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(54) Title: NAVIGATION APPARATUS AND METHOD FOR USE THEREIN

(57) Abstract: A navigation apparatus (200) comprises a processor (202) and a memory (214) accessible by the processor (202) storing map data, wherein the processor (202) is arranged to store in the memory (214) route data indicative of one or more routes taken by the navigation device (200) which do not exist in the map data.

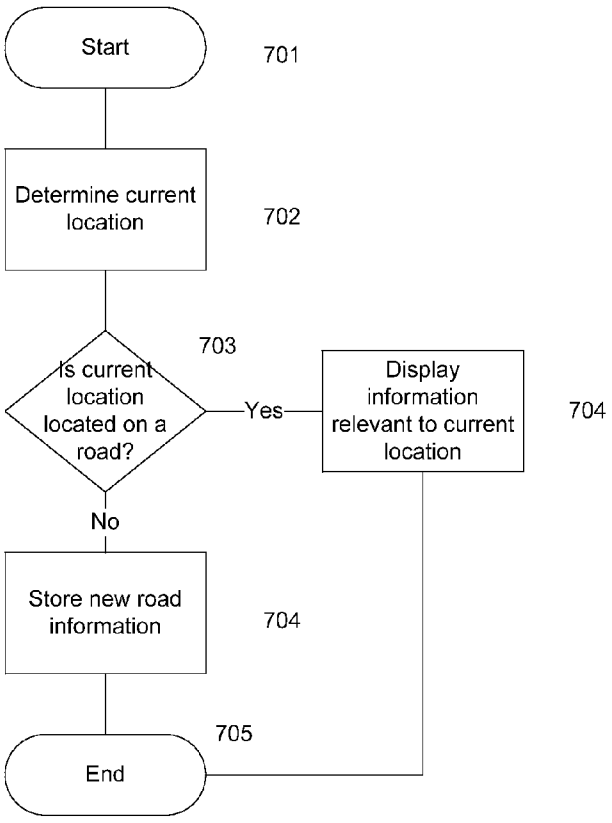

FIG. 7

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NAVIGATION APPARATUS AND METHOD FOR USE THEREIN

Field of the Invention

The present invention relates to a navigation apparatus of the type that provides navigational functionality with reference to map data. The present invention also relates to a method of navigation with reference to map data. The present invention further relates, although not exclusively, to a navigation apparatus of the type that determines a route to a destination along roads defined in map data and method thereof.

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.

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, 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.

A further important function provided by the device is automatic route re-calculation in the event that: a user deviates from the 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.

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. Such devices are of great utility when the user is not familiar with the route to the destination to which they are navigating.

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.

As is known in the art, map information can be expressed in a number of ways and indeed can comprise a number of separate information components, which are used in combination by the PND.

One aspect of map data is information relating to the layout of roads or highways. Map data specifies the location of roads in order to allow navigation to destinations. However, a problem arises when the layout of roads changes, or new roads are built which are not included in the map data.

Summary of the Invention

According to a first aspect of the present invention, there is provided a navigation apparatus comprising a processor (202) and a memory (214) accessible by the processor (202) storing map data; wherein the processor (202) is arranged to store in the memory (214) route data indicative of one or more routes taken by the navigation device (200) which do not exist in the map data.

According to a second aspect of the present invention, there is provided a method for use in a navigation apparatus, comprising storing in a memory (214) route data indicative of one or more routes taken by the navigation device (200) not corresponding to roadways indicated in map data accessible by the navigation device..

It is thus possible to provide an apparatus and method capable of including routes corresponding to new roads in map data. Consequently, user experience is enhanced, because a navigation apparatus automatically updates to take account of new roads.

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 the navigation device of Figure 2 or any other suitable navigation device;

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 diagram illustrating an example layout of roads in map data; and

Figure 7 is a flow chart illustrating an example of a method according to an embodiment of the present invention.

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 times 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 example.

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, oftentimes independent 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.

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 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 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 some or all of the above described route planning and navigation functionality) can run. The application software 286 provides an operational environment 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. In this

respect, part of the application software 286 comprises a map addition module 288.

Figure 6 is an illustration of a road layout in part of map data stored in memory 214. The map data contains information relating to two roads 61, 62 connecting locations A and B, where the two roads 61, 62 meet at a junction. Subsequent to the map data being stored in memory 214 of navigation device 200, a new road 63 has been built which connects to both of the existing roads 61, 62. The usefulness of the new road 63 is particularly in travelling between A and B and reduces a distance that needs to be travelled by a user. However, since road 63 is not present in map data accessible to the navigation device 200, then navigation device 200 cannot take advantage of potential savings in journey distance and/or time obtainable through using the new road 63.

In embodiments of the present invention, the navigation device 200 stores data relating to new routes made by the navigation device 200. An option to store or record new routes may be presented to the user in the form of a question on the display device 206, for example when the navigation device 200 is turned on. Alternatively, the option may be selected in a menu screen of the navigation device 200, for example in a “user preferences” setting screen.

Once activated, the navigation device 200 is arranged to determine a current location, for example, using GPS signals and, with reference to existing map data, a road on which it is located. If during navigation, either so called “free driving” or navigating to one or more destinations for which a route has been calculated, the navigation device 200 determines that it’s current location does not correspond to a road in the map data, then the navigation device 200 stores route information indicating a route taken which departs from roads defined in the existing map data.

Referring to Figure 6, assuming that the navigation device 200 is travelling from A to B, initially the navigation device 200 travels along road 62. At the junction between roads 62 and 63 the navigation device 200 departs from road 62 onto road 63, which the navigation device determines is not present in map data. The navigation device 200, in particular the map addition module 288 thereof, determines that the route has departed from road 62 into an area in which no road is known to exist. Therefore the map addition module 288 begins to store information indicating a new route in memory 214. The new route follows the road 63 which does not exist in the map data. In this way, information indicating a route between roads 61 and 62 corresponding to new road 63 is stored in memory 214 of navigation device 200.

The information relating to new routes may be stored in a separate file from the original map data in memory 214 of the navigation device 200. In some embodiments, a

separate copy of the original map data may be utilised and new routes added to the separate copy.

An embodiment of a method of the present invention is shown in Figure 7. The method begins in step 701 wherein the navigation device 200 has been configured to store new route information in memory 214. In step 702 the navigation device 200 determines its current location, for example by use of GPS signals as explained above. In step 703 the navigation device 200 determines if the current location corresponds to a road in the existing map data, either originally supplied map data or additional road data stored in memory 214 as a result of the current process. If the current location does correspond to an existing road, then information relating to the current road is displayed on display device 206 in step 704. However, if the current location does not correspond to a road in the map data, then it is assumed that the navigation device 200 is travelling on a new road and the processor 202 is arranged to store information recording the path taken by the navigation device 200 in the memory 214 as new road data.

When the navigation device 200 is used to determine a route to a destination and new road data exists in memory 214, the navigation device 200 may use the new road data in the route determination. For example, in the illustration of Figure 6, the navigation device 200 having information relating to road 63 stored in memory 214 may determine a route between A and B via road 63.

In some embodiments, the new routes may be communicated via communications channel 152 to the server 150. The server 150 may collect new road information from a plurality of users and may allow the sharing of the new road information amongst navigation devices 200, for example, by downloading one or more files storing new road data or allowing access to new road data via communications channel 152. Users may then be able to use the new road data in route determination.

Advantageously, embodiments of the present invention allow navigation devices to supplement map data with routes taken by the navigation device.

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.

Whilst embodiments described in the foregoing detailed description refer to GPS, it should be noted that the navigation device may utilise any kind of 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.

Alternative embodiments of the invention can be implemented as a computer program product for use with a computer system, the computer program product being, for example, a series of computer instructions stored on a tangible data recording medium, such as a diskette, CD-ROM, ROM, or fixed disk, or embodied in a computer data signal, the signal being transmitted over a tangible medium or a wireless medium, for example, microwave or infrared. The 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 apparatus (200) comprising:

a processor (202); and

a memory (214) accessible by the processor (202) storing map data;

characterised in that:

the processor (202) is arranged to store in the memory (214) route data indicative of one or more routes taken by the navigation device (200) which do not exist in the map data.

2. The navigation apparatus (200) of claim 1, comprising:

means (224) for determining a current location of the navigation device;

wherein the processor (202) is arranged to determine whether the current location corresponds to a road defined in the map data, and to store route data in the memory (214) (214) when the current location does not correspond to a road in the map data.

3. The navigation apparatus (200) of claim 2, wherein the processor (202) is arranged to determine whether the current location corresponds to route data stored in the memory (214) and not to store further route data when data indicate the route already exists in the memory (214).

4. The navigation apparatus (200) of any preceding claim, wherein the processor (202) is arranged to determine a route to a destination with reference to the map data and the route data stored in the memory (214).

5. The navigation apparatus (200) of any preceding claim, wherein the route data is separately stored from the map data in the memory (214).

6. The navigation apparatus (200) of any preceding claim, comprising means (166, 168) for communicating with a server (150), wherein the navigation device is arranged to transmit the route data to the server (150).

7. A method for use in a navigation apparatus (200), comprising:

storing in a memory (214) route data indicative of one or more routes taken by the navigation device (200) not corresponding to roadways indicated in map data

accessible by the navigation device.

8. The method of claim 7, comprising:

determining a current location of the navigation apparatus (200);

determining whether the current location corresponds to a roadway indicated in the map data;

storing route data in the memory (214) when the current location does not correspond to a roadway.

9. The method of claim 7 or 8, comprising determining a route to a destination with reference to the route data stored in the memory (214) and the map data.

10. The method of any of claims 7 to 9, comprising:

determining whether the current location is indicated in the route data and not storing route data when said current location is indicated in the route data.

11. The method of any of claims 7 to 10, comprising communicating the route data with a server (150).

12. The method of any of claims 7 to 11, wherein the route data is stored separately in the memory (214) from the map data.

13. A machine readable storage medium comprising instructions stored thereon which, when executed by a computer, perform the method of any of claims 7 to 12.

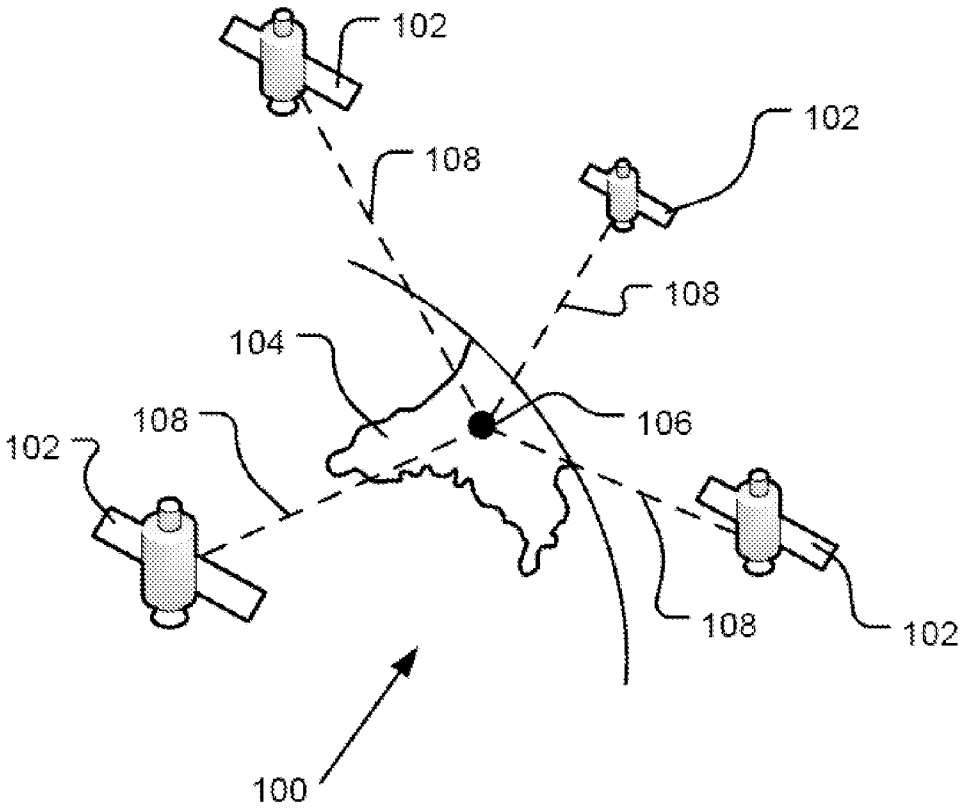
102
102
108
108
104
106
102
108
108
102
100

FIG. 1

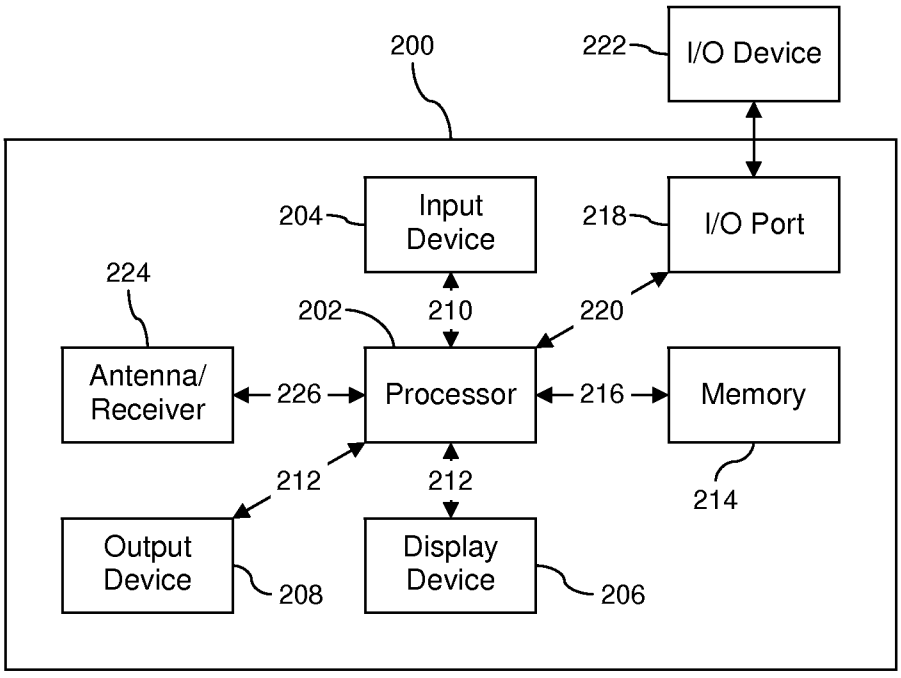
200
222
I/O Device
Input Device
204
218
I/O Port
224
202
210
220
Antenna/ Receiver
226
Processor
216
Memory
212
212
214
Output Device
208
Display Device
206

FIG. 2

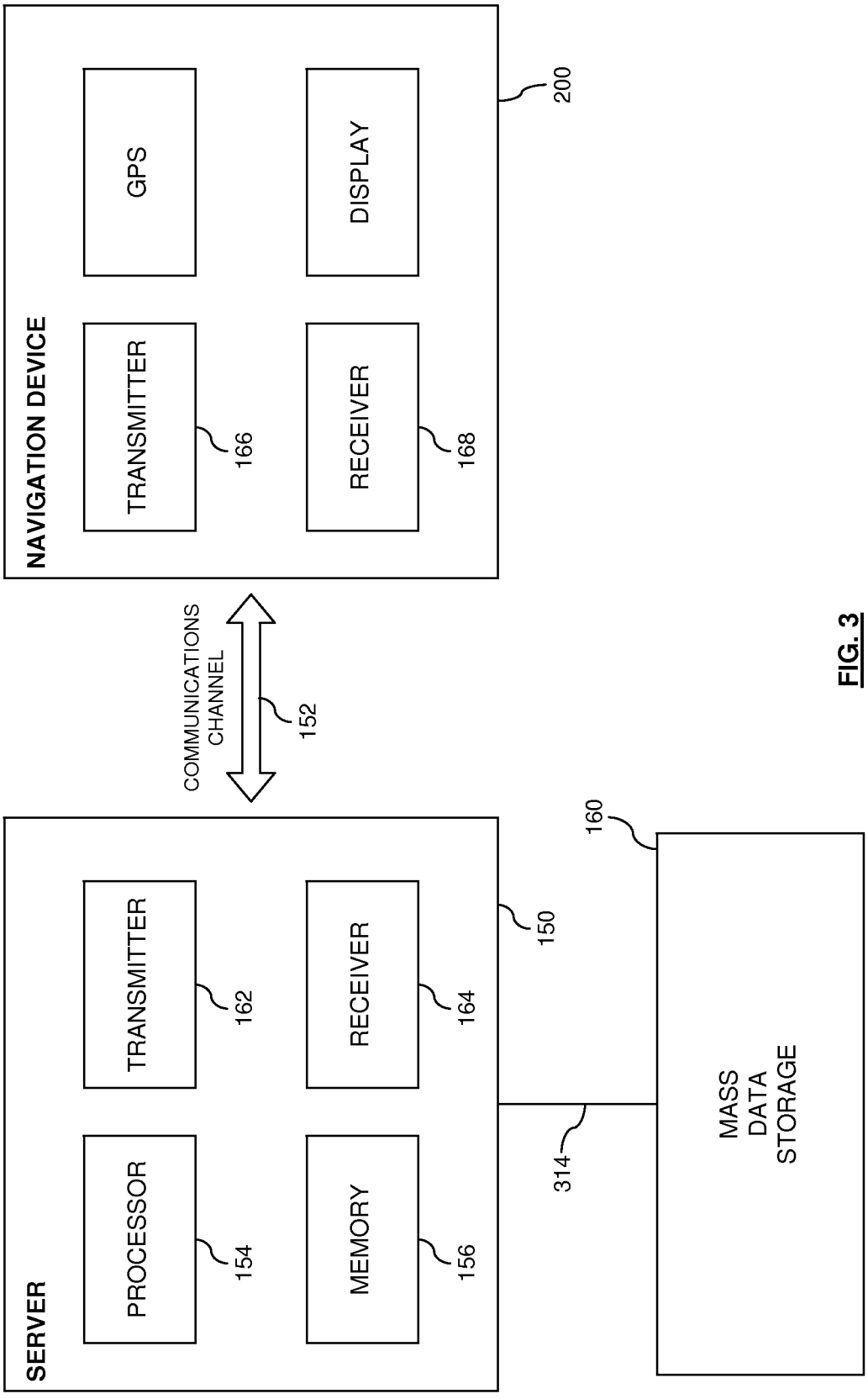
NAVIGATION DEVICE
GPS
DISPLAY
TRANSMITTER
166
RECEIVER
168
200
COMMUNICATIONS CHANNEL
152
SERVER
PROCESSOR
154
TRANSMITTER
162
MEMORY
156
RECEIVER
164
150
160
314
MASS DATA STORAGE

FIG. 3

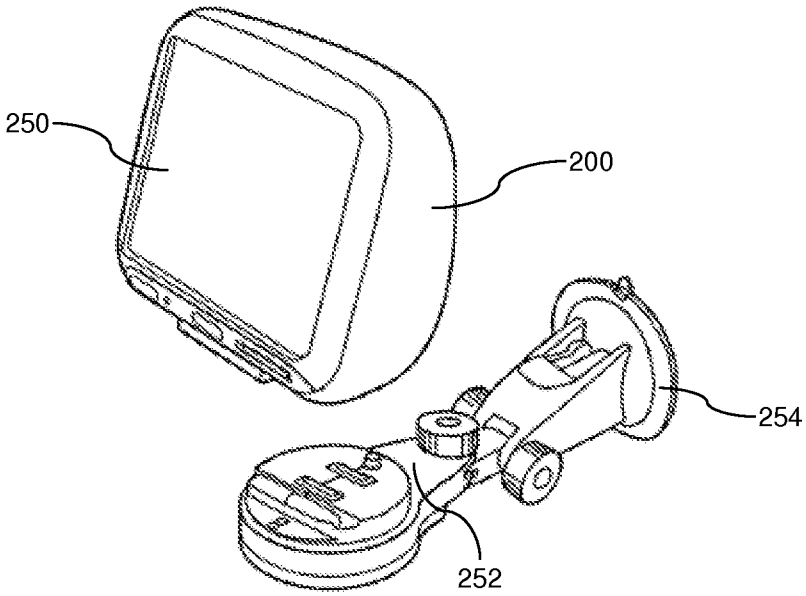
250
200
254
252

FIG. 4a

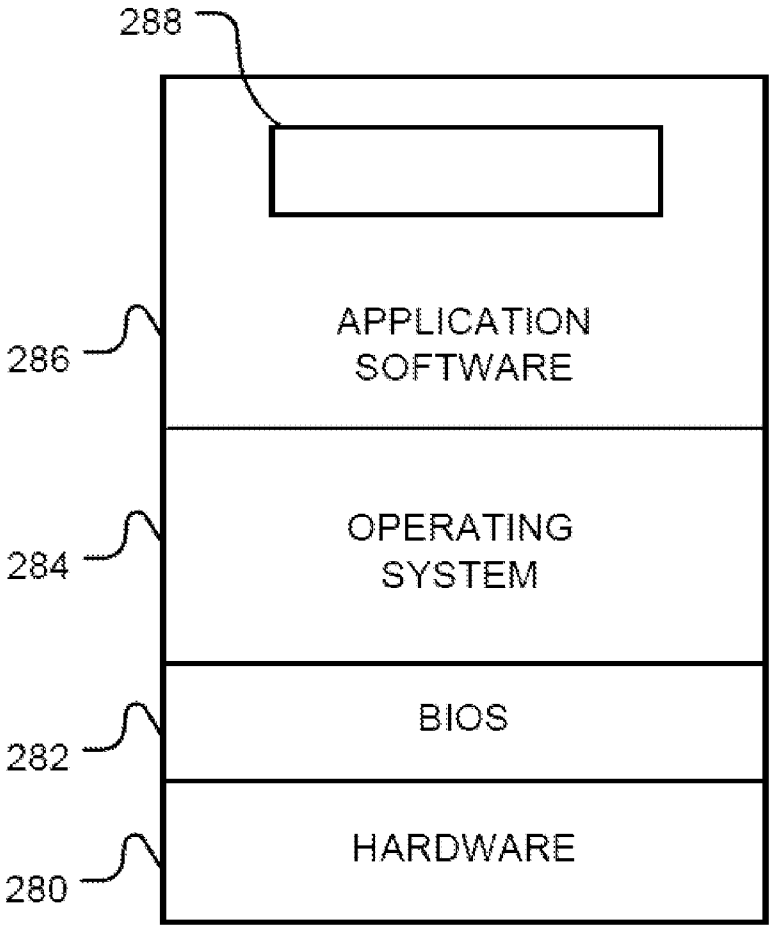
288
APPLICATION SOFTWARE
286
OPERATING SYSTEM
284
BIOS
282
HARDWARE
280

FIG. 5

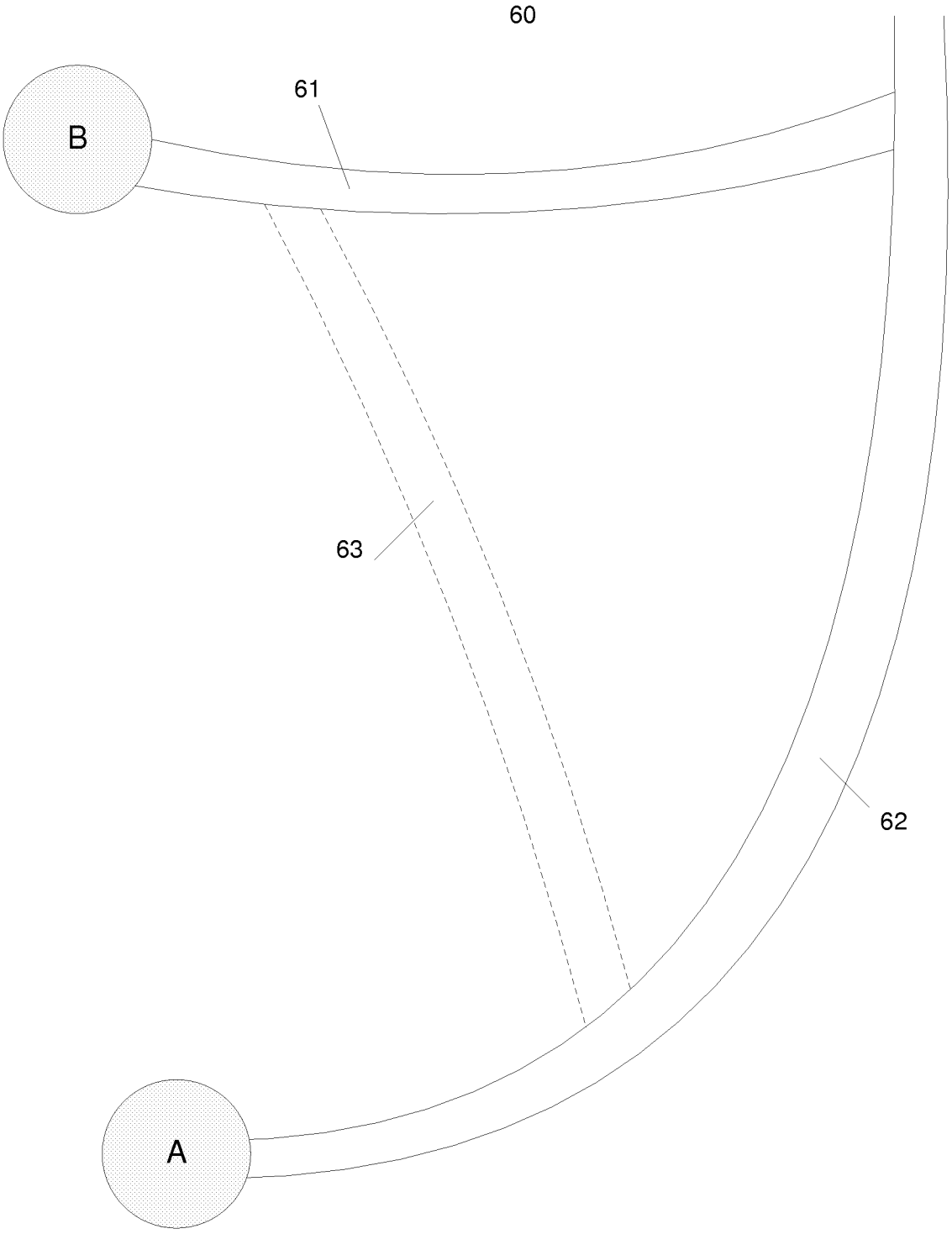

FIG. 6

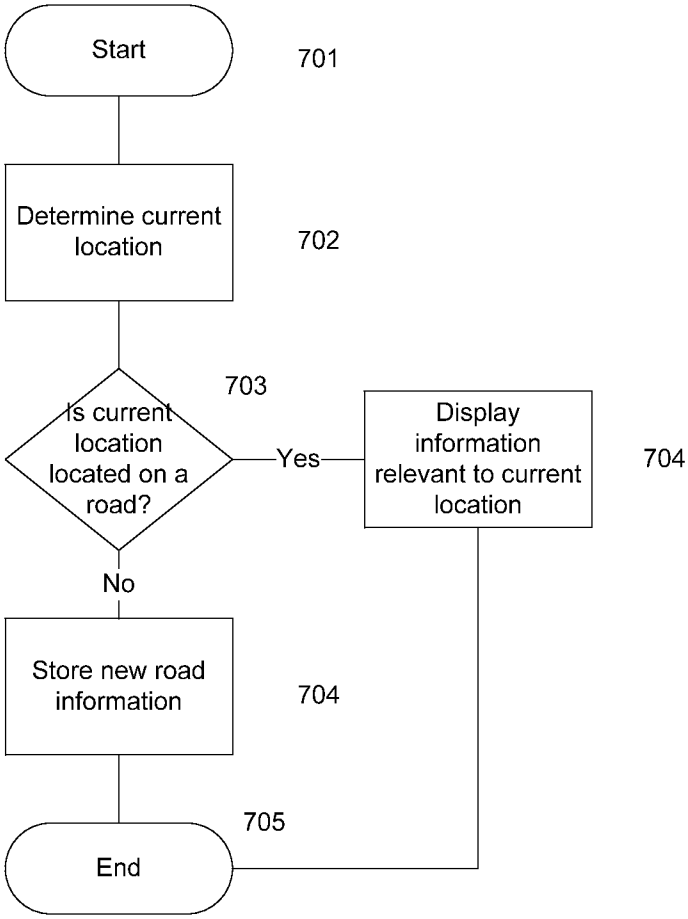
Start
701
Determine current location
702
703
Is current location located on a road?
Yes
Display information relevant to current location
704
No
Store new road information
704
705
End

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/063384

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01C21/32

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 G09B

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, IBM-TDB, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 530 025 A (HARMAN INT IND [US]) 11 May 2005 (2005-05-11) paragraphs [0014] - [0019], [0021], [0023]; figure 1 paragraphs [0051] - [0055]; figure 6 claim 53 -----	1-13
X	US 6 263 276 B1 (YOKOYAMA SHOJI [JP] ET AL) 17 July 2001 (2001-07-17) column 4, line 15 - line 45 column 7, line 31 - column 8, line 10; figure 1 column 8, line 44 - column 9, line 45; figure 2 column 13, line 7 - column 14, line 1; figures 8A,8B -----	1-13

-/--

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

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"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
3 June 2009	12/06/2009

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	Jakob, Clemens

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/063384

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/103692 A1 (NOMURA TOSHIO [JP]) 1 May 2008 (2008-05-01) paragraphs [0022], [0023], [0027], [0028], [0030], [0031]; figures 1,2 paragraphs [0034] - [0044]; figure 3	1-4, 6-11,13
X	US 2006/217879 A1 (IKEUCHI TOMOYA [JP] ET AL) 28 September 2006 (2006-09-28) paragraphs [0076] - [0085]; figure 1 paragraphs [0089] - [0096]; figures 2,3	1-5, 7-10,12, 13

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2008/063384

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1530025 A	11-05-2005	AT 419512 T	15-01-2009
		US 2005102098 A1	12-05-2005
US 6263276 B1	17-07-2001	NONE	
US 2008103692 A1	01-05-2008	NONE	
US 2006217879 A1	28-09-2006	DE 112005000048 T5	20-07-2006
		WO 2006008859 A1	26-01-2006
		JP 4130441 B2	06-08-2008
		JP 2006053123 A	23-02-2006