

[54] COMPUTERIZED NAVIGATION SYSTEM

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[58] Field of Search 340/988, 990, 340/995, 991; 364/449

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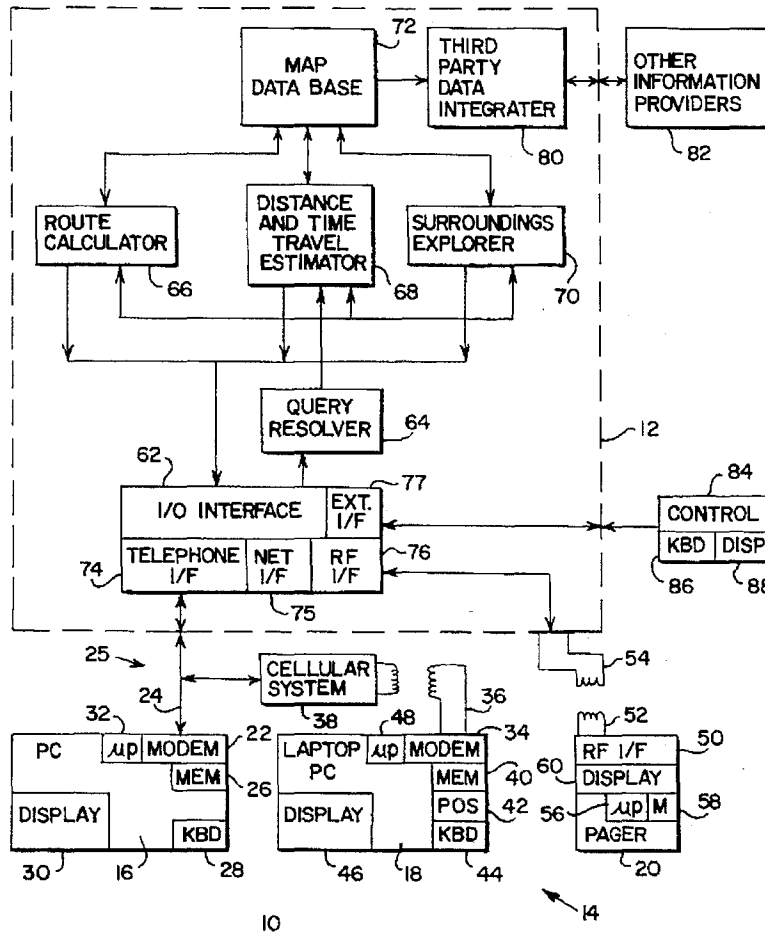
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Attorney, Agent, or Firm—Alice O. Martin

[57] ABSTRACT

The invention provides a method and system for providing route guidance information from a base unit to a remote unit in response to a request from the remote unit. The remote unit may be a mobile unit or a fixed unit. A query is formatted at the remote unit, the query including the request, and communicated from the remote unit to the base unit. The requested route guidance information is calculated at the base unit in response to the query, using a database located at the base unit. A response to the query is formatted at the base unit, the response including the route guidance information. The response is communicated from the base unit to the remote unit for display.

56 Claims, 3 Drawing Sheets



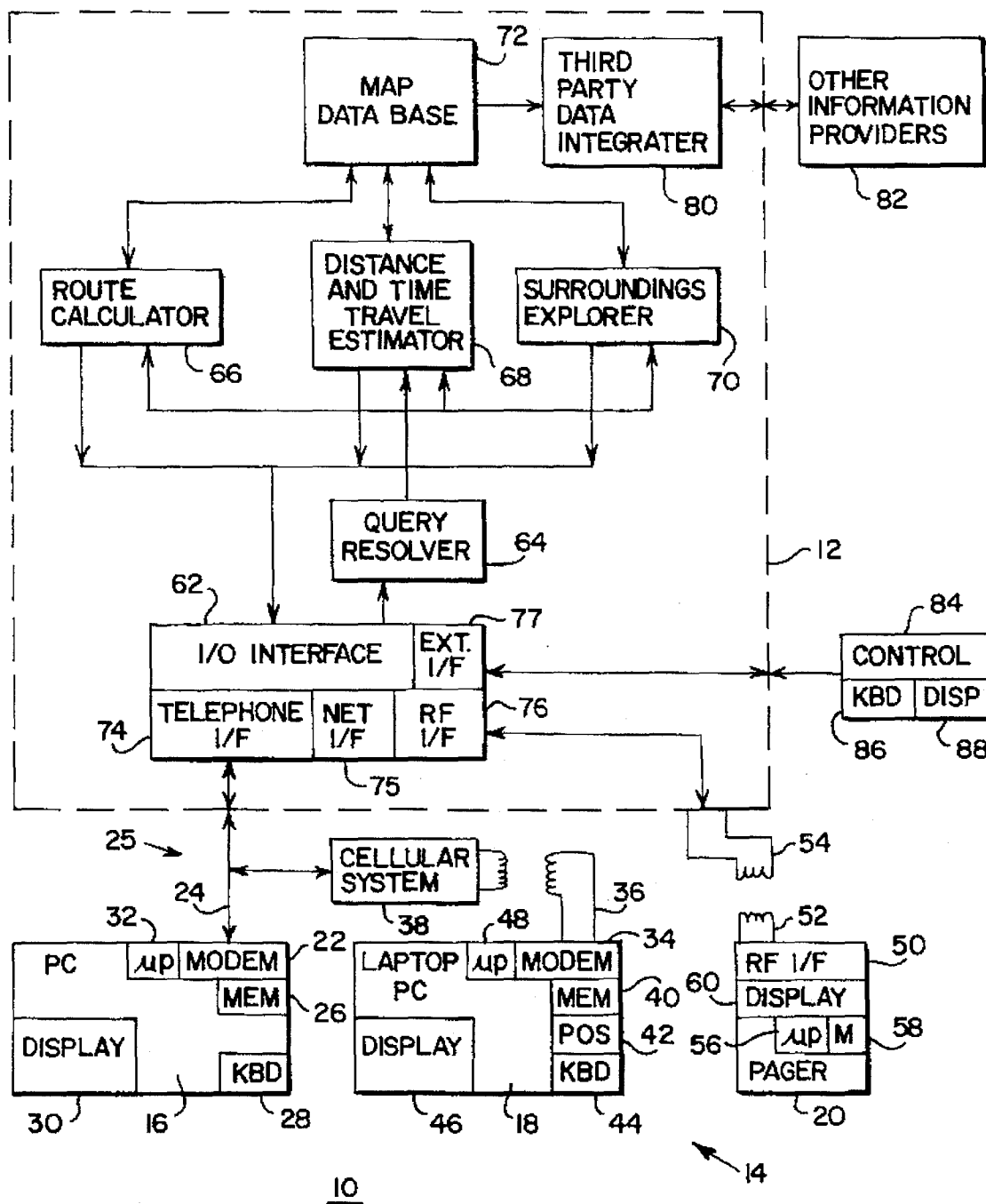


FIG. 1

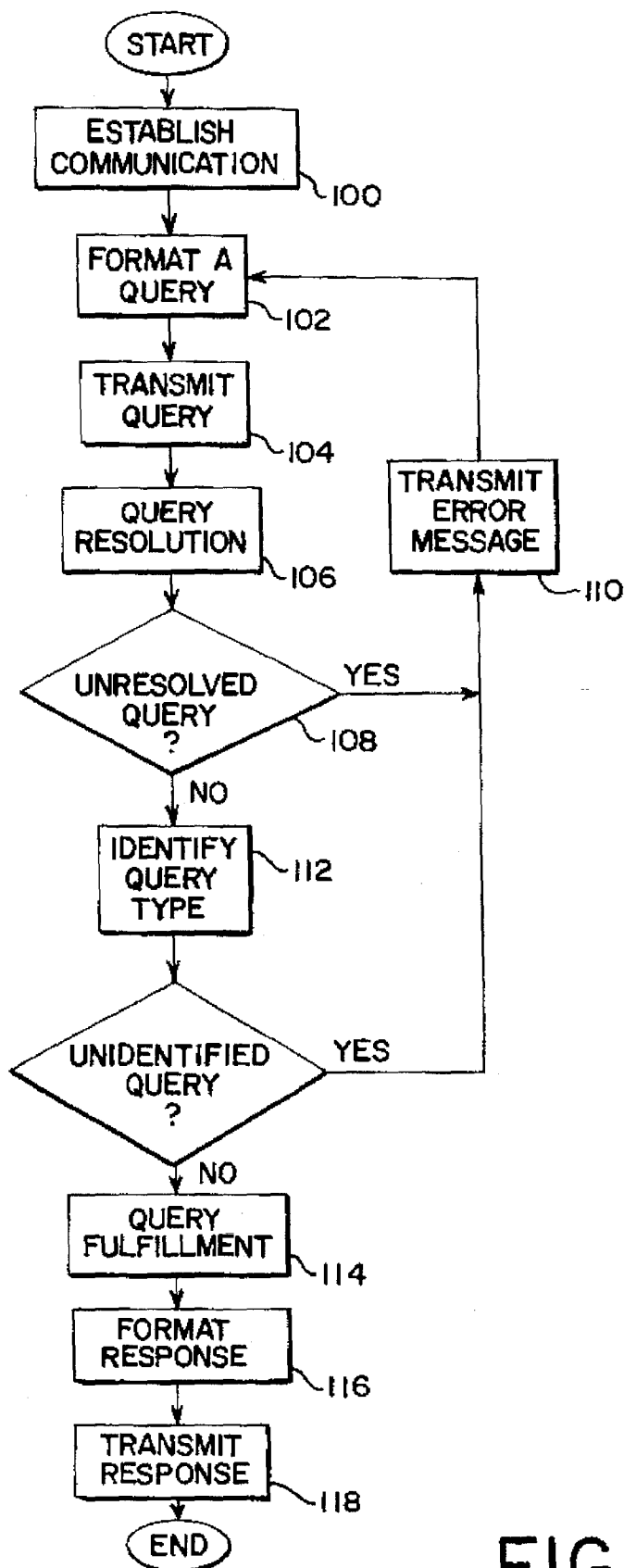


FIG. 2

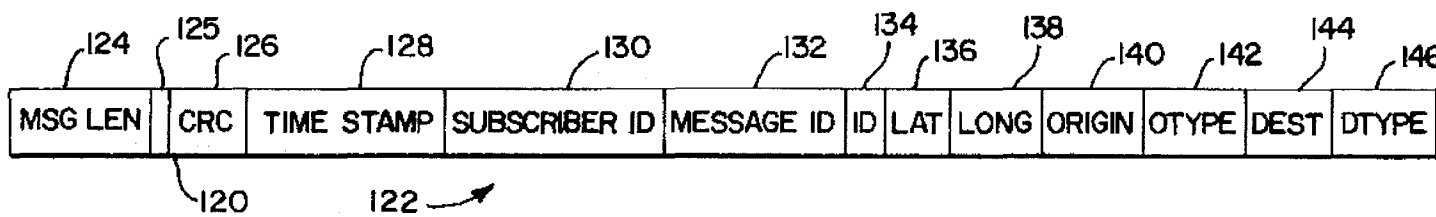


FIG. 3

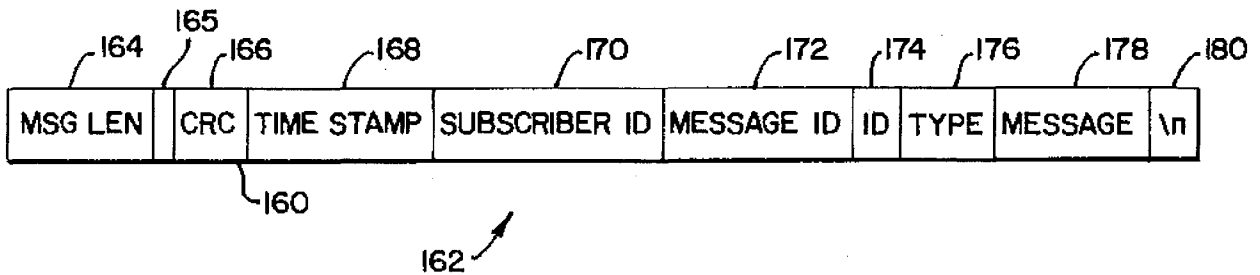


FIG. 4

COMPUTERIZED NAVIGATION SYSTEM

BACKGROUND OF THE INVENTION

The invention generally relates to a system and method for providing route guidance and tracking information from a base unit to a mobile unit over wireless and wireline devices. The invention more particularly relates to an apparatus and method for providing to a mobile unit route guidance and tracking information which has been calculated at a base unit in response to a query from the mobile unit.

Systems have been developed which provide geographical or position-dependent information to a mobile user. Such systems are generally installed in an automobile or other vehicle. These systems generally include an on-board geographic database which may be accessed to determine geographic information, such as locations of points of interest, directions to points of interest, and directions between a specified origin and a destination. An on-board computer calculates route guidance information using data from the database in response to user inputs.

Such systems are known as autonomous route guidance systems, since they are independent and self-contained. The systems generally include a geographic database, positioning sensors, and a computer including a keyboard and display. The geographic database is a representation of a region or metropolitan area and may include, for example, street names, navigation attributes, such as turn restrictions and one-way streets, street addresses, and points of interest, such as airports, restaurants and museums. The positioning sensors may determine geographic position from RF (Radio Frequency) triangulation or in response to signals from, for example, GPS (Global Positioning System), LORAN C or other similar positioning systems, and from motion and direction detectors. The computer calculates route guidance information in response to inputs from the other system components as well as operator input. The route guidance information is provided to the user in the form of navigational text or map graphics.

Autonomous route guidance systems have many drawbacks, however, which have prevented their widespread use. Because the system is autonomous and has an on-board database, the system must include large storage capabilities for storing all the data which form the database. Technologies such as CD-ROM have allowed storage of an entire database but require still a tradeoff between cost and fast, efficient data access.

Another problem with the database provided with autonomous route guidance systems is maintenance or currency of the database. As new streets are built, or as old streets are reconfigured, as businesses and other points of interest open and close, the database on CD-ROM or other media becomes out of date. In addition, when a database is compiled, it may include errors which are then replicated in the many copies provided to users. These errors may require correction in the user copies by replacing those database copies. Moreover, incorrect or outdated information in the database can lead to errors when calculating routes. When an out-of-date database does not include the information that a particular roadway is closed, the system may be unable to calculate an alternate route.

Autonomous route guidance systems may improve the accuracy of the system by providing occasional database updates to users. However, distribution of the database, in a

medium such as CD-ROM or floppy disk, to remotely located mobile users may be difficult. In addition, the media themselves are expensive since they may generally be used only a single time.

Other aspects of such prior art autonomous route guidance systems add to their cost and inconvenience. Because the systems are autonomous, they must include all components, including the computer, the database and the position sensor. Using present technology, such a system is too heavy and too large to be readily transported by an individual. In addition, the complete system has power requirements which make battery operation impractical. As a result, autonomous route guidance systems have been limited to installation in automobiles or other vehicles which can accommodate the size and power requirements of such a system. The current best price for a complete autonomous route guidance system is at least \$2,000. This includes only the cost for a single, dedicated autonomous route guidance system.

Another type of route guidance system has been tested in Europe using beacons to provide a guidance signal to on-board equipment. The system directs the user to travel from beacon to beacon, creating a step-wise path between an origin and a destination. The navigational information thus provided forms a generally inefficient routing path from origin to destination. In addition, such a system does not provide the capability to query a database for information about nearby points of interest and other geographical information.

Therefore, there is a need for a routing and information system that continually provides access to up-to-date, correct geographic information by a remote user. There is a further need for a routing and information system which can be implemented on lightweight, portable devices for easy, convenient transportation and use. There is a further need for a routing and information system which is independent of any particular hardware configuration and may be implemented on any suitably equipped data processing apparatus, such as a desktop personal computer, a laptop computer, a personal digital assistant or even a pager. There is a further need for a routing and information system which provides communication between mobile units and a base unit over any available channel, including wireless and wireline channels. There is a still further need for a data communication protocol for providing accurate, reliable communication in such a system, independent of hardware configuration.

SUMMARY OF THE INVENTION

The invention therefore provides a method of providing route guidance information from a base unit to a mobile unit in response to a request from the mobile unit. The method comprises the steps of formatting a query at the mobile unit, the query including the request, communicating the query from the mobile unit to the base unit, and calculating the route guidance information at the base unit in response to the query. The method further comprises the steps of formatting a response to the query at the base unit, the response including the route guidance information, and communicating the response from the base unit to the mobile unit. The remote guidance information may include navigation instructions from an origin to a destination, information about one or more points of interest within the region of an origin or other geographically referenced information.

The invention further provides a system for communicating routing information between a base unit and a mobile unit. The system comprises input means at the mobile unit

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