled to an input device 204 and a display device, for example a display screen 206. Although reference is made here to the input device 204 in the singular, the skilled person should appreciate that the input device 204 represents any number of input devices, including a keyboard device, voice input device, touch panel and/or any other known input device utilised to input information. Likewise, the display screen 206 can include any type of display screen such as a Liquid Crystal Display (LCD), for example.

In one arrangement, one aspect of the input device 204, the touch panel, and the display screen 206 are integrated so as to provide an integrated input and display device, including a touchpad or touchscreen input 250 (Figure 4) to enable both input of information (via direct input, menu selection, etc.) and display of information through the touch panel screen so that a user need only touch a portion of the display screen 206 to select one of a plurality of display choices or to activate one of a plurality of virtual or "soft" buttons. In this respect, the processor 202 supports a Graphical User Interface (GUI) that operates in conjunction with the touchscreen.

In the navigation device 200, the processor 202 is operatively connected to and capable of receiving input information from input device 204 via a connection 210, and operatively connected to at least one of the display screen 206 and the output device 208, via respective output connections 212, to output information thereto. The navigation device 200 may include an output device 208, for example an audible output device (e.g. a loudspeaker). As the output device 208 can produce audible information for a user of the navigation device 200, it is should equally be understood that input device 204 can include a microphone and software for receiving input voice commands as well. Further, the navigation device 200 can also include any additional input device 204 and/or any additional output device, such as audio input/output devices for example.

The processor 202 is operatively connected to memory 214 via connection 216 and is further adapted to receive/send information from/to input/output (I/O) ports 218 via connection 220, wherein the I/O port 218 is connectible to an I/O device 222 external to the navigation device 200. The external I/O device 222 may include, but is not limited to an external listening device, such as an earpiece for example. The connection to I/O

device 222 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 earpiece or headphones, and/or for connection to a mobile telephone for example, wherein the mobile telephone connection can 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.

Figure 3 further illustrates an operative connection between the processor 202 and an antenna/receiver 224 via connection 226, wherein the antenna/receiver 224 can be a GPS antenna/receiver for example. It should be understood that the antenna and receiver designated by reference numeral 224 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.

Figure 3 additionally shows an input 285 for receiving real time detected lane information. As will be described with reference to Figure 8 this information is generated by a sensor module which will normally, but not necessarily essentially, be located at a distance from the navigation device 200. Such sensor modules are known and are arranged to derive data from indicators or markers arrayed along a route along which the user of the navigation device is being guided by the device. As will be described in greater detail hereinafter a navigation device in accordance with the present invention gives in operation a display showing the position of the device as it moves along a route towards a selected destination.

It will, of course, be understood by one of ordinary skill in the art that the electronic components shown in Figure 3 are powered by one or more power sources (not shown) in a conventional manner. As will also be understood by one of ordinary skill in the art, different configurations of the components shown in Figure 3 are contemplated. For example, the components shown in Figure 3 may be in communication with one another via wired and/or wireless connections and the like. Thus, the navigation device 200 described herein can be a portable or handheld navigation device 200.

In addition, the portable or handheld navigation device 200 of Figure 3 can be connected or “docked” in a known manner to 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.

Referring to Figure 4, the navigation device 200 may be a unit that includes the integrated input and display device 206 and the other components of Figure 2 (including,

but not limited to, the internal GPS receiver 224, the microprocessor 202, a power supply (not shown), memory systems 214, etc.).

The navigation device 200 may sit on an arm 252, which itself may be secured to a vehicle dashboard/window/etc. using a suction cup 254. This arm 252 is one example of a docking station to which the navigation device 200 can be docked. The navigation device 200 can be docked or otherwise connected to the arm 252 of the docking station by snap connecting the navigation device 200 to the arm 252 for example. The navigation device 200 may then be rotatable on the arm 252. To release the connection between the navigation device 200 and the docking station, a button (not shown) on the navigation device 200 may be pressed, for example. Other equally suitable arrangements for coupling and decoupling the navigation device 200 to a docking station are well known to persons of ordinary skill in the art.

Turning to Figure 5, the processor 202 and memory 214 cooperate to support a BIOS (Basic Input/Output System) 282 that functions as an interface between functional hardware components 280 of the navigation device 200 and the sensor module 285 and the software executed by the device. The processor 202 then loads an operating system 284 from the memory 214, which provides an environment in which application software 286 (implementing or all of the above described route planning and navigation) can run. The application software 286 provides an operational environment that supports including the GUI that supports core functions of the navigation device, for example map viewing, route planning, navigation functions and any other functions associated therewith.

Turning to Figure 6, the view generation module 288 supported by the processor 202 comprises a map data processor capable of communicating with a view generation engine 292. The map processor is capable of accessing the memory 214 in order to access map data 293. The map data 293 comprises a wide range of data such as terrain data, land use data and cartographic data along with data representing roads and tracks. In accordance with the present embodiment this map data also includes details of road lanes. This road lane data may be limited to roads with multiple lanes and in particular to situations such as shown in Figure 7 of the drawings. When the navigation device is in the process of providing a user of the device with guidance to a destination or merely following the progress of a trip movement along a route is described as taking place in a longitudinal direction.

Turning now to Figure 7 this shows one situation in which, for example a car or lorry driver when travelling at speed or under conditions of adverse visibility would be helped

by being provided with information indicating the position of his/her vehicle in a direction transverse to its longitudinal (as defined) direction of movement. As shown in Figure 7 a car is approaching a point where there are three possible routes which are initially substantially parallel to one another. Under conditions such as adverse visibility, the driver would have to make a rapid decision as to which road to take. In such a case information as to which road the driver is actually on will be important in making the correct decision and perhaps avoiding a rapid and dangerous change of lane.

Referring now to the block diagram of Figure 8 there is shown the basic elements of a lane guidance system in accordance with an embodiment of the present invention and which is capable of analysing sensor-acquired information from lane markings. Such a system is capable of determining not only the presence of the markings but can also determine if and which road markings (dashed, block line, single solid, solid and dashed,dashed and solid, double solid) is crossed.

Figure 8 schematically illustrates one embodiment of the present invention . A vehicle is generally indicated at 400 and a PND similar to that described hereinbefore is shown at 200. A lane sensor module 401 and the PND are connected to a control module 402 by a bus 403 which can be of the type known as a CAN bus. This control module and bus can control components such as the vehicle head and rear lights, automatic wind screen wipers, air conditioning and on-board entertainment systems in addition to the PND and air sensor module. As such control systems are well known no further description will be given. The control module 402 contains appropriate algorithms for monitoring the output from the sensor module. The sensor module 401 in the present embodiment contains a CMOS camera the output of which can either be processed in the sensor module or in control module 402 by an image processing algorithm to as to separate the picked-up lane information for the rest of the image and distinguish between the various lane markings as set out above. It will of course b appreciated that other sensor systems are possible so that the lane sensor module can be arranged to detect electro-magnetic waves generated during the passage of vehicle 300 past appropriate elements positioned along the route of the vehicle.

Figure 9 is a flow diagram showing processing steps of the embodiment of Figure 8 The navigation device is switched on at step S10 and the desired destination entered at step S11. At step S12 the device acquires its location and at step S13 a route is calculated. Naturally this can be to an intermediate destination rather than a final destination. At step S14 a decision in one embodiment can be made by the driver as to whether or not the sensor module is to be enabled. If so the lateral position of the vehicle

is calculated. For some routes data derived from the sensor module may not be required so that the driver can make this decision. Alternatively the sensors or sensors of the sensor module may always be enabled so that when appropriate indicators such as cat's eyes or lane markings are detected lateral position data is automatically calculated in step S14.

In another embodiment the map data concerning the area through which the navigation device is programmed to travel will contain data relating the situations such as that shown in Figure 7, namely situations in which lateral position information is important. These situations are automatically flagged by the processor 202 and the sensor module 301 is enabled automatically when the approach of an important situation is detected. In such a case an indication can be given to the driver that the sensors are operational and that the lateral position is important. The calculated lateral position is then displayed along with the already displayed route and icon present during the normal operation of a navigation device in step S16. If the sensor module has been manually disabled or has not been flagged a normal display of the position of the device along its route is displayed in step S15 using the data generated in step S13.

It will of course be appreciated that presenting information to the driver of a vehicle when approaching a road situation such as shown in Figure 7 with regard to its lateral position represents a particular problem. This is because of the scale of the actual width of a road means that lane information may be difficult to view. The present embodiment operates by giving an audible warning that a problem with regard to lanes and lane changing is approaching. In addition the system will of course continue to give an indication as to where the vehicle is. This may be achieved by for the period of the predicted lane change zooming in to an enlarged image for the part of the display surrounding the icon indicating the location of the vehicle

Referring now to Figures 10 to 19, an illustrative destination location input process will firstly be described in respect of a user whose start location is at an airport in Lyon, France, and who wishes to navigate to a street address in Grenoble, France, for which the user knows the street name and building number. Although not shown, the user uses a settings menu option supported by the application software 286 in order to select view generation in a three-dimensional mode.

When this user switches on the navigation device 200, the device 200 acquires a GPS fix and calculates (in a known manner) the current location of the navigation device 200. The user is then presented, as shown in Figure 10, with a display 300 showing in pseudo three-dimensions the local environment 302 in which the navigation device 200

is determined to be located, and in a region 304 of the display 300 below the local environment a series of control and status messages.

By touching the display of the local environment 302, the navigation device 200 switches to display (as shown in Figure 11) a series of virtual or soft buttons 306 by means of which a user can, inter alia, input a destination to which they wish to navigate.

By touching the "Navigate to" virtual button 308, the navigation device 200 switches to display (as shown in Figure 12) a plurality of virtual buttons that are each associated with a different category of selectable destinations. In this instance, the display shows a "home" button that if pressed would set the destination to a stored home location. The "favourite" button, if pressed, reveals a list of destinations that the user has previously stored in the navigation device 200 and if one of these destinations is then selected the destination for the route to be calculated is set to the selected previously stored destination. The "recent destination" soft button, if pressed, reveals a list of selectable destinations held in the memory of the navigation device 200 and to which the user has recently navigated. Selection of one of the destinations populating this list would set the destination location for this route to the selected (previously visited) location. The "point of interest" button, if pressed, reveals a number of options by means of which a user can opt to navigate to any of a plurality of locations, such as Automatic Teller Machines (ATMs), petrol stations or tourist attractions for example, that have been pre-stored in the navigation device 200 as locations to which a user of the navigation device 200 might want to navigate to. The triangular "arrow" shaped virtual button provides access to additional sub-menu options relating to the "Navigate to ..." menu option, and an "address" button 310 commences a process by which the user can input the street address of the destination to which the user wishes to navigate. Since the user, in this example, knows the street address of the destination to which the user wishes the navigation device 200 to navigate, it is assumed that the "address" button 310 is operated (by touching the button displayed on the touchscreen), whereupon (as shown in Figure 13) the user is presented with a series of address input options – in particular for address input by "city centre", by "postcode", by "crossing or intersection" (for example a junction of two roads) and by "street and house number".

In this example, the user knows the street address and house number of the destination and hence selects the "street and house number" virtual button 312 whereupon the user is then presented, as shown in Figure 14, a prompt 314 to enter the name of the city to which they wish to navigate, a flag button 316 by means of which the user can select the country in which the desired city is located, and a virtual keyboard

318 that may be operated by the user, if necessary, to input the name of the destination city. In this instance the user has previously navigated to locations in Lyon and Grenoble, and the navigation device 200 therefore additionally provides the user with a list 320 of selectable cites.

The user in this instance wishes to navigate to Grenoble, and on selection of Grenoble from the list 320 the navigation device 200 displays, as shown in Figure 15, the virtual keyboard 318 by means of which a user can input street names, a prompt 322 for entry of a streetname and, in this instance, as the user has previously navigated to a street in Grenoble, a list 324 of selectable streets in Grenoble.

In this example, the user wishes to return to the street, Avenue Du Général De Gaulle previously visited by the user, the user selects Avenue Du Général De Gaulle from the displayed list 324. Once a street has been selected, the navigation device 200 then displays a restricted, largely numeric, virtual keypad 326 and prompts the user, by means of prompt 328, to enter the number of the house in the selected street and city to which the user wishes to navigate. If the user has previously navigated to a building number in this street, then that number (as shown in Figure 16) is initially shown. If, as in this instance, the user wishes to navigate to No. 6, Avenue Du Général De Gaulle once again, then the user need only touch a “done” virtual button 330 displayed at the bottom right hand corner of the display 300. If the user should wish to navigate to a different building number in Avenue Du Général De Gaulle, then all the user need do is operate the virtual keypad 328 to input an appropriate building number. Figure 19 is a screen view close to arrival at the selected destination.

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 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 a series of computer instructions can constitute all or part of the functionality described above, and can also be stored in any memory device, volatile or non-volatile, such as semiconductor, magnetic, optical or other memory device.

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

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 whether or not that particular combination has been specifically enumerated in the accompanying claims at this time.

CLAIMS

1 A navigation device comprising: a processing resource couplable to a data store comprising data relating to an area through which the device can guide a user to a selected destination; an input for enabling a user to select a desired location, a location determination unit operably coupled to the processing resource and capable of determining the location of the device in respect of the area; a display device operably coupled to the processing resource for displaying an area surrounding the determined location of the device and an icon representing the device, and wherein the processsing resource is adapted to cooperate with a sensor resource for generating data from an indicator or array of indicators positioned along a selected route being followed by device by receiving position data generated by the sensor resource from such an indicator or array of indicators and to generate in response to the received data an indication for the user of the lateral position of the device in respect of its longitudinal direction of travel.

2) A device according to claim 1, wherein the device is adapted to be mounted in a road-travelling vehicle.

3) A device according to claim 1 claim or claim 2 wherein the sensor resource comprises a least one scanning resource for scanning markers or indicators arranged along the actual route which the device is displaying on the display device.

4) A device according to claim 1 or claim 2 wherein the sensor resource is optical resource and is operative to scan road lane markings.

5) A device according to any preceding claim wherein the sensor resource is operative to detect at least one substantially continuous structure associated with an actual route which the device is displaying on the display device.

6) A device according to any preceding claim wherein the data store is adapted to detect from the stored data relating to a selected route situations in which lateral position information may be of importance to the user of the navigation device

7) A device according to claim 5 or claim 6 wherein the sensor operates electro

magnetically.

8) A system comprising a navigation device according to any one of the preceding claims wherein the data store is remotely located from navigation apparatus and is accessible via a communications network

9) A method of generating a view to be displayed by a navigation device, the method comprising determining a location associated with the navigation device;

displaying an icon representing the actual location of the navigation device on the display of a route leading to the determined location;

detecting by one or more sensors an indicator or an array of indicators associated with the route along which the navigation device is travelling so as to generate data;

processing the data generated by the or each sensor to determine the position of the navigation device in relation to the indicator or or indicator array,

and generating an indication of the position of the device with respect to its position lateral to the direction of its movement along the route.

10) A method according to claim 8 wherein the sensing of the indicator or array of indicators is carried out optically.

11) A method according to claim 10 wherein the sensor or sensor array is arranged to scan reflective markings arranged along the actual selected route.

12 A method according to claim 9 wherein the sensor or sensor array operates by detecting electro-magnetic waves generated during or by the passage of the navigation device.

13) A method according to any one of claims 9 to 12 and including generating an indication for informing a user of the navigation device that a situation is about to occur in which lateral position information is of importance to the user.

14) A computer program element comprising computer program code means for enabling a computer to execute the method according to any one of claims 9 to 13.

15) A computer program element according to claim 14 and embodied on a computer readable medium.

16 A data store of a navigation device comprising map data together with data indicating route areas where the lateral position of the device is of importance.

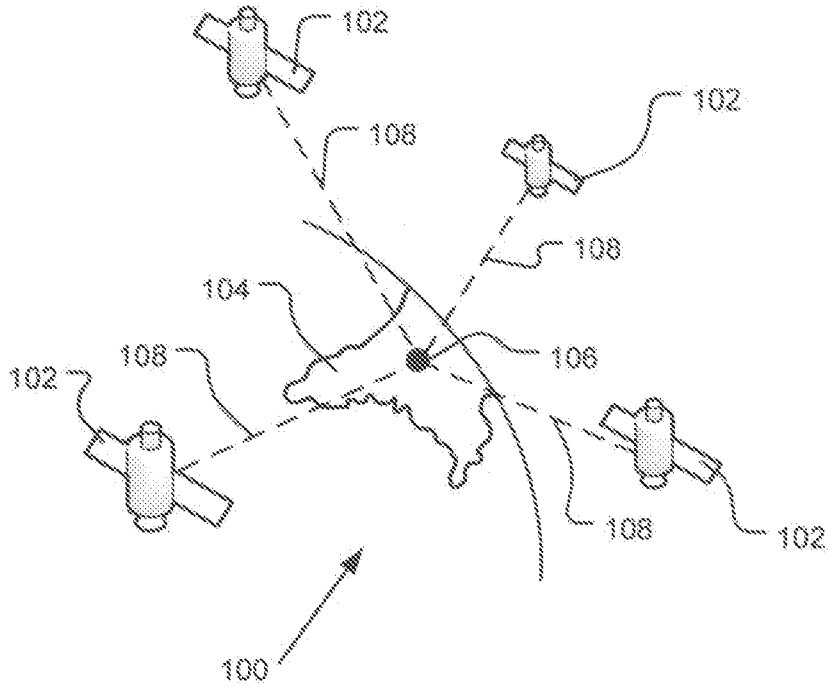


Figure 1

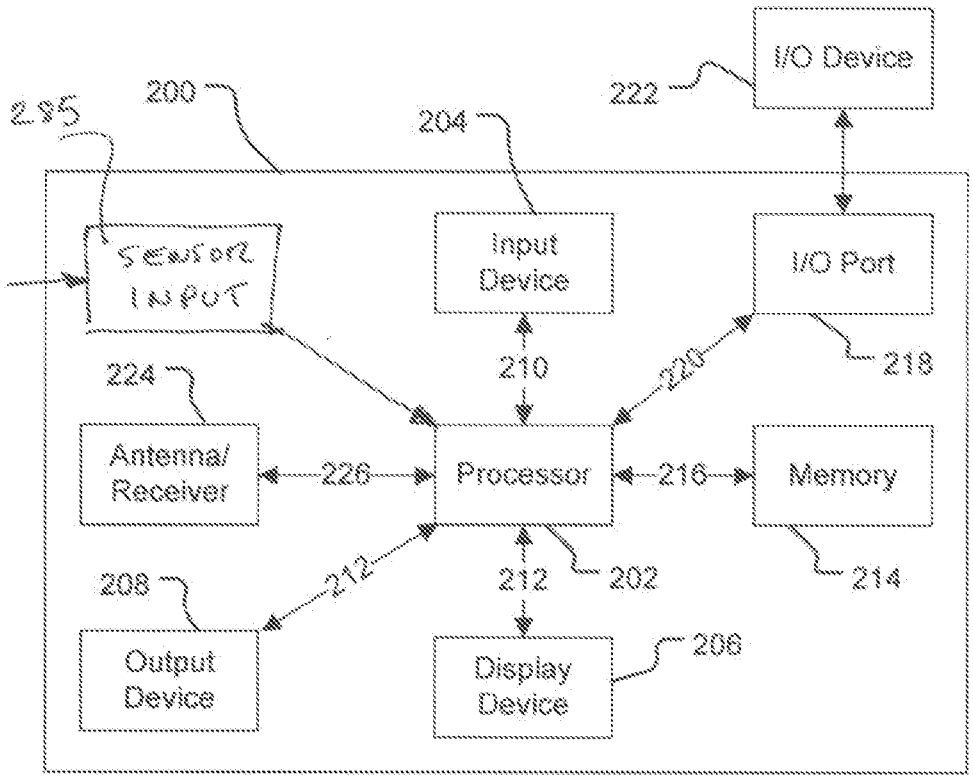


Figure 3

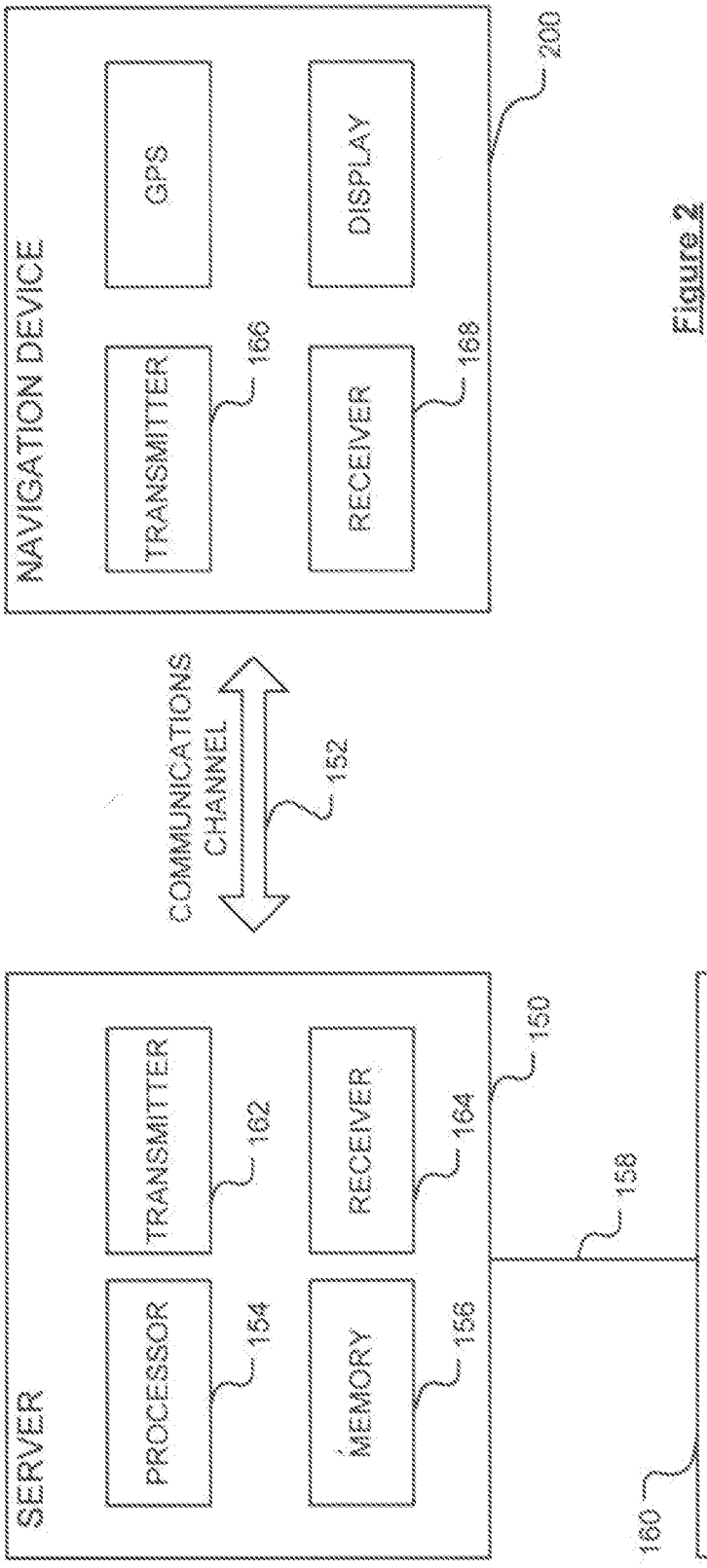

NAVIGATION DEVICE
GPS
DISPLAY
TRANSMITTER
RECEIVER
166
168
200
COMMUNICATIONS CHANNEL
152
SERVER
PROCESSOR
TRANSMITTER
MEMORY
RECEIVER
154
162
156
164
150
158
160
MASS DATA STORAGE

Figure 2

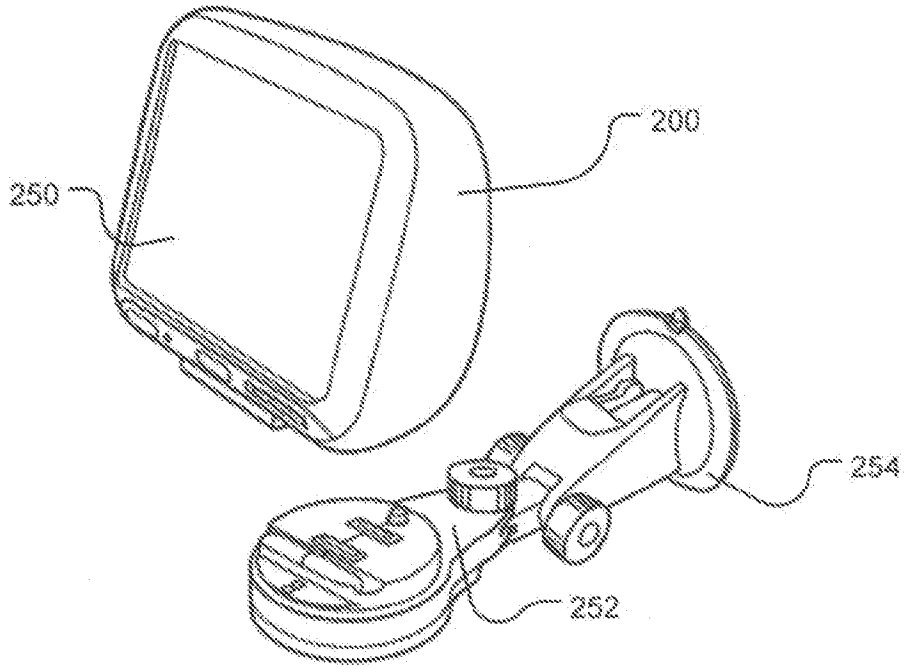


Figure 4

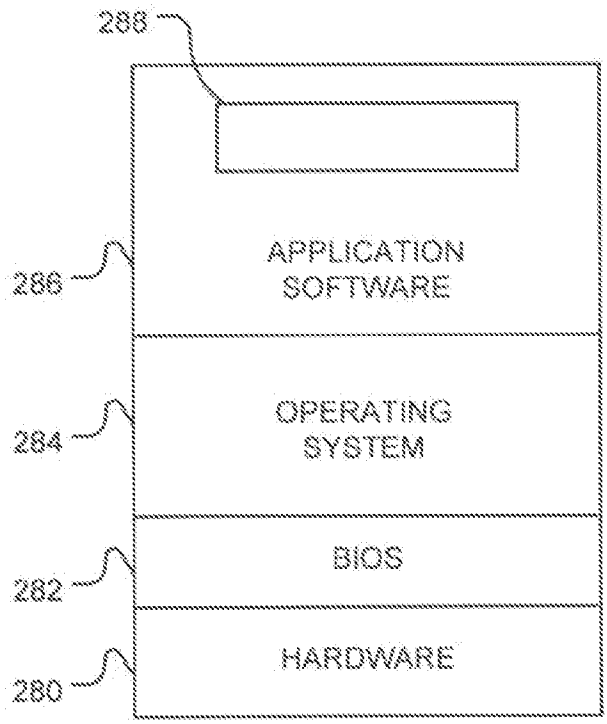


Figure 5

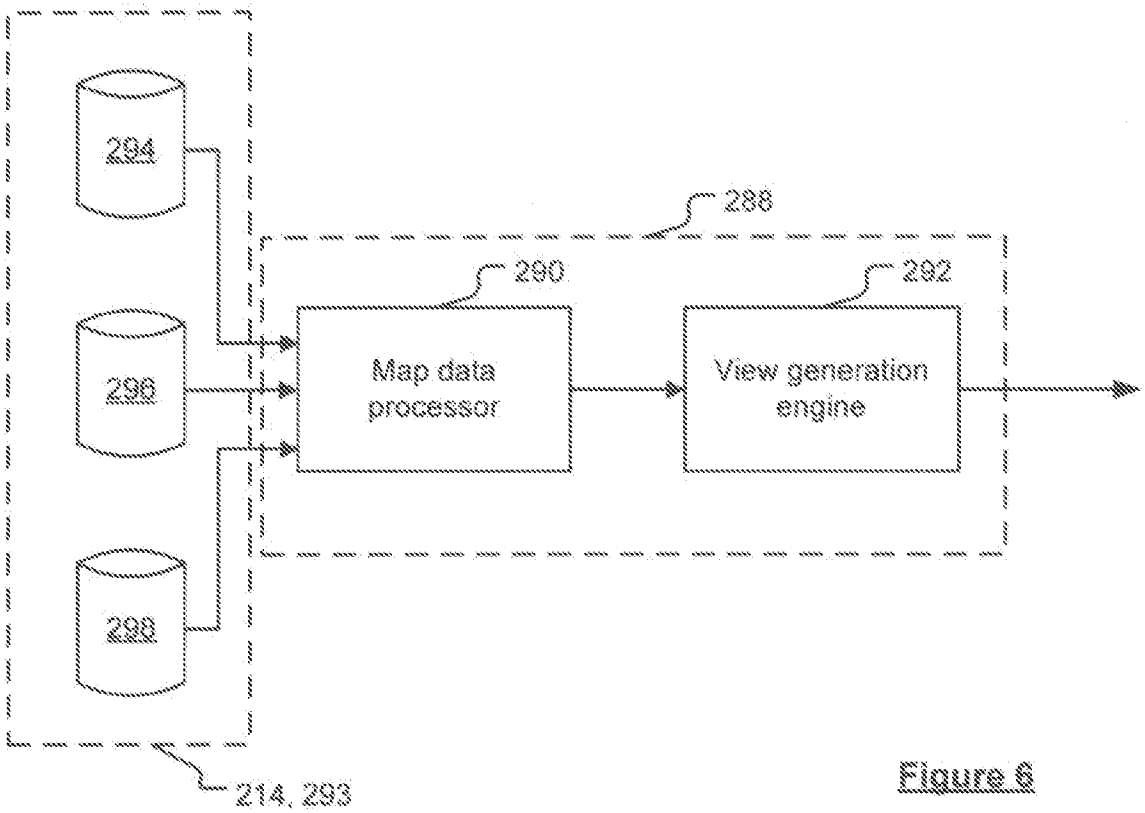

294
296
298
288
290
292
Map data processor
View generation engine
214, 293

Figure 6

FIGURE 7

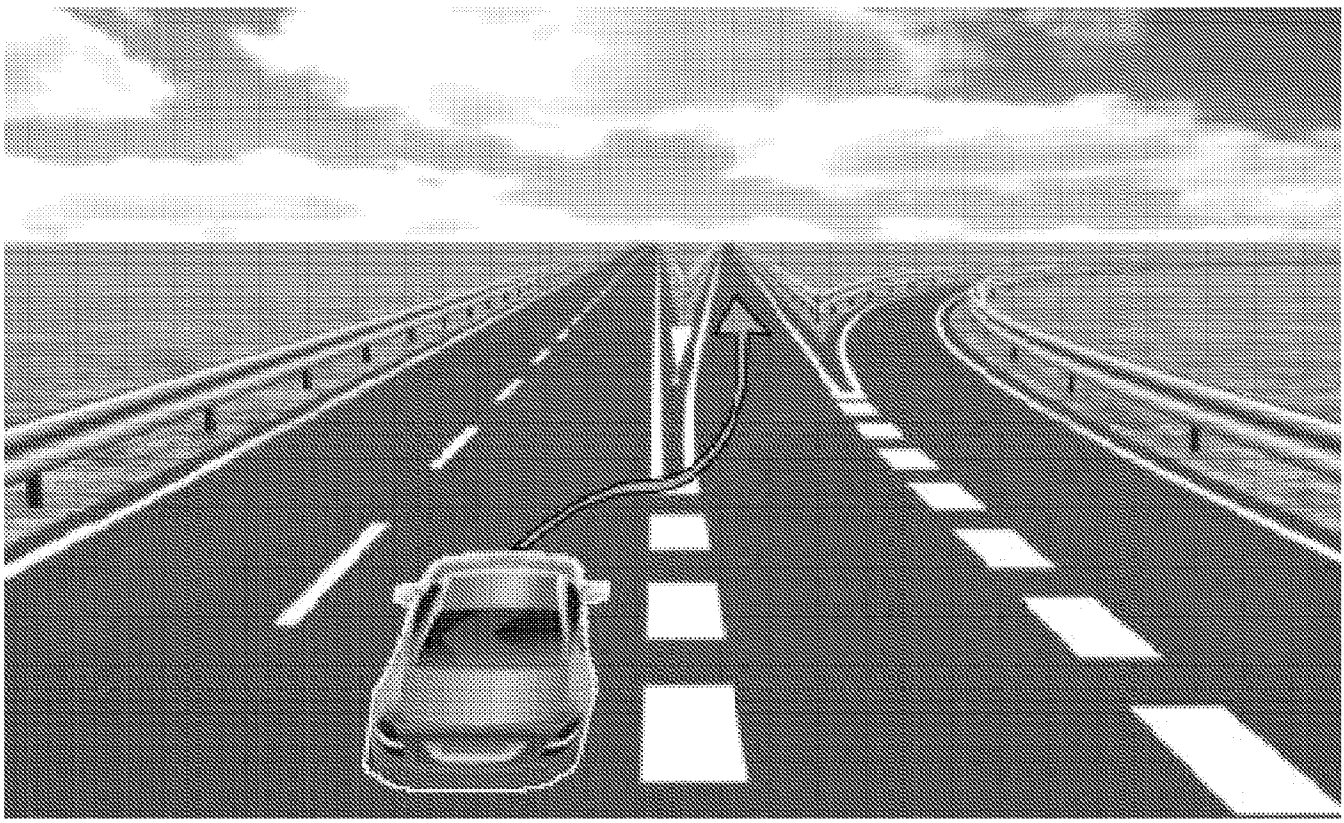


FIGURE 8

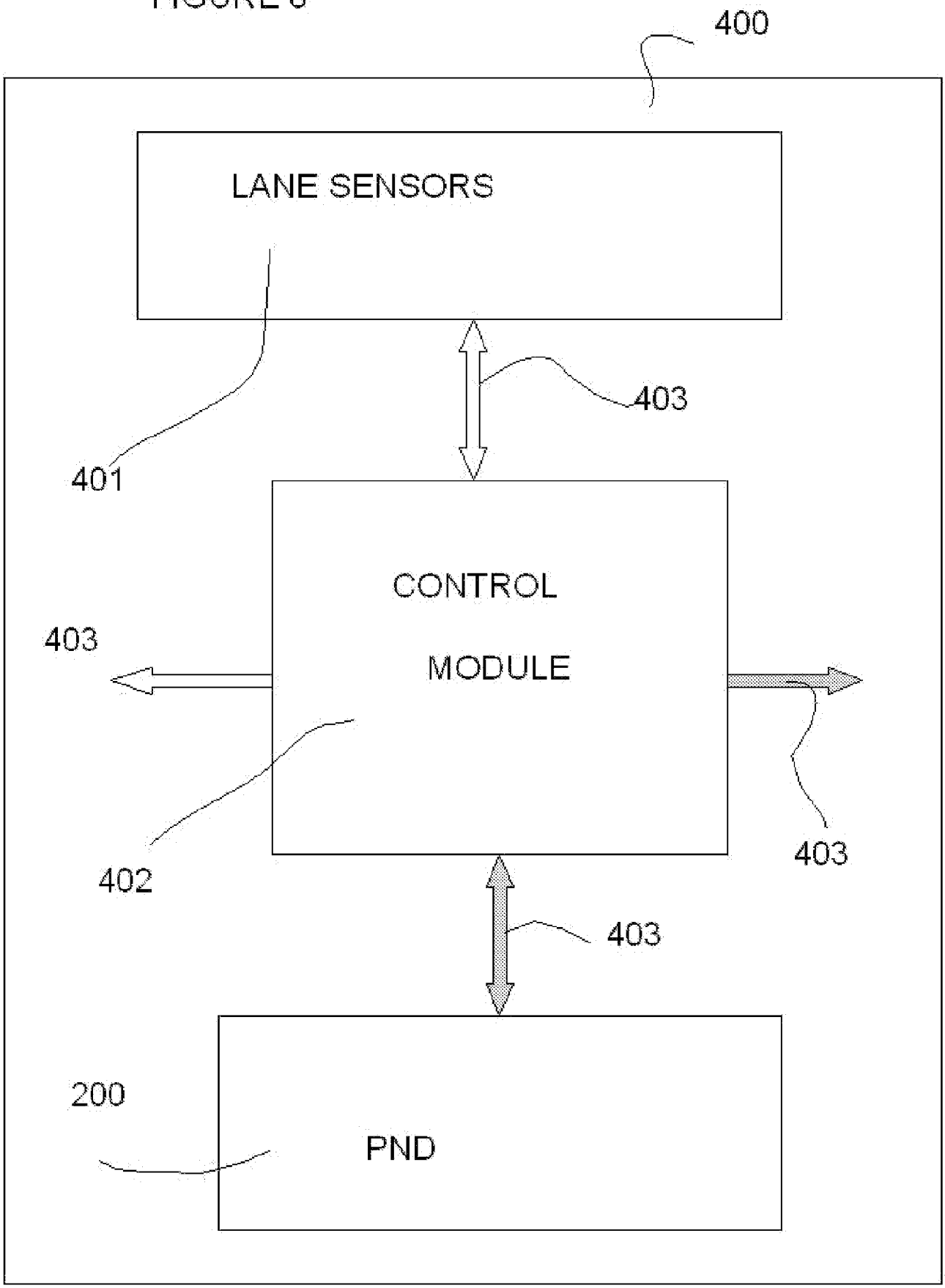

400
LANE SENSORS
401
403
CONTROL
MODULE
403
402
403
403
200
PND

FIGURE 9

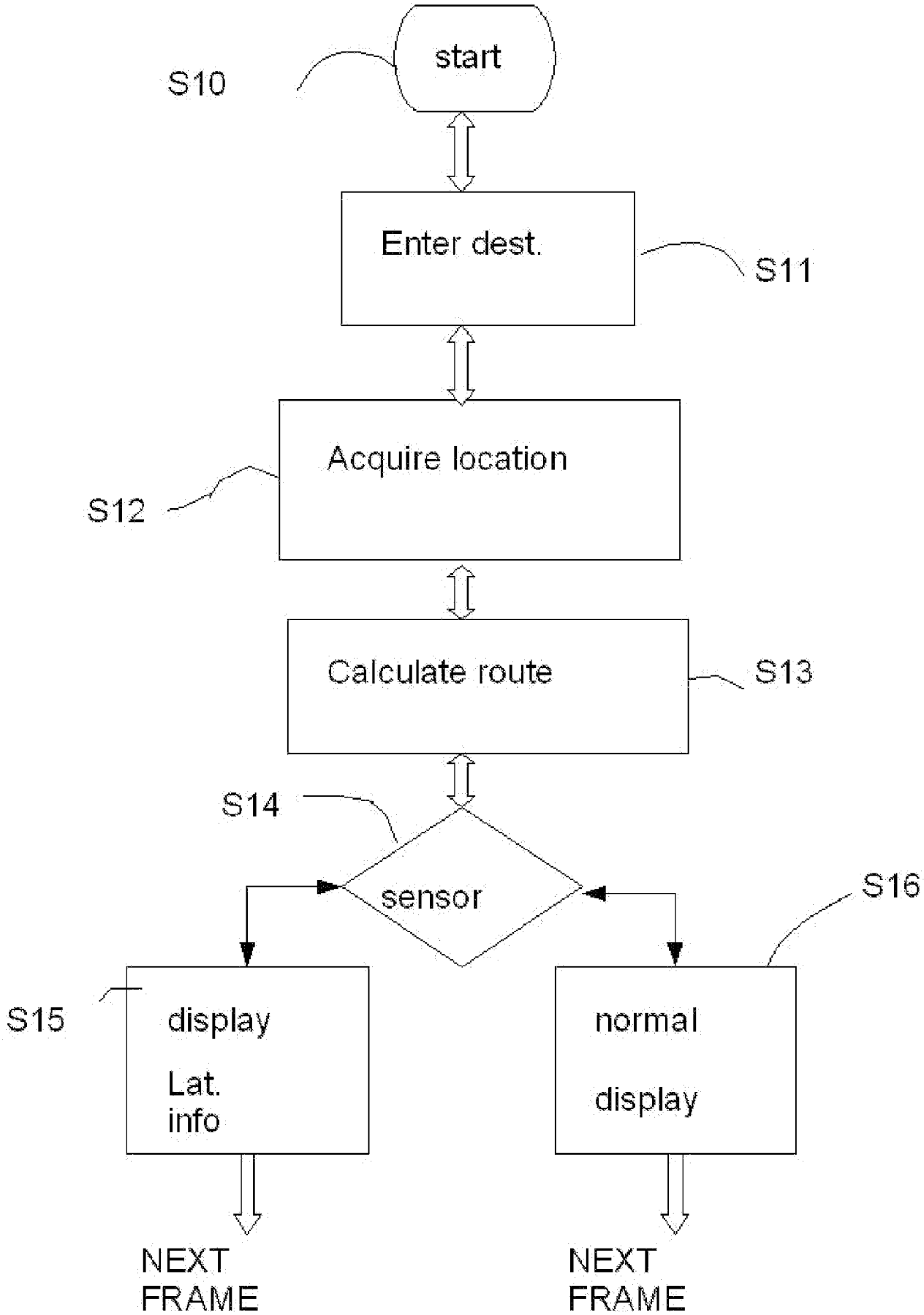

start
S10
Enter dest.
S11
Acquire location
S12
Calculate route
S13
S14
sensor
S16
S15
display
Lat.
info
normal
display
NEXT
FRAME
NEXT
FRAME

Figure 10

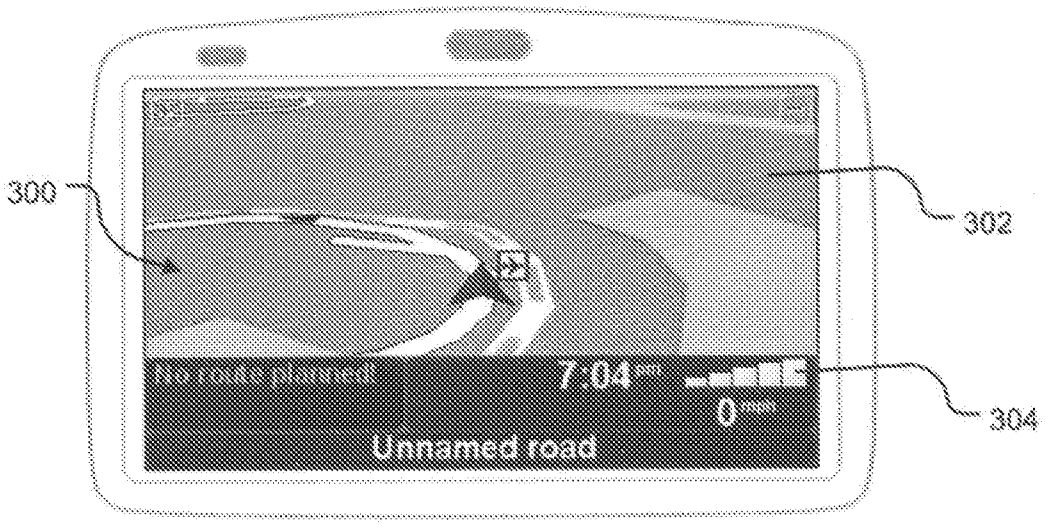


Figure 11

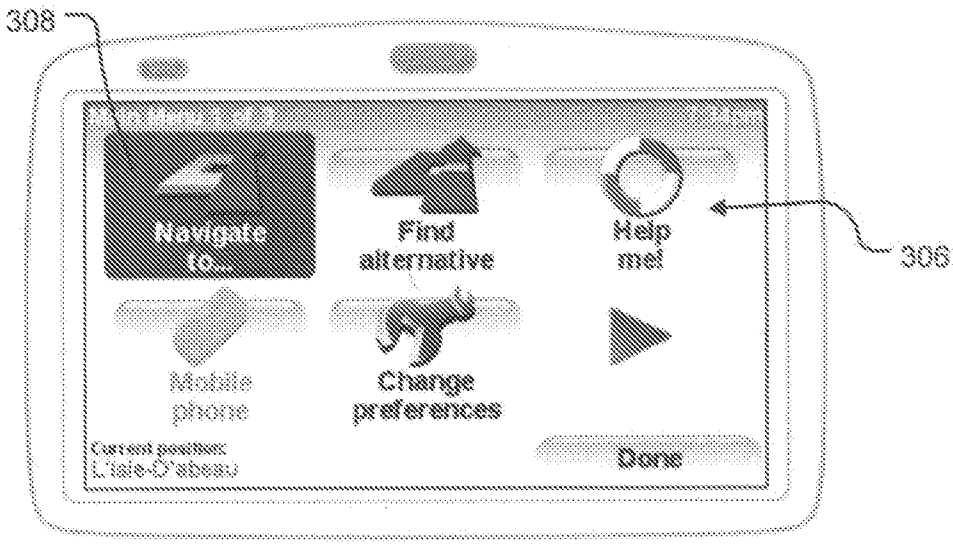


Figure 12

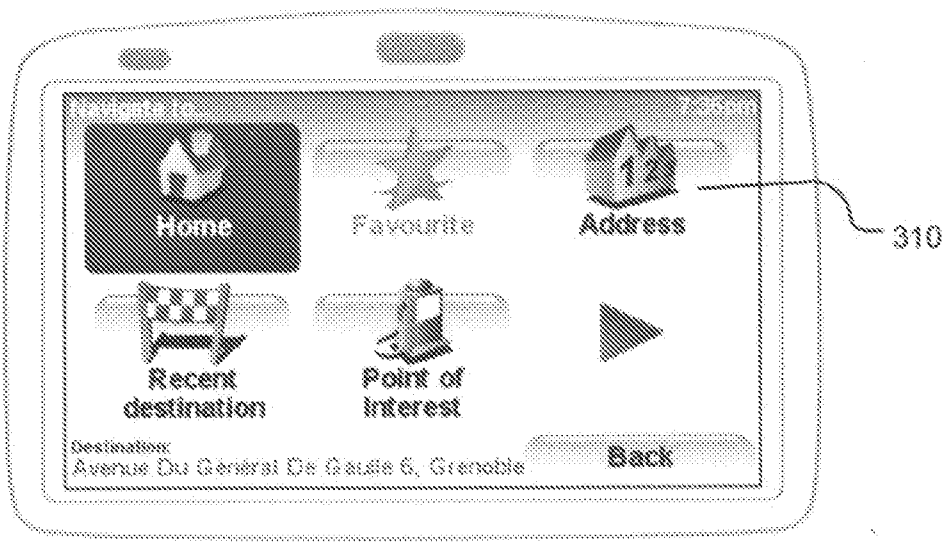


Figure 13

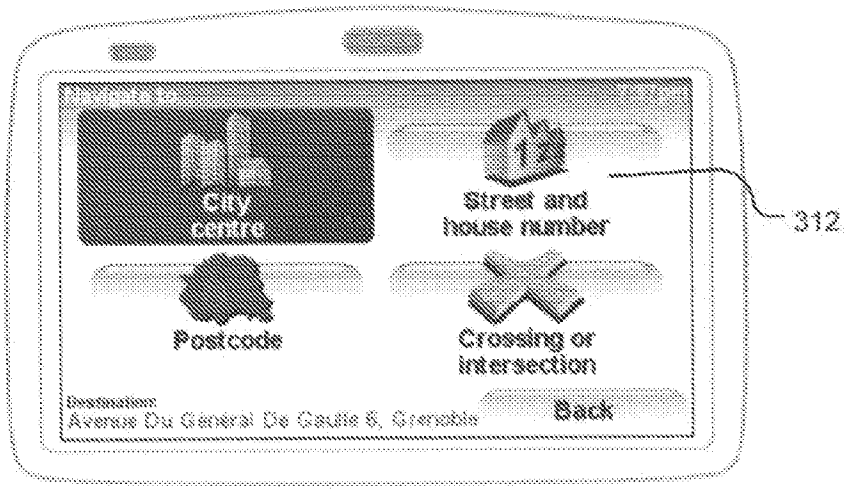


Figure 14

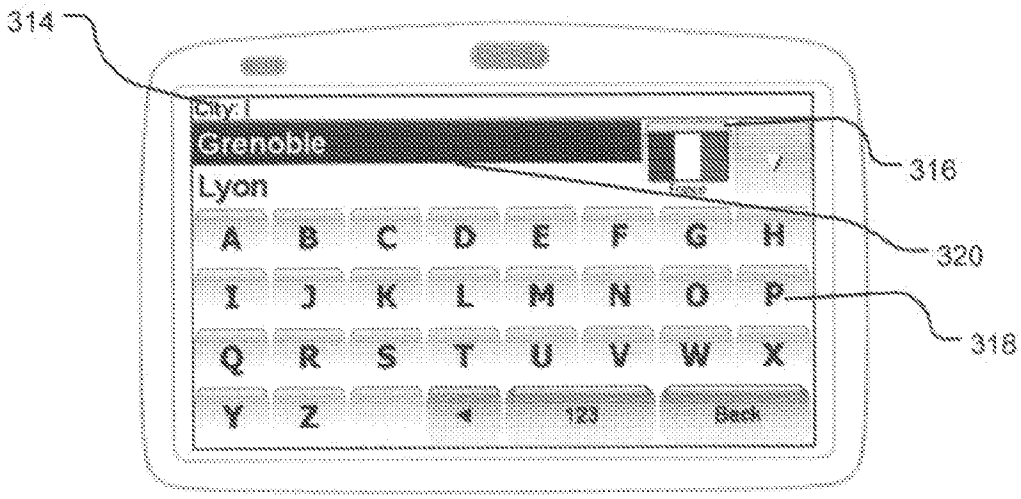


Figure 15

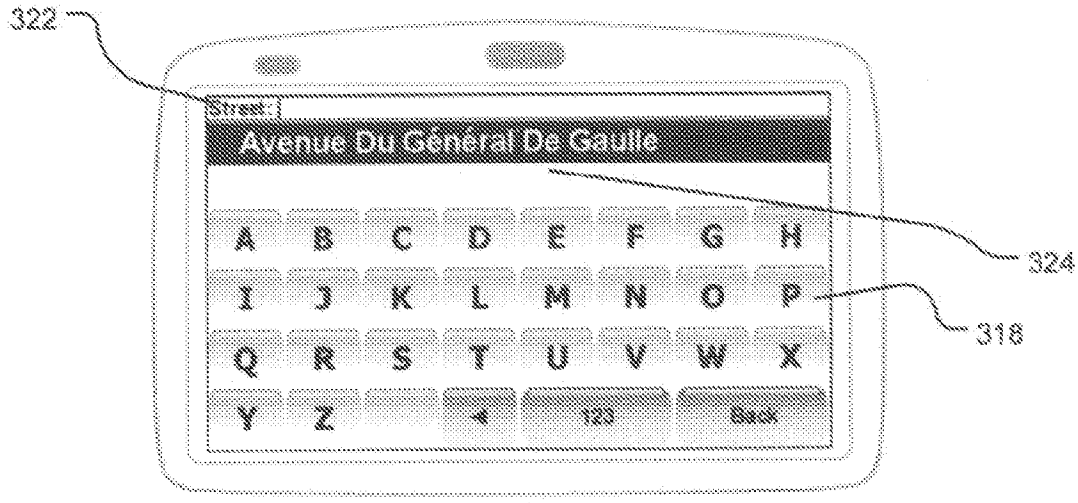


Figure 16

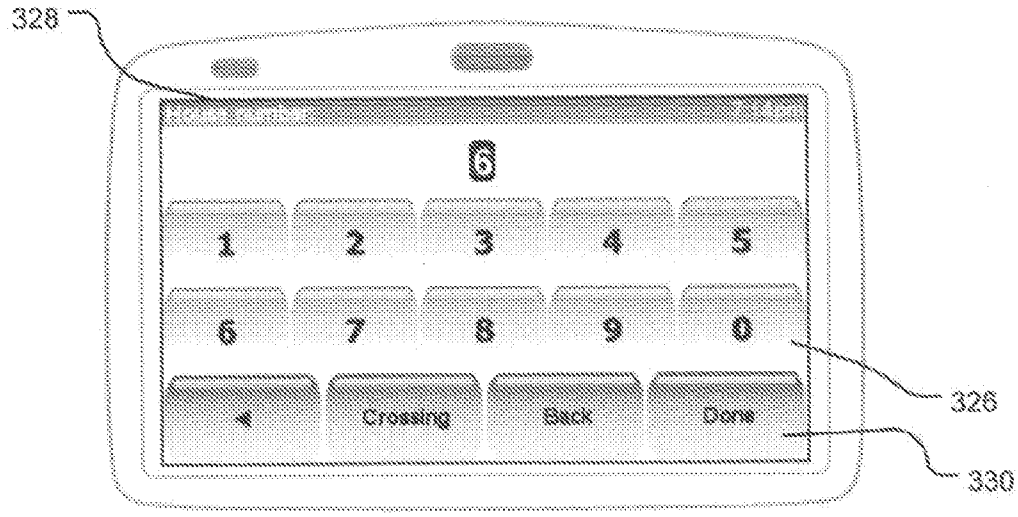


Figure 17

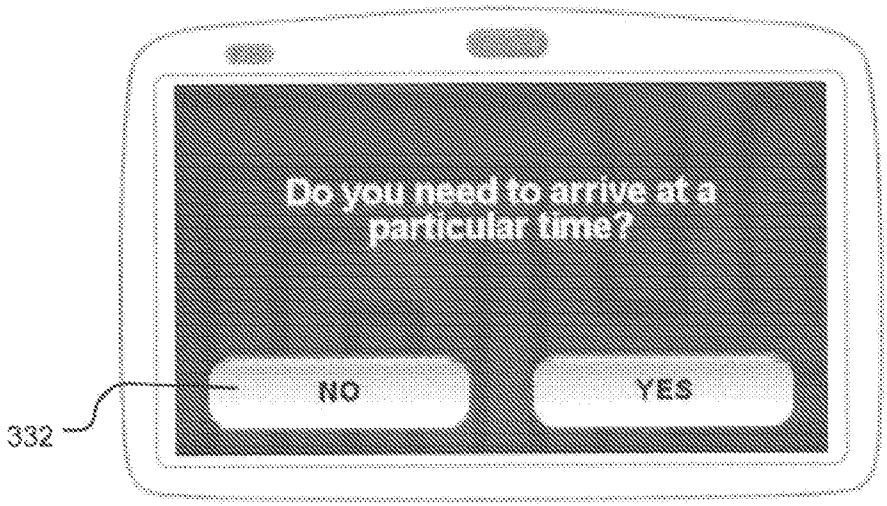


Figure 18

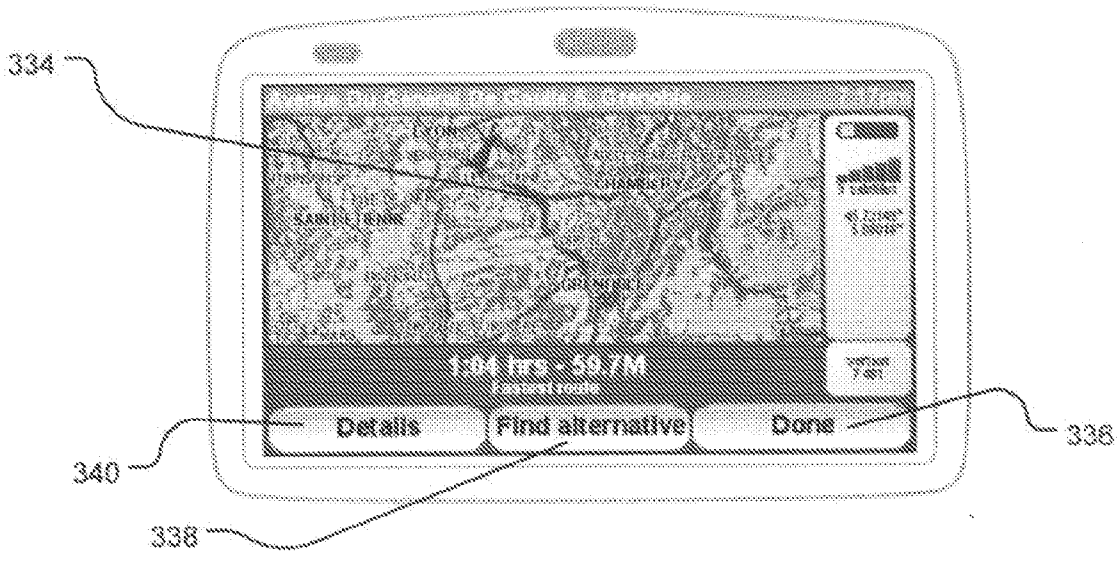
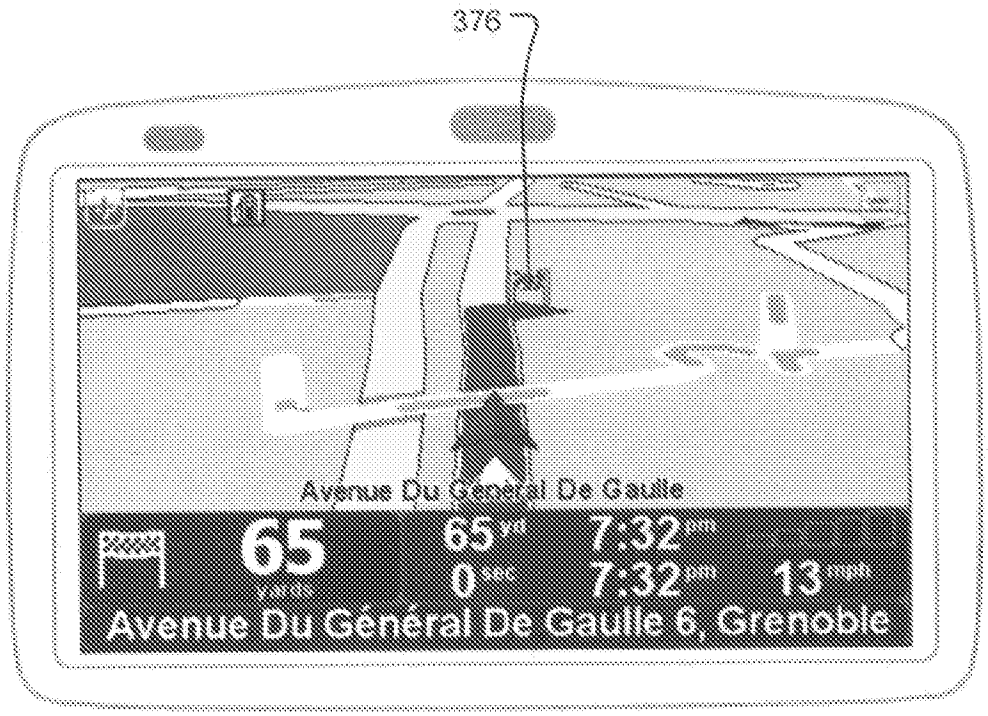


Figure 19


376
Avenue Du General De Gaulle
65
65
0
7:32
7:32
13
Avenue Du Général De Gaulle 6, Grenoble

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/068321

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01C21/34

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 G08G

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/106460 A1 (NAKAYAMA TAKAAKI [JP]; OONISHI SHINO [JP]; TAKEUCHI KENSUKE [JP]) 10 May 2007 (2007-05-10) paragraph [0047] paragraph [0055] - paragraph [0056]	1-10, 13-16
X	DE 10 2006 031877 A1 (AISIN AW CO [JP]) 25 January 2007 (2007-01-25) paragraph [0023] paragraph [0042]	1-7, 9-11, 13-16
X	US 2001/056326 A1 (KIMURA KEIICHI [JP]) 27 December 2001 (2001-12-27) paragraph [0008] paragraph [0074] - paragraph [0076] paragraph [0094] - paragraph [0102]	1-7, 9-10, 13-16

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 September 2009	18/09/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Rabenstein, Winfried

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/068321

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006/088916 A2 (UNIV MINNESOTA [US]; SHANKWITZ CRAIG [US]; BEVILACQUA MATHEW WILLIAM) 24 August 2006 (2006-08-24) page 1, line 24 - page 2, line 3 page 7, line 23 - line 33 page 15, line 10 - line 19 -----	1-3,6-7, 9,12-16

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2008/068321

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 2001056326 A1	27-12-2001	JP 2001289654 A	19-10-2001
WO 2006088916 A2	24-08-2006	US 2009115638 A1	07-05-2009