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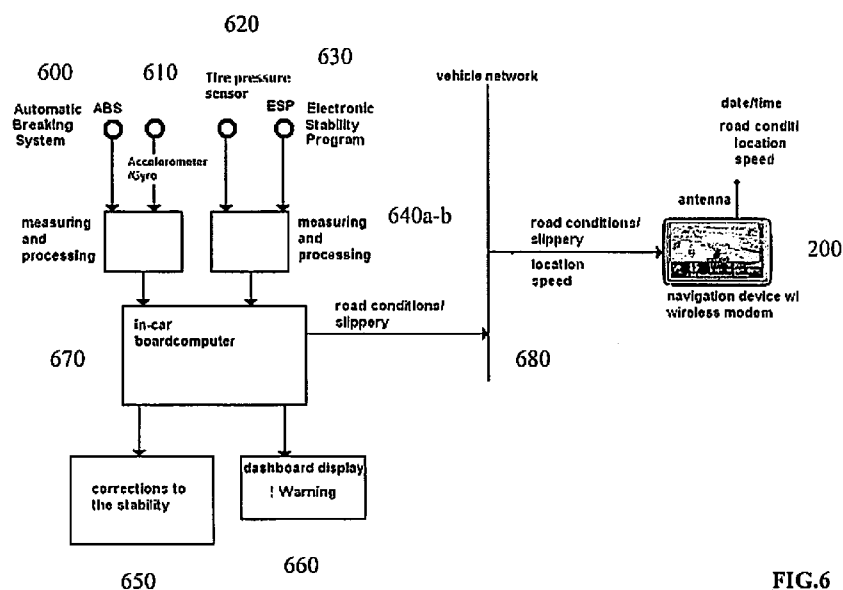


FIG.6

(57) Abstract: A method involving a vehicle in which a navigation device (200) is located and determining driving conditions is disclosed. The method includes determining, using at least a processor (210) of the navigation device (200), driving conditions of a segment of road on which the vehicle is traveling, based at least in part on a speed of at least one wheel of the vehicle at a first location. The method may also include outputting the determined road conditions at the first location to a server (302) remote to the navigation device (200).

COLLECTING DRIVING CONDITIONS FROM NAVIGATION DEVICES**Field**

[0001] The present application generally relates to navigation methods and devices. In particular, embodiments relate to portable navigation devices and in-vehicle navigation devices capable of acquiring and displaying driving conditions. Other embodiments relate, more generally, to any type of processing device that may be configured to execute navigation software so as to provide route planning, road conditions and also preferably navigation, functionality.

Background

[0002] Portable navigation devices (PNDs) that include GPS (Global Positioning System) signal reception and processing functionality are well known and are widely employed for vehicles or other devices.

[0003] In recent years, many consumers have been provided with a variety of devices and systems to enable them to locate places on a digital map using GPS signal reception and processing functionality. The variety of devices and systems used by consumers are in the form of in-vehicle navigation systems that enables drivers to navigate over streets and roads; and hand held devices such as personal digital assistants (PDAs), personal navigation devices (PNDs), and cell phones or other types of mobile devices that may generate maps showing road condition data.

[0004] During navigation along a calculated route or as a map display, it is usual for such navigation devices to provide visual and/or map information, i.e. road conditions. Such information may be regularly 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.

[0005] Navigation devices are of great utility when the user is not familiar with the route, the map area or the road conditions to which they soon may be navigating.

[0006] Currently, determining road conditions is based primarily on fixed sensors on a road. However, these fixed sensors may require high maintenance costs to keep them operable.

[0007] Ideally, the determination of road conditions and driving conditions for a particular segment of a road represent current and accurate road conditions. However, this may not always be the case. Currently, most road conditions and driving conditions are based on extrapolated data from temperature sensors and precipitation sensors only. More so, data collected from the temperature sensors and precipitation sensors may only give a limited estimation of how slippery a road may get.

[0008] In addition to fixed road sensors, road condition data or driving condition data may be obtained using specialized road measurement cars. However, specialized road measurement cars may be very costly, time consuming, not provide a large data range and size and may not provide current road conditions.

[0009] Furthermore, the road conditions obtained by the specialized road measurement cars or extrapolated from fixed sensors may include unnecessary or undesirable descriptions of the road conditions for a particular road segment. Certain users may only desire to know that other vehicles have slipped or braked on a particular road segment.

SUMMARY

[0010] In at least one embodiment, a method is disclosed involving a vehicle in which a navigation device is located. The method may include determining, using at least a processor of the navigation device, driving conditions of a segment of road on which the vehicle is traveling. The driving conditions may be based at least in part on a speed of at least one wheel of the vehicle at a first

location. The determined driving conditions at the first location may be outputted by the navigation device to a remote server.

[0011] Another embodiment may include a navigation device that includes a processor that may be configured to determine driving conditions of a segment of road on which a vehicle, in which the navigation device is located, may be traveling based at least in part on a speed of at least one wheel of the vehicle and a second location. The processor may also be configured to output the determined driving conditions at the first location to a remote server. The processor may also be configured to receive driving condition data from the remote central server and display the received driving condition data on a display of the navigation device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present application will be described in more detail below by using example embodiments, which will be explained with the aid of the drawings, in which:

[0013] FIG. 1 illustrates a Global Positioning System (GPS);

[0014] FIG. 2 illustrates a navigation device according to an example embodiment;

[0015] FIG. 3 illustrates a manner in which a navigation device may receive information over a wireless communications channel, according to an example embodiment;

[0016] FIGS. 4a and 4b illustrate perspective views of the navigation device of FIG. 2;

[0017] FIG. 5 is a flow chart illustrating an example embodiment.

[0018] FIG. 6 illustrates a navigation device in communication with a computer in a vehicle; and

[0019] FIG. 7 illustrates a plurality of navigation devices in communication with a server.

[0020] These Figures are intended to illustrate the general characteristics of methods, structure and/or materials utilized in certain example embodiments and to supplement the written description provided below. These drawings are not, however, to scale and may not precisely reflect the precise structural or performance characteristics of any given embodiment, and should not be interpreted as defining or limiting the range of values or properties encompassed by example embodiments. For example, the relative thicknesses and positioning of molecules, layers, regions and/or structural elements may be reduced or exaggerated for clarity. The use of similar or identical reference numbers in the various drawings is intended to indicate the presence of a similar or identical element or feature.

DETAILED DESCRIPTION

[0021] Various example embodiments will now be described more fully with reference to the accompanying drawings in which some example embodiments are illustrated.

[0022] Accordingly, while example embodiments are capable of various modifications and alternative forms, embodiments thereof are shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that there is no intent to limit example embodiments to the particular forms disclosed, but on the contrary, example embodiments are to cover all modifications, equivalents, and alternatives falling within the scope of example embodiments. Like numbers refer to like elements throughout the description of the figures.

[0023] It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first element could be termed a second element, and, similarly, a second element could be termed a first element, without departing from the scope of example embodiments. As used herein, the term

“and/or” includes any and all combinations of one or more of the associated listed items.

[0024] It will be understood that when an element is referred to as being “connected” or “coupled” to another element, it can be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being “directly connected” or “directly coupled” to another element, there are no intervening elements present. Other words used to describe the relationship between elements should be interpreted in a like fashion (*e.g.*, “between” versus “directly between,” “adjacent” versus “directly adjacent,” etc.).

[0025] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of example embodiments. As used herein, the singular forms “a,” “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises,” “comprising,” “includes” and/or “including,” when used herein, specify the presence of stated features, integers, steps, operations, elements and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components and/or groups thereof.

[0026] Spatially relative terms, *e.g.*, “beneath,” “below,” “lower,” “above,” “upper” and the like, may be used herein for ease of description to describe one element or a relationship between a feature and another element or feature as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as “below” or “beneath” other elements or features would then be oriented “above” the other elements or features. Thus, for example, the term “below” can encompass both an orientation which is above as well as below. The device may be otherwise

oriented (rotated 90 degrees or viewed or referenced at other orientations) and the spatially relative descriptors used herein should be interpreted accordingly.

[0027] It should also be noted that in some alternative implementations, the functions/acts noted may occur out of the order noted in the figures. For example, two figures shown in succession may in fact be executed substantially concurrently or may sometimes be executed in the reverse order, depending upon the functionality/acts involved.

[0028] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which example embodiments belong. It will be further understood that terms, e.g., those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0029] Portions of example embodiments and corresponding detailed description are presented in terms of software, or algorithms and symbolic representations of operation on data bits within a computer memory. These descriptions and representations are the ones by which those of ordinary skill in the art effectively convey the substance of their work to others of ordinary skill in the art. An algorithm, as the term is used here, and as it is used generally, is conceived to be a self-consistent sequence of steps leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of optical, electrical, or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It is convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like.

[0030] In the following description, illustrative embodiments will be described with reference to acts and symbolic representations of operations (e.g., in the form of flowcharts) that may be implemented as program modules or functional processes include routines, programs, objects, components, data structures,

that perform particular tasks or implement particular abstract data types and may be implemented using existing hardware at existing network elements or control nodes (e.g., a database). Such existing hardware may include one or more Central Processing Units (CPUs), digital signal processors (DSPs), application-specific-integrated-circuits, field programmable gate arrays (FPGAs) computers or the like.

[0031] It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise, or as is apparent from the discussion, terms such as “processing” or “computing” or “calculating” or “determining” or “displaying” or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical, electronic quantities within the computer system’s registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

[0032] Note also that the software implemented aspects of example embodiments are typically encoded on some form of computer readable medium or implemented over some type of transmission medium. The computer readable medium may be magnetic (e.g., a floppy disk or a hard drive) or optical (e.g., a compact disk read only memory, or “CD ROM”), and may be read only or random access. Similarly, the transmission medium may be twisted wire pairs, coaxial cable, optical fiber, or some other suitable transmission medium known to the art. Example embodiments are not limited by these aspects of any given implementation.

[0033] Example embodiments will now be described with particular reference to a portable navigation device (PND). It should be understood that the teachings of the present disclosure are not limited to PNDs and are universally applicable to any type of processing device that is configured to display maps. It follows therefore that in the context of the present application, a map

displaying device is intended to include (without limitation) any type of route planning and/or navigation device, irrespective of whether that device is embodied as a PND, a navigation device built into a vehicle, or indeed a computing resource (such as a desktop or portable personal computer (PC), mobile telephone or portable digital assistant (PDA) displaying maps).

[0034] It will also be apparent from the following that the teachings of the present disclosure 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.

[0035] FIG. 1 illustrates an example view of Global Positioning System (GPS), usable by navigation devices, including a navigation device according to an example embodiment. Such systems are used for a variety of purposes. In general, GPS is a satellite-radio based navigation system capable of determining continuous position, velocity, time, and in some instances direction information for an unlimited number of users.

[0036] Formerly known as NAVSTAR, the GPS incorporates a plurality of satellites which work with the earth in extremely precise orbits. Based on these precise orbits, GPS satellites can relay their location to any number of receiving units.

[0037] 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 can be determined, with only two signals using other triangulation techniques). When implementing geometric triangulation, the receiver utilizes the three known positions to determine an own two-dimensional position relative to the satellites. Determining the two-dimensional position can be done in a known manner. Additionally, acquiring a fourth satellite signal will allow the receiving device to calculate a three dimensional position of the receiver 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.

[0038] FIG. 1 illustrates a GPS system 100. A plurality of satellites 120 are in orbit about the earth 124. The orbit of each satellite 120 may not be synchronous with the orbits of other satellites 120 and, in fact, is likely asynchronous. A GPS receiver 140, usable in navigation devices according to example embodiments, is shown receiving spread spectrum GPS satellite signals 160 from the various satellites 120.

[0039] The spread spectrum signals 160 may be continuously transmitted from each satellite 120 to utilize a highly accurate frequency standard accomplished with an extremely accurate atomic clock. Each satellite 120, as part of its data signal transmission 160, transmits a data stream indicative of that particular satellite 120. It is appreciated by those skilled in the relevant art that the GPS receiver 140 generally acquires spread spectrum GPS satellite signals 160 from at least three satellites 120 for the GPS receiver 140 to calculate its two-dimensional position by triangulation. Acquisition of an additional signal, resulting in signals 160 from a total of four satellites 120, permits the GPS receiver 140 to calculate its three-dimensional position in a known manner.

[0040] FIG. 2 illustrates a block diagram of a navigation device 200 according to an example embodiment. 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.

[0041] The navigation device 200 includes a processor 210 connected to an input device 220 and a display screen 240. The input device 220 may include a keyboard device, voice input device, and/or any other known input device utilized to input information; and the display screen 240 can include any type of display screen such as an LCD display, for example. In at least one example embodiment, the input device 220 and the display screen 240 are integrated into an integrated input and display device, including a touchpad or touch screen input wherein a user need only touch a portion of the display screen 240 to select one of a plurality of display choices or to activate one of a plurality of virtual buttons.

[0042] The navigation device may include an output device 260, for example, an audible output device (*e.g.*, a loudspeaker). As the output device 260 can produce audible information for a user of the navigation device 200, it is should equally be understood that the input device 220 can include a microphone and software for receiving input voice commands as well.

[0043] In the navigation device 200, the processor 210 is operatively connected to and set to receive input information from input device 240 via a connection 225, and operatively connected to at least one of the display screen 240 and the output device 250, via output connections 245, to output information thereto. Further, the processor 210 is operatively connected to the memory 230 via the connection 235 and is further adapted to receive/send information from/to input/output (I/O) ports 270 via a connection 275, wherein the I/O port 270 is connectible to an I/O device 280 external to the navigation device 200.

[0044] The external I/O device 280 may include, but is not limited to an external listening device such as an earpiece. For example, the connection to the I/O device 280 can further be a wired or wireless connection to any other external device such as a car stereo unit for hands-free operation and/or for voice activated operation, for connection to an ear piece or head phones, and/or for connection to a mobile phone. Moreover, the mobile phone connection may be used to establish a TCP/IP connection between the

navigation device 200 and the internet or any other network, and/or to establish a connection to a server via the internet or some other network.

[0045] FIG. 2 further illustrates an operative connection between the processor 210 and an antenna/receiver 250 via a connection 255. The antenna/receiver 250 can be a GPS antenna/receiver, for example. It will be understood that the antenna and receiver designated by reference numeral 250 are combined schematically for illustration, but that the antenna and receiver may be separately located components, and that the antenna may be a GPS patch antenna or helical antenna for example.

[0046] Further, it will be understood by one of ordinary skill in the art that the electronic components shown in FIG. 2 are powered by power sources (not shown) in a conventional manner. As will be understood by one of ordinary skill in the art, different configurations of the components shown in FIG. 2 are considered within the scope of example embodiments. For example, in one embodiment, the components shown in FIG. 2 may be in communication with one another via wired and/or wireless connections and the like. Thus, the scope of the navigation device 200 includes a portable or handheld navigation device 200.

[0047] In addition, the portable or handheld navigation device 200 of FIG. 2 can be connected or “docked” in a known manner to a motorized vehicle such as a car or boat, for example. Such a navigation device 200 is then removable from the docked location for portable or handheld navigation use.

[0048] Referring now to FIG. 3, the navigation device 200 may establish a “mobile” or telecommunications network connection with a server 302 via a mobile device (not shown) (such as a mobile phone, PDA, and/or any device with mobile phone technology) establishing a digital connection (such as a digital connection via known Bluetooth technology). Thereafter, through its network service provider, the mobile device can establish a network connection (through the internet for example) with the server 302. As such, the “mobile” network connection is established between the navigation device 200 (which can be, and often times is mobile as it travels alone and/or in a vehicle) and

the server 302 to provide a “real-time” or at least very “up to date” gateway for information.

[0049] The establishing of the network connection between the mobile device (via a service provider) and another device such as the server 302, using the Internet (such as the World Wide Web), for example, can be done in a known manner. This can include use of a TCP/IP layered protocol, for example. The mobile device can utilize any number of communication standards such as CDMA, GSM and WAN.

[0050] As such, an internet connection may be utilized which is achieved via data connection, via a mobile phone or mobile phone technology within the navigation device 200, for example. For this connection, the internet connection between the server 302 and the navigation device 200 is established. This can be done, for example, through a mobile phone or other mobile device and a GPRS (General Packet Radio Service)-connection. GPRS connection is a high-speed data connection for mobile devices provided by telecom operators; GPRS is a method to connect to the internet.

[0051] The navigation device 200 can further complete a data connection with the mobile device, and eventually with the internet and server 302, via existing Bluetooth technology, for example, in a known manner, wherein the data protocol can utilize any number of standards, such as the GSRM, the Data Protocol Standard for the GSM standard, for example.

[0052] The navigation device 200 may include its own mobile phone technology within the navigation device 200 (including an internal antenna, of the navigation device 200, for example). The mobile phone technology within the navigation device 200 can include internal components as specified above, and/or can include an insertable card (e.g. Subscriber Identity Module or SIM card), complete with necessary mobile phone technology and/or an antenna, for example. As such, mobile phone technology within the navigation device 200 can similarly establish a network connection between the navigation device 200 and the server 302, via the internet for example, in a manner similar to

that of any mobile device. The navigation device 200 may be connected wirelessly or wired to a computer in the vehicle.

[0053] For GPRS phone settings, a Bluetooth enabled navigation device may be used to correctly work with the ever changing spectrum of mobile phone models and manufacturers. Model/manufacture specific settings may be stored on the navigation device 200, for example. The data stored for this information can be updated.

[0054] In FIG. 3, the navigation device 200 is depicted as being in communication with the server 302 via a generic communications channel 318 that can be implemented by any of a number of different arrangements. The server 302 and navigation device 200 can communicate when a connection via communications channel 318 is established between the server 302 and the navigation device 200 (noting that such a connection can be a data connection via mobile device and a direct connection via personal computer via the Internet).

[0055] The server 302 includes, in addition to other components which may not be illustrated, a processor 304 operatively connected to a memory 306 and further operatively connected, via a wired or wireless connection 314, to a mass data storage device. The processor 304 is further operatively connected to a transmitter 308 and a receiver 310, to transmit and send information to and from navigation device 200 via communications channel 318, respectively. The signals sent and received may include data, communication, and/or other propagated signals. The transmitter 308 and receiver 310 may be selected and/or designed according to a communications requirement and communication technology used in the communication design for the navigation system 200. Further, it should be noted that the functions of the transmitter 308 and receiver 310 may be combined into a signal transceiver.

[0056] The server 302 is further connected to (or includes) the mass storage device 312. The mass storage device 312 may be coupled to the server 302 via communication link 314. The mass storage device 312 contains a

store of navigation data and map information, and can again be a separate device from the server 302 or can be incorporated into the server 302.

[0057] The navigation device 200 is adapted to communicate with the server 302 through a communications channel 318, and includes the processor 210 and the memory 230, as previously described with regard to FIG. 2, as well as the transmitter 320 and receiver 322 to send and receive signals and/or data through the communications channel 318, noting that these devices can further be used to communicate with devices other than server 302. Further, the transmitter 320 and receiver 322 are selected or designed according to communication requirements and communication technology used in the communication design for the navigation device 200 and the functions of the transmitter 320 and receiver 322 may be combined into a single transceiver.

[0058] Software stored in the memory 306 provides instructions for the processor 304 and allows the server 302 to provide services to the navigation device 200. One service provided by the server 302 involves processing requests from the navigation device 200 and transmitting navigation data from the mass data storage 312 to the navigation device 200. Another service provided by the server 302 includes processing the navigation data using various algorithms for a desired application and sending the results of these calculations to the navigation device 200.

[0059] The communications channel 318 generically represents a propagating medium or path that connects the navigation device 200 and the server 302. Both the server 302 and navigation device 200 include transmitters 308, 320 for transmitting data through the communication channel 318 and receivers 310, 322 for receiving data that has been transmitted through the communications channel 318.

[0060] The communications channel 318 is not limited to a particular communication technology. The communication channel 318 may include several communication links that use a variety of technologies. For example, the communications channel 318 can be adapted to provide a path for electrical, optical, and/or electromagnetic communications. As such, the

communications channel 318 includes, but is not limited to, one or a combination of the following: electric circuits, electrical conductors such as wires and coaxial cables, fiber optic cables, converters, radio-frequency (RF) waves, the atmosphere and empty space. Furthermore, the communications channel 318 can include intermediate devices such as routers, repeaters, buffers, transmitters, and receivers.

[0061] In an example embodiment, the communications channel 318 includes telephone and computer networks. Furthermore, the communications channel 318 may be capable of accommodating wireless communications such as radio frequency, microwave frequency, and infrared communication. Additionally, the communications channel 318 can accommodate satellite communication.

[0062] The communications signals transmitted through the communications channel 318 include, but are not limited to, signals as may be required or desired for given communication technology. For example, the signals may be adapted to be used in cellular communication technology such as Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Code Division Multiple Access (CDMA) and Global System for Mobile Communications (GSM). Both digital and analogue signals can be transmitted through the communication channel 318. These signals may be modulated, encrypted and/or compressed signals as may be desirable for the communication technology.

[0063] The server 302 is a remote server accessible by the navigation device 200 via a wireless channel. The server 302 may include a network server located on a local area network (LAN), wide area network (WAN) and/or virtual private network (VPN).

[0064] The server 302 may include a personal computer such as a desktop or laptop computer, and the communications channel 318 may be a cable connected between the personal computer and the navigation device 200. Alternatively, a personal computer may be connected between the navigation device 200 and the server 302 to establish an internet connection between the

server 302 and the navigation device 200. Alternatively, a mobile telephone or other handheld device may establish a wireless connection to the internet, for connecting the navigation device 200 to the server 302 via the internet.

[0065] The navigation device 200 may be provided with information from the server 302 via information downloads which may be periodically updated automatically or upon a user connecting navigation device 200 to the server 302 and/or may be more dynamic upon a more constant or frequent connection being made between the server 302 and navigation device 200 via a wireless mobile connection device and TCP/IP connection, for example. For many dynamic calculations, the processor 304 in the server 302 may be used to handle the bulk of the processing; however, processor 210 of navigation device 200 can also handle much processing and calculation, oftentimes independent of a connection to a server 302.

[0066] As indicated above in FIG. 2, a navigation device 200 includes the processor 210, the input device 220, and the display screen 240. The input device 220 and display screen 240 are integrated into an integrated input and display device to enable both input of information (via direct input, menu selection) and display of information through a touch panel screen, for example. Such a screen may be a touch input LCD screen, for example, as is well known to those of ordinary skill in the art. Further, the navigation device 200 can also include any additional input device 220 and/or any additional output device 241, such as audio input/output devices, for example.

[0067] FIGS. 4a and 4b are perspective views of the navigation device 200. As shown in FIG. 4a, the navigation device 200 may be a unit that includes an integrated input and display device 290 (a touch panel screen, for example) and the other components of FIG. 2 (including but not limited to internal GPS receiver 250, microprocessor 210, a power supply, memory systems 230, etc.).

[0068] The navigation device 200 may sit on an arm 292, which itself may be secured to a vehicle dashboard/window/etc. using a suction cup 294. This arm 292 is one example of a docking station to which the navigation device 200 can be docked.

[0069] As shown in FIG. 4b, the navigation device 200 can be docked or otherwise connected to an arm 292 of the docking station by snap connecting the navigation device 200 to the arm 292, for example. The navigation device 200 may then be rotatable on the arm 292, as shown by the arrow of FIG. 4b. To release the connection between the navigation device 200 and the docking station, a button on the navigation device 200 may be pressed, for example. Other equally suitable arrangements for coupling and decoupling the navigation device to a docking station are well known to persons of ordinary skill in the art.

[0070] An example embodiment of the present application is directed to a method involving a vehicle in which a navigation device 200 is housed. In an example embodiment, the method includes determining, using at least a processor 210 of the navigation device 200, driving conditions of a segment of road on which the vehicle is traveling. The driving conditions may be based at least in part on a speed of at least one wheel of the vehicle at a first location. The determined driving conditions at a first location may be outputted from the navigation device 200 to server 302.

[0071] FIG. 5 is a flow chart of an example method of collecting driving condition data. Driving condition data may refer to any data relating to the environment or state of a particular segment of road, such as road conditions, safety conditions, any unsafe conditions, etc. Driving condition data may be collected from sensors in a vehicle, for example, automatic breaking system sensors, vehicle speed sensors, tire pressure sensors or electronic stability program sensors. Driving condition data of a particular segment of road may be correlated with a particular segment of road by GPS or any other position determining technology. Driving condition data may be used to generate an electronic map displaying hazardous road conditions on the display 240 of the navigation device 200. The driving condition data may be displayed on the display 240 in symbols or in text. The road condition data may also be audibly outputted using the output device 260 of the navigation device 200.

[0072] Referring to FIG. 5, a method of collecting driving condition data according to at least one example embodiment may include collecting data from sensors in a vehicle, while the vehicle is traversing a particular segment of road. In S500, the sensors in the vehicle may be in communication with the computer in the vehicle and the sensors may transmit driving condition data to the computer in the vehicle. For example, if the vehicle is traversing a slippery or icy segment of road the electronic stability program sensor in the vehicle may be triggered. The electronic stability program sensor may transmit the data collected by the sensor to the computer in the vehicle.

[0073] The computer in the vehicle may be in communication, for example, by any wireless communication technology or through a direct wired connection with the navigation device 200 housed in the vehicle.

[0074] Proceeding in the process, in S510 a computer in the vehicle may then transmit the driving condition data to the navigation device S510. The navigation device 200, through GPS or any location determination device may locate where/when the sensor in the vehicle is triggered.

[0075] In S520, the navigation device 200 may create a time stamp to mark a time when the vehicle traversing the particular segment of road, when the sensor in the vehicle is triggered. The time stamp may include the date that the vehicle was traversing the particular of segment of road when the sensor in the vehicle is triggered.

[0076] As stated above in FIG. 3, the navigation device 200 may be in communication with the server 302. The navigation device 200 may transmit the driving condition data, including the data acquired by the sensors in the vehicle, the time stamp and the location of where the sensor in the vehicle was triggered, to the server 302.

[0077] In S520, server 302 may receive the driving condition data, filter the data in some manner and broadcast the filtered data to at least one second navigation device. For example, server 302 may filter the received driving condition data to create a road condition database and/or improve upon an existing database.

[0078] According to at least one example embodiment, the server 302 may filter the data based at least in part, on a number of vehicles transmitting driving condition data to the server 302 at a particular segment of road.

[0079] According to another example embodiment, the server 302 may filter the data based at least in part, on a number of vehicles transmitting driving condition data to the server 302 at a particular segment of road, with a time stamp indicating when the sensor of the vehicle was triggered on the particular segment of road.

[0080] According to another example embodiment, the server 302 may filter the received driving condition data based on the type of sensor in the vehicle that was triggered while traversing a particular segment of road.

[0081] Thereafter in S530, server 302 may broadcast the filtered data to at least one second navigation device, which may be configured to receive the filtered data.

[0082] At least such a second navigation device, may be configured to receive the broadcasted data in S540. As mentioned above in FIG 3, the server 302 and the navigation devices may communicate through communication channels 318.

[0083] At least the second navigation device may be configured to display the broadcasted data while traversing a route of travel. At least the second navigation device may be configured to display the broadcasted data on a display 240 displaying a particular map image. At least the second navigation device may also be configured to audibly output the broadcasted data using the navigation devices output device 260.

[0084] In one example embodiment, the broadcasted data may be displayed at the second navigation device as symbols corresponding to particular road hazards. For example, a symbol may indicate an icy road or a sharp turn on a particular segment of road.

[0085] By tracking the behavior of vehicles traversing segments of roads over time, updates may be made to the driving condition database. According to at least one example embodiment of a method of recording road condition

data, the more vehicles that traverse a particular segment of road the more accurate driving condition database may be. Server 302 may update the driving condition database to more accurately warn drivers of hazardous driving conditions.

[0086] FIG. 6 illustrates an example embodiment of a navigation device 200 in communication with a computer 670 in a vehicle. The navigation device 200 may have a processor 210 that may be configured to determine driving conditions of a segment of road on which a vehicle, in which the navigation device 200 may be housed, is traveling.

[0087] The driving conditions may be determined based at least in part on a speed of at least one wheel of the vehicle at a first location. Additionally, at least one wheel of the vehicle may have sensors. The sensors on the wheel may include, for example automatic breaking system sensors 600, accelerometer/gyro sensors 610, tire pressure sensors 620, electronic stability program sensors 630, or any other sensors that may be capable of acquiring data, such as vehicle speed sensors, break assist sensors, optical sensors, rain sensors, weather sensors or traction control sensors.

[0088] When at least one of the sensors is triggered, for example by a hazardous road condition, the sensor may acquire data. The triggered sensor may process (in 640a) and measure (in 640b) the data, and then a computer in the vehicle may access the data from the sensor. The sensor may process the data by verifying that the sensor has acquired data, for example, and the sensor may measure the data values using numerical indicators, for example.

[0089] The computer of the vehicle 670, at least based on the processed and measured data, may perform stability corrections 650 to the vehicle. The computer of the vehicle may also be in communication with a dashboard display 660 (for an in-vehicle navigation device for example) and may display a warning signal on the dashboard display 660 corresponding to the triggered sensor (or on a display of a PND 200 for example).

[0090] The computer of the vehicle 670 may be in communication with a navigation device 200 (in-vehicle or PND for example) through a

communication channel 680. The communication channel may include, but is not limited to any wireless communication technology such as blue tooth for example. Alternatively the navigation device 200 (in-vehicle or PND) may be directly connected to the computer in the vehicle 670.

[0091] The computer in the vehicle 220 may transmit the processed and measured data from a sensor, such as the automatic breaking system sensor 600, to the navigation device 200.

[0092] The navigation device 200 may receive the data transmitted from the computer in the vehicle 670, and a processor 210 of the navigation device 200 may be able to determine the location where the sensor in the vehicle was triggered. The location where the sensor in the vehicle was triggered may be determined based on the receipt of a GPS signal or any other locating signal.

[0093] When navigation device 200 receives the data transmitted from the computer in the vehicle 670 the navigation device 200 may associate the time stamp with the location of the vehicle and the time the navigation device 200 receives the data. The time stamp may include the time and/or date when the navigation device 200 received the data from the computer 220 of the vehicle.

[0094] As mentioned above in Fig. 2, the navigation device 200 may use the mobile phone connection to establish a TCP/IP connection between the navigation device 200 and the internet, any other network, and/or to establish a connection to the server 302. The processor 210 of the navigation device 200 may use the mobile phone connection or any other connection to output the determined driving conditions to the server 302. The outputted driving condition data may be outputted in real time to the server 302.

[0095] An example embodiment of the present application is directed to a server 302 including a processor 304 that may be configured to receive, from at least one navigation device 200, driving conditions of a segment of a road on which a vehicle housing the navigation device 200 is travelling. The driving conditions that server 302 receives may be determined based in part on a speed of at least one wheel of the vehicle at a location of the vehicle and the time stamp.

[0096] The location of the vehicle may be determined based on a GPS receipt or any location determination device/method. The time stamp may indicate the time the navigation device 200 received driving condition data from the computer in the vehicle 670.

[0097] FIG. 7 illustrates at least one navigation device 200 in communication with a server 302 according to an example embodiment. As mentioned above in FIG. 2, a plurality of navigation devices 700a-c may be in communication with server 302. The plurality of navigation devices may communicate with server 302 through similar communication channels as communication channel 318.

[0098] Server 302 may receive driving condition data from at least one navigation device 700a-c. The received driving condition data may include the time stamp and location where the sensor in the vehicle was triggered to filter the driving conditions.

[0099] Server 302 may filter the received driving conditions to create a database, based at least in part on the location of the received driving condition data, type of sensor triggered and the time stamp. Server 302 may further filter the received driving condition data based in part on the quantity of navigation devices transmitting road condition data to the server 302 at a particular location.

[00100] Based on the filtered data, server 302 may determine driving conditions for a segment of road. For example, if there are a plurality navigation devices 700a-c transmitting driving condition data indicating that similar sensors in the plurality of vehicles were triggered at a same segment of road, the server 302 may infer that there is a hazardous driving condition at the particular segment of road.

[00101] In another embodiment, the driving conditions at the particular segment of road may be determined by the server 302 at least based in part using the time stamp and the location the sensor in the vehicle was triggered. As mentioned above, the time stamp may be the time the navigation devices 700a-c receive road condition data from computers in the vehicle 670. Using the time, stamp the server 302 may determine how many vehicles had sensors

that were triggered while traversing a particular segment of road over a time period. If a plurality of vehicles over a period of time had sensors triggered while traversing a particular segment of road, the server 302 may determine that it may be likely that the cause of the triggered sensors are hazardous driving conditions on the segment of road.

[00102] Using the time stamp, server 302 may determine if the hazardous driving conditions on the particular segment of road are temporary or fixed.

[00103] Server 302 may determine if hazardous driving conditions on a particular segment of road are fixed. If a plurality of vehicles continuously report data, through navigation devices 700a-c, indicating hazardous driving conditions over an extended period of time, server 302 may determine that it may be likely there is a fixed hazardous driving condition. This is due to the fact that if there is a fixed hazardous driving condition, it may be likely that most vehicles traversing a particular segment of road will have similar sensors triggered by the hazardous driving condition. Examples of a fixed hazardous driving condition may be a pot hole, a sharp turn, an obstructed view, etc.

[00104] Server 302 may also determine if hazardous driving conditions on a particular segment of road are temporary. If server 302 receives hazardous driving condition data from a plurality of navigation devices 700a-c at a particular segment of road, only over a short period of time, and if server 302 typically receives only minimal driving condition data at a particular segment of road, the server 302 may determine that it may be likely that the hazardous driving conditions are temporary. This is due to the fact, that if the hazardous driving conditions were fixed, then it may be likely that a plurality of vehicles that traverse the particular segment of road would frequently have sensors that are triggered. Examples of temporary hazardous driving conditions may be precipitation, sun blinding the driver of a vehicle, ice, fog, a traffic accident, etc.

[00105] Thus, if server 302 constantly receives driving condition data on a particular segment of road from navigation devices 700a-c, the server 302 may determine that it may be likely that the road has a fixed hazardous driving

condition. Alternatively, if server 302 receives driving condition data on a particular segment of road for a short period of time, the particular segment of road may contain a temporary hazardous driving conditions.

[00106] Server 302 may determine the cause of the hazardous driving condition based on the type of triggered sensor in the vehicle. If server 302 receives driving condition data from a plurality of navigation devices 700a-c at a particular segment of road which may contain indications that a similar sensor in each vehicle has been triggered, then server 302 may be able to determine the type of hazardous driving condition. Server 302 may be able to infer from the indicating sensors the type of hazardous driving conditions. For example, if server 302 receives driving condition data at a particular segment of road from a plurality of navigation devices 700a-c that indicate a tire pressure sensor in a vehicle has been activated while traversing the particular segment of road, then it may be likely that there is a pot hole or other defect in the particular segment of road. This may be due to the fact that while a vehicle is traversing a pot hole it is necessary to activate a tire pressure sensor in the vehicle to maintain stability.

[00107] Server 302 may broadcast the determined data to multiple or at least one other navigation device 700a-c. Server 302 may broadcast the determined data in print on a website, through email or through any other broadcasting channel.

[00108] Server 302 may broadcast the determined data in a protocol that at least one of the navigation devices 700a-c may translate the into a symbol. At least one of the navigation devices 700a-c may use thresholds to translate the data into a symbol. The threshold values may determine the severity of the driving conditions.

[00109] The symbols may be displayed on the display of at least one navigation devices 700a-c indicating the type of hazardous road conditions on at least one segment of road. The symbols may include pictures indicating hazardous weather, sharp curves, poor road quality or any other symbol that may assist users of the navigation devices. The symbols may also be displayed

on the display of at least one of the navigation devices 700a-c indicating the severity of the driving conditions. For example, the symbols may be symbols indicating light, medium or heavy snow. As stated above in FIG. 2 the navigation devices 700a-c may be able to communicate with sever 302 through wireless communication channels 318.

[00110] At least one navigation device 700a-c may receive the broadcasted road condition data at least at a second location. The navigation devices 700a-c may receive the broadcasted driving condition data and may display the broadcasted data on a display 240 of the navigation the device 700a-c. The navigation device 700a-c may display the received driving condition data indicating the hazardous road condition as a symbol or as text on the display 240, for example. The navigation devices 700a-c may also/alternatively audibly output the received driving conditions by an output device 260 in the navigation device 700a-c.

[00111] A user of at least one navigation device 700a-c may use a map database in the navigation device to determine a route of travel from a start location to an end location. Once the navigation device has determined the route of travel, the navigation device may display the broadcasted driving conditions along the route on the display 240. The broadcasted driving conditions may be displayed as symbols on the segments of roads along the determined route. The broadcasted data may be displayed as text notifying users of hazardous driving conditions.

[00112] In another embodiment, at least one of navigation device 700a-c may display a map image on the display 240. The navigation device may display symbols of driving condition data on particular segments of road containing hazardous road conditions while viewing the image of a map.

[00113] One having ordinary skill in the art will understand that a sequential dataset pre-processed according to methods described above may represent a route in a virtual environment of an electronic map. Generally, map features according to data that has been pre-processed may be more accurate than maps that have not been pre-processed. Methods as described herein may

improve the accuracy of maps and facilitate maps based on 'real time' data collected on a continuous basis.

[00114] The methods of the embodiments expressed above may be implemented in the form of a device, such as a server and/or a navigation device for example. Thus, such aspects are encompassed within at least one embodiment of the present application.

[00115] Further, at least one of the methods of at least one embodiment may be implemented as a computer data signal embodied in the carrier wave or propagated signal that represents a sequence of instructions which, when executed by a processor (such as the processor 304 of the server 302, and/or the processor 210 of the navigation device 200, for example) causes the processor to perform a respective method. In at least one other embodiment, at least one method provided above may be implemented above as a set of instructions contained on a computer readable or computer accessible medium, such as one of the memory devices previously described, for example, to perform the respective method when executed by a processor or other computer device. In varying embodiments, the medium may be a magnetic medium, electronic medium and/or optical medium.

[00116] Even further, any of the aforementioned methods may be embodied in the form of a program. The program may be stored on a computer readable media and is adapted to perform any one of the aforementioned methods when run on a computer device (a device including a processor). Thus, the storage medium or computer readable medium, is adapted to store information and is adapted to interact with a data processing facility or computer device to perform the method of any of the above mentioned embodiments.

[00117] As one of ordinary skill in the art will understand upon reading the disclosure, the electronic components of the navigation device 200 and/or the components of the server 302 can be embodied as computer hardware circuitry or as a computer readable program, or as a combination of both.

[00118] The system and method of embodiments of the present application include software operative on the processor to perform at least one of the

methods according to the teachings of the present application. One of ordinary skill in the art will understand, upon reading and comprehending this disclosure, the manner in which a software program can be launched from a computer readable medium in a computer based system to execute the functions found in the software program. One of ordinary skill in the art will further understand the various programming languages which may be employed to create a software program designed to implement and perform at least one of the methods of the present application.

[00119] The programs can be structured in an object-orientation using an object-oriented language including but not limited to JAVA, Smalltalk and C++, and the programs can be structured in a procedural-orientation using a procedural language including but not limited to COBAL and C. The software components can communicate in any number of ways that are well known to those of ordinary skill in the art, including but not limited to by application of program interfaces (API), interprocess communication techniques, including but not limited to report procedure call (RPC), common object request broker architecture (CORBA), Component Object Model (COM), Distributed Component Object Model (DCOM), Distributed System Object Model (DSOM), and Remote Method Invocation (RMI). However, as will be appreciated by one of ordinary skill in the art upon reading the present application disclosure, the teachings of the present application are not limited to a particular programming language or environment.

[00120] The above systems, devices, and methods have been described by way of example and not by way of limitation with respect to improving accuracy, processor speed, and ease of user interaction with a navigation device.

[00121] Further, elements and/or features of different example embodiments may be combined with each other and/or substituted for each other within the scope of this disclosure and appended claims.

[00122] Still further, any one of the above-described and other example features may be embodied in the form of an apparatus, method, system, computer program and computer program product. For example, any of the

aforementioned methods may be embodied in the form of a system or device, including, but not limited to, any of the structure for performing the methodology illustrated in the drawings.

[00123] Example embodiments being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

Claims

1. A method involving a vehicle in which a navigation device (200) is located, the method comprising:

determining, using at least a processor (210) of the navigation device (200), driving conditions of a segment of road on which the vehicle is traveling, based at least in part on a speed of at least one wheel of the vehicle at a first location; and

outputting the determined driving conditions at the first location to a server (230) remote to the navigation device (200).
2. The method of claim 1, further comprising:

receiving, from the server (230), determined driving conditions at least at a second location; and

displaying on a display (260) of the navigation device (200) the received determined driving conditions at least at the second location.
3. The method of claim 2, wherein the receiving of determined driving conditions is at least one of in print on a website, an email or a personal broadcasting channel.
4. The method of claim 2 or 3, further comprising:

determining, using at least the processor (210) of the navigation device (200), a

route of travel from a start location to an end location; and
displaying the received driving conditions along the route on the
display (260).

5. The method of claim 2, 3 or 4, wherein the determining of the first location and the second location is done by receipt of a GPS signal.
6. The method of any preceding claim, wherein the determining of the driving conditions is based on at least one of detection of an automatic break system (270) of the vehicle being in safety mode and detection of an electronic stability program (280) of the vehicle being in correction mode.
7. The method of any preceding claim, wherein the determining of the road conditions is based on at least signals received from sensors in the vehicle.
8. The method of any preceding claim, wherein the outputting of the determined road conditions at the first location includes an output of a time stamp.
9. The method of any preceding claim, further comprising:

measuring and processing data collected by a computer (250) of the vehicle.

10. A computer readable medium including program segments for when executed on a processor (210) of a navigation device (200), causing the navigation device (200) to implement the method of any preceding claim.
11. A navigation device (200), comprising:
a processor (210) configured to,
determine driving conditions of a segment of road on which a vehicle, in which the navigation device (200) is located, is traveling, based at least in part on a speed of at least one wheel of the vehicle at a first location, and
output the determined driving conditions at the first location to a server (230) remote to the navigation device (200).
12. The navigation device (200) of claim 11, wherein the processor (210) is configured to receive determined driving conditions at least at a second location, from the server (230).
13. The navigation device (200) of claim 12, further comprising:

a display (260) to display the received driving conditions at least at the second location.

14. The navigation device (200) of any of claims 11-13, wherein the processor (210) is configured to output the determined driving conditions at the first location including a time stamp.

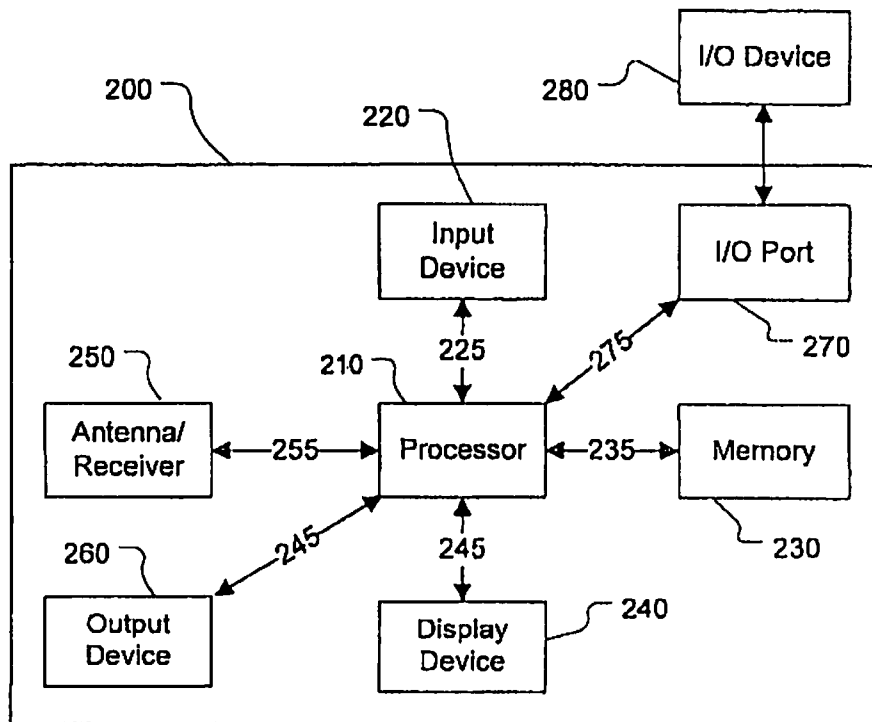
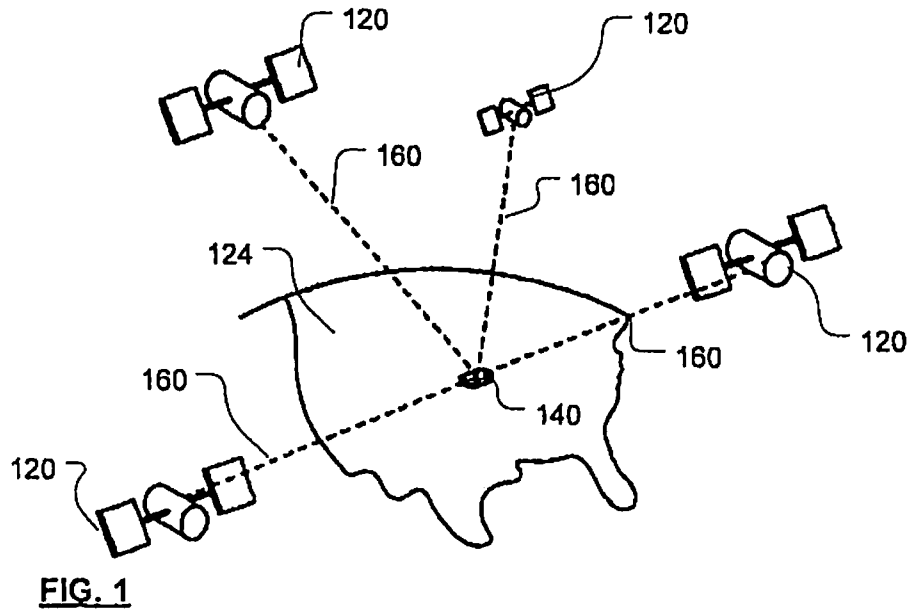
15. The navigation device (200) of any of claims 11-14, wherein the processor is configured to determine a route of travel from a start location to an end location, the navigation device (200) further comprising:

a display (260) to display the determined driving conditions along the route of travel.

16. The navigation device (200) of claim 13, wherein the first and the second location are determined by receipt of a GPS signal

17. The navigation device (200) of any claims 11-16, wherein the processor (210) is configured to determine driving conditions at least based on the detection of an automatic break system (270) of the vehicle being in safety mode and detection of an electronic stability program (280) of the vehicle being in correction mode.

18. The navigation device (200) of any claims 11-17, wherein the processor (210) is configured to determine driving conditions at least based on the signals received from sensors on the vehicle.
19. The navigation device (200) of any claims 11-18, wherein the processor (210) is configured to receive the determined driving conditions in at least one of print on a website, an email and a personal broadcasting channel.
20. The navigation device (200) of any claims 11-19, wherein the navigation device (200) is a personal navigation device.
21. The navigation device (200) of any claims 11-19, wherein the navigation device (200) is an in-vehicle navigation device.



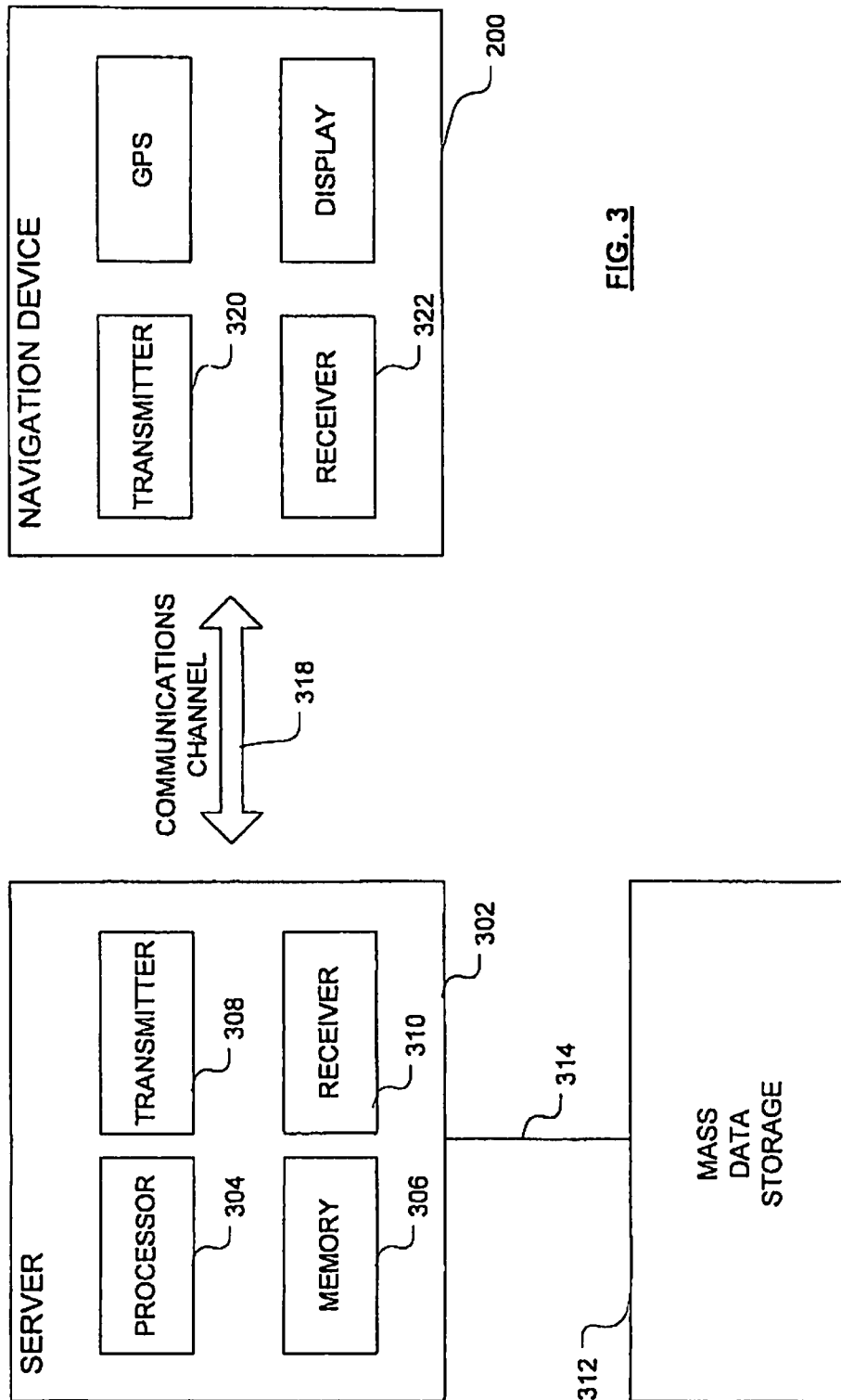


FIG. 3

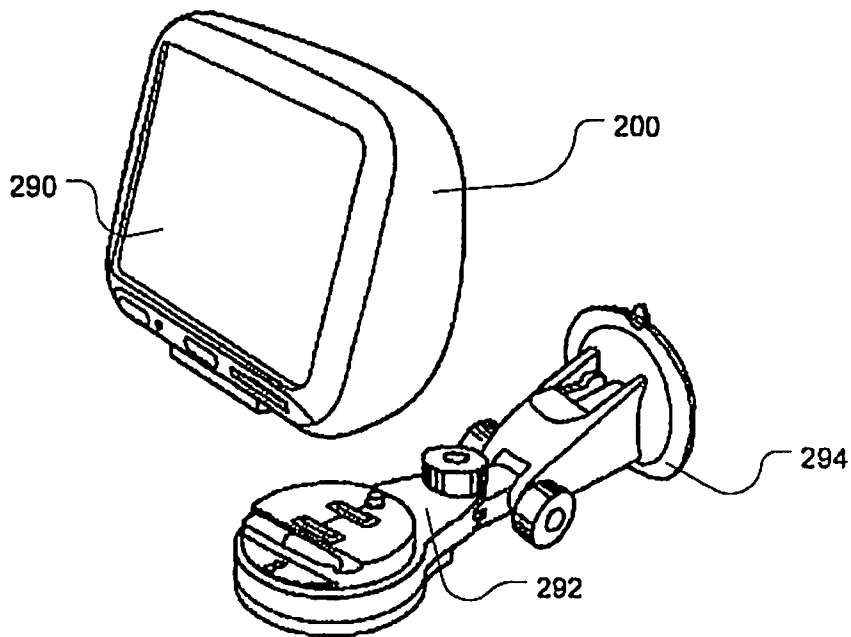


FIG. 4a

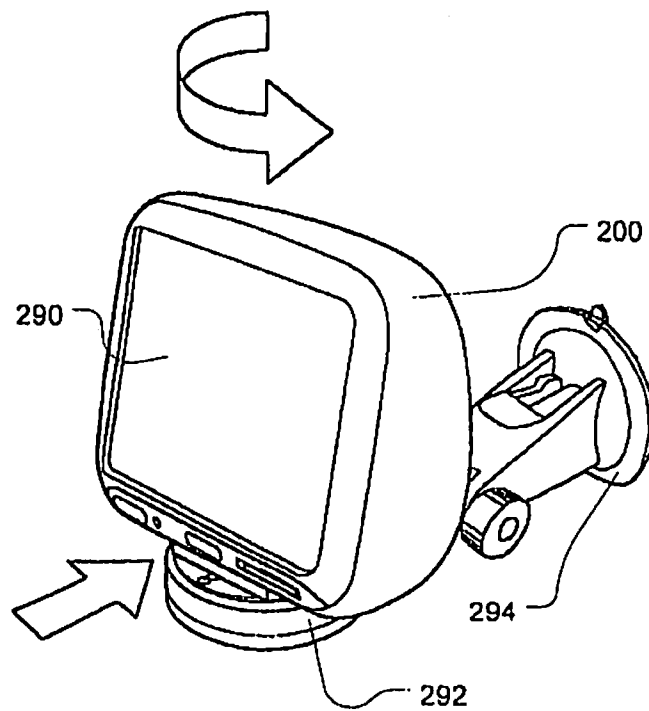
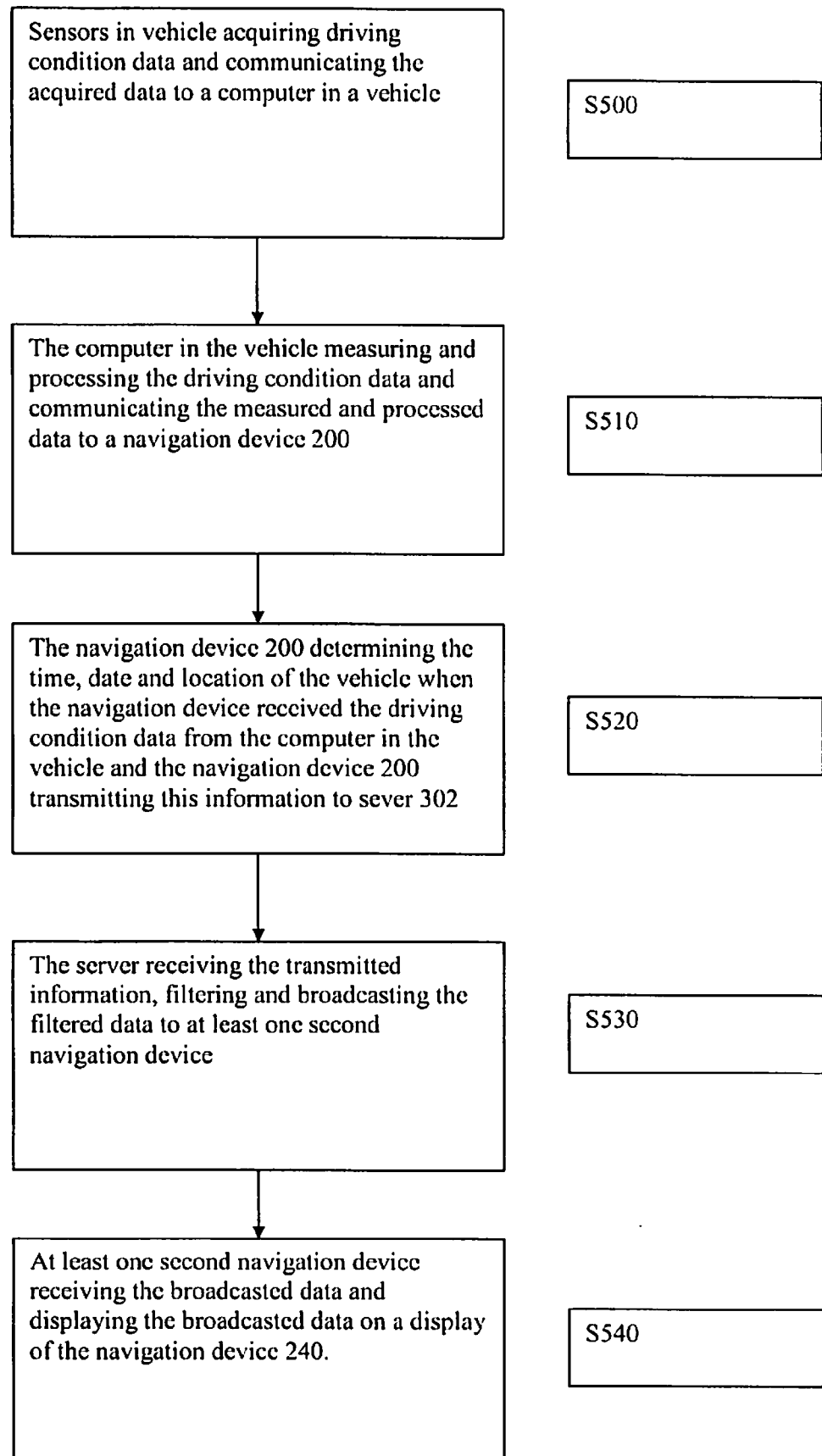
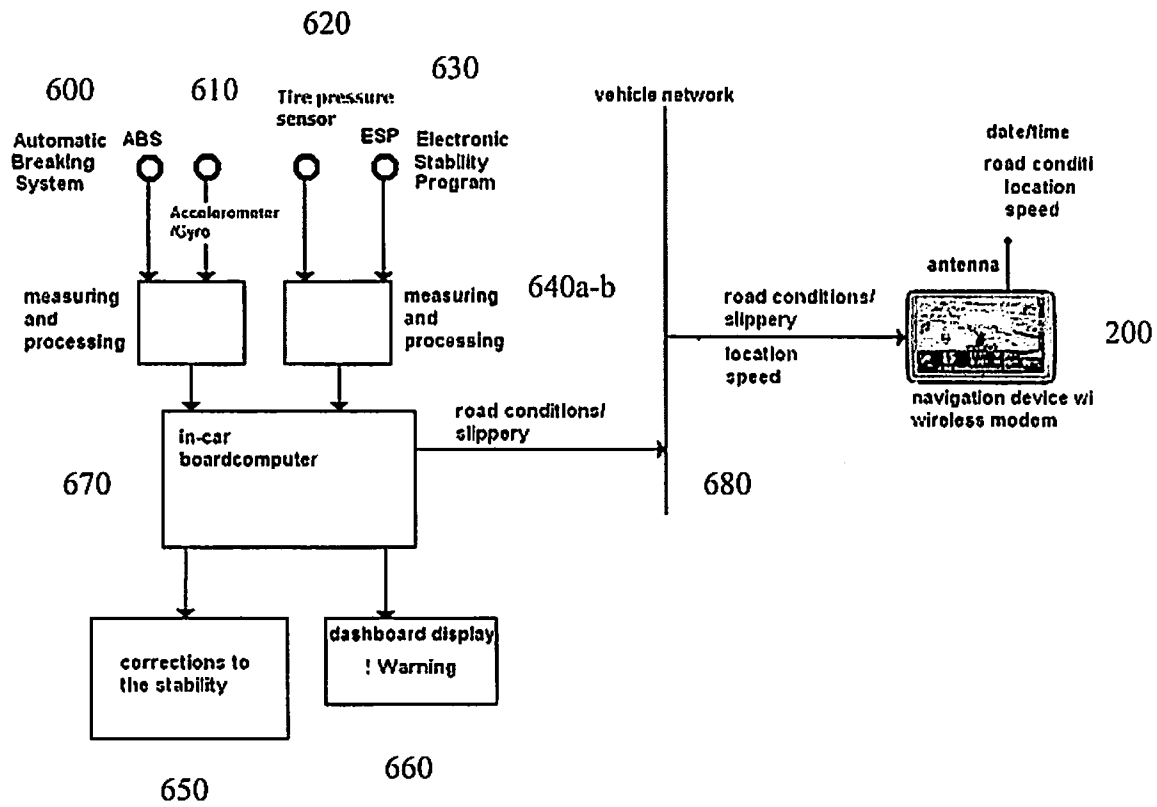


FIG. 4b

FIG. 5

**FIG.6**

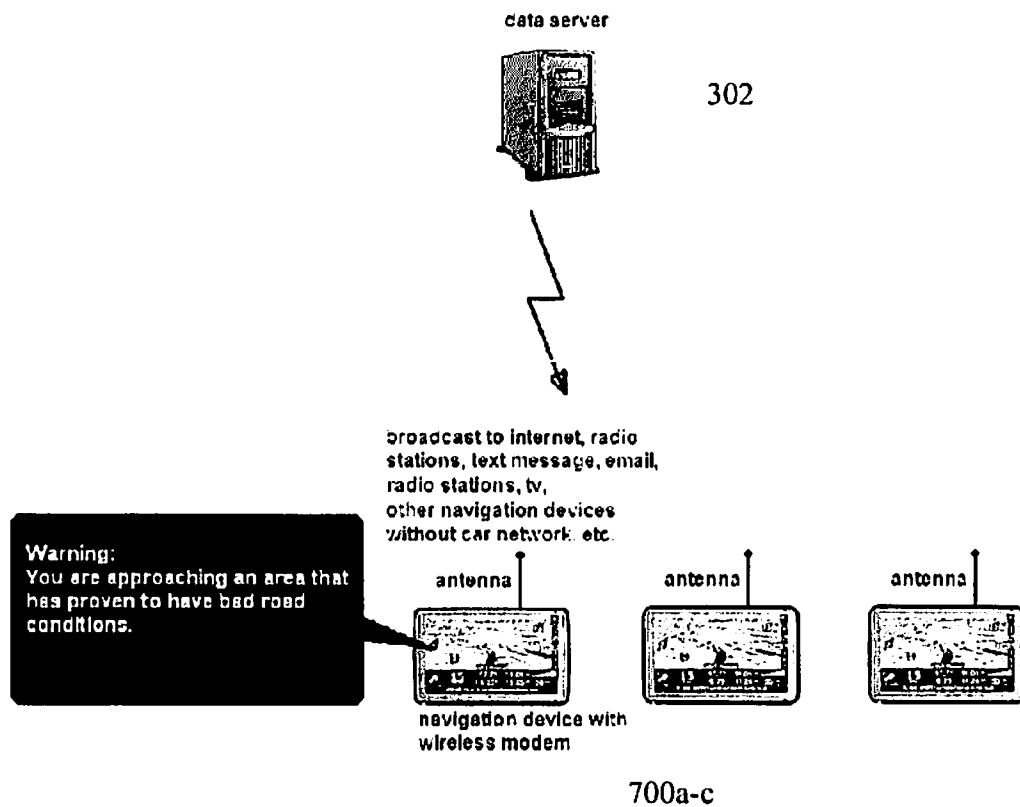


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/068034

A. CLASSIFICATION OF SUBJECT MATTER

INV. G01C21/26 G08G1/0967 G08G1/0968
ADD.

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)

G08G G01C

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

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

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	JP 2009 277146 A (TOYOTA MOTOR CORP) 26 November 2009 (2009-11-26) paragraphs [0021] - [0026]; figures 1,2 -----	1-21
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X	EP 1 345 191 A1 (RENAULT SA [FR]) 17 September 2003 (2003-09-17) paragraphs [0009] - [0018] -----	1-21

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

☒ See patent family annex.

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Date of the actual completion of the international search

10 September 2010

Date of mailing of the international search report

22/09/2010

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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