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[54] **POSITION BASED PERSONAL DIGITAL ASSISTANT**

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[51] **Int. Cl.**[6] **G01C 21/00**; G06F 165/00

[52] **U.S. Cl.** **701/211**; 701/213

[58] **Field of Search** 701/1, 211, 213, 701/300; 342/357, 457; 340/995, 996; 364/705.05, 705.07, 705.08

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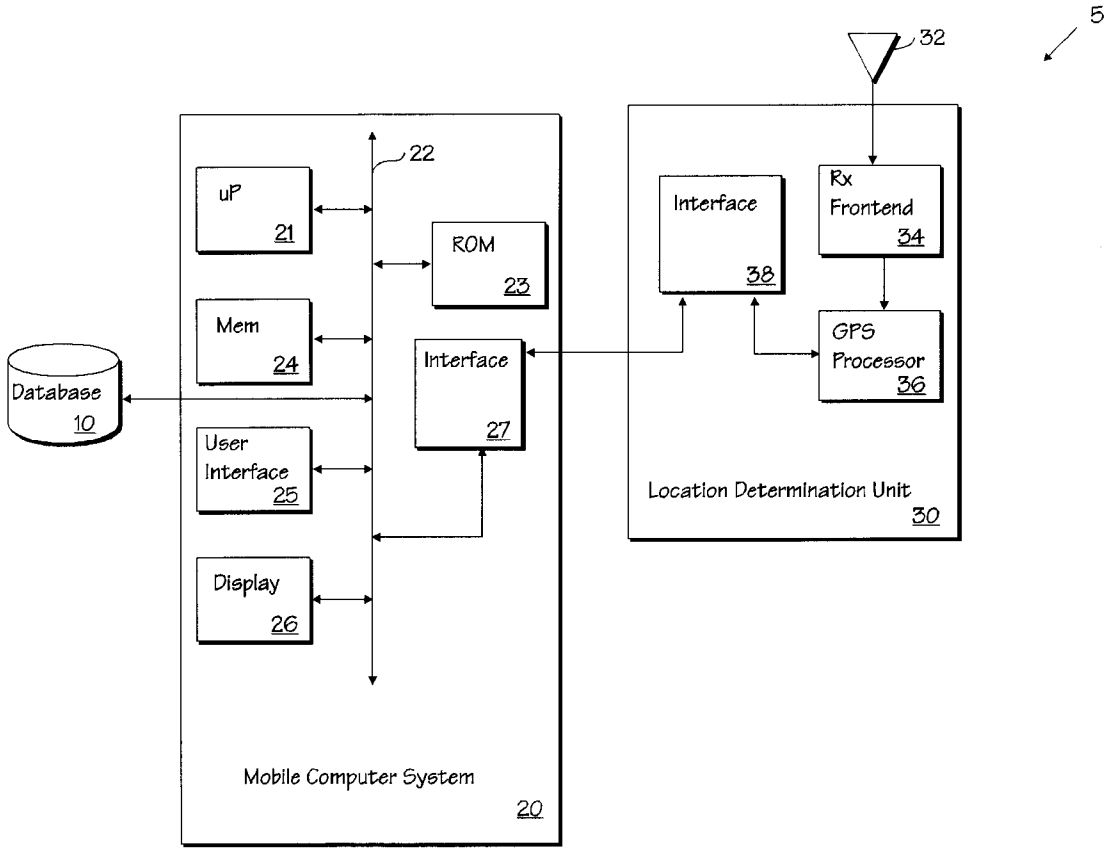
[57] **ABSTRACT**

A task description is stored in a database accessible by a mobile computer system. The mobile computer system receives positioning information corresponding to its geographic location and indexes the database based on the positioning information when the information indicates that the mobile computer system is in a geographic location that facilitates completion of a task associated with the task description. The database may be resident in the mobile computer system or accessible in other ways, for example, via the Internet. The task description preferably includes a geocode which corresponds to the geographic location at which completion of the task may be facilitated. The task description may also include textual, voice or other message which can be displayed and/or played back to a user. The positioning information may be obtained from a GPS satellite, a GLONASS satellite or a pseudolite. The mobile computer system may be a portable unit, such as a PDA, or integrated within a vehicle.

35 Claims, 2 Drawing Sheets



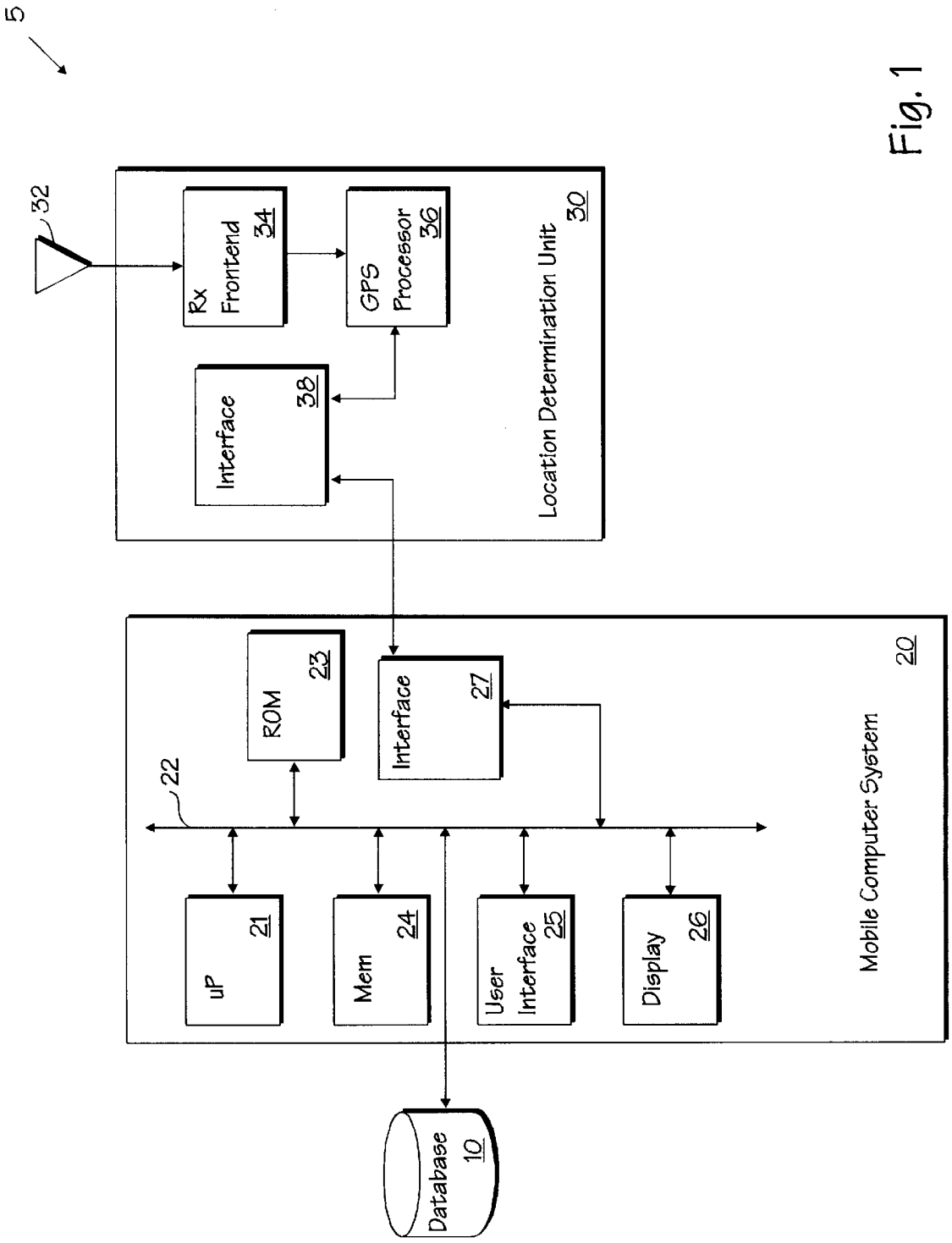


Fig. 1

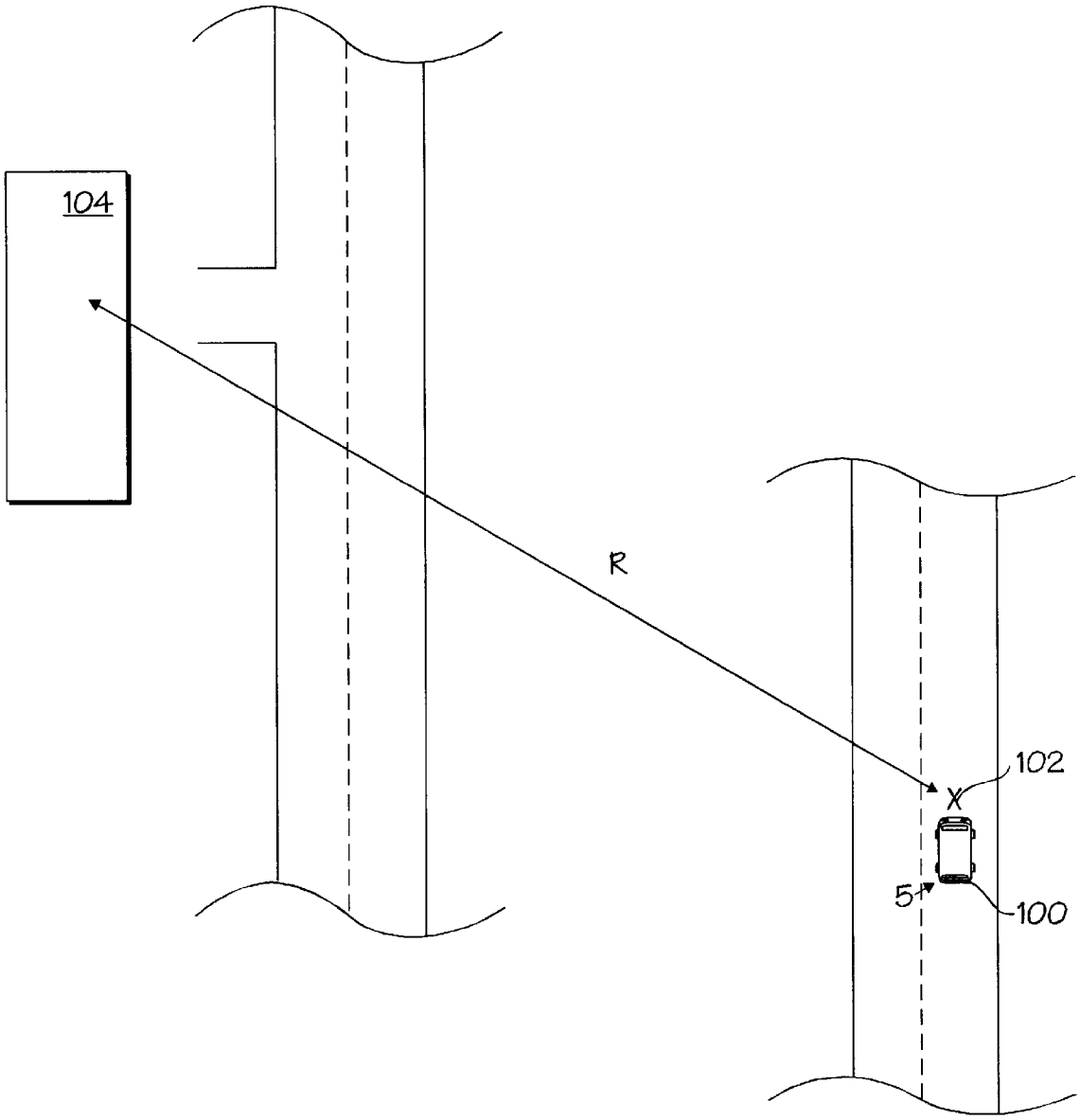


Fig. 2

POSITION BASED PERSONAL DIGITAL ASSISTANT

FIELD OF THE INVENTION

The present invention relates generally to real time positioning systems and, more particularly, to the use of such systems to control access to computer databases to assist in task scheduling.

BACKGROUND

Personal Digital Assistants (PDAs) have become more and more common in today's society. The term PDA refers generally to mobile computer systems, typically handheld, which users employ for a variety of tasks such as storing telephone and address lists (databases), calendaring information, task (i.e., to-do) lists, etc. Some PDAs also incorporate a wireless communication link, allowing the unit to operate as a portable facsimile device, Internet access device and/or pager. Further, PDAs can be configured to operate with Global Positioning System (GPS) receivers as described in U.S. Pat. No. 5,528,248 to Steiner et al., entitled "Personal Digital Location Assistant Including a Memory Cartridge, A GPS Smart Antenna and a Personal Computing Device" assigned to the assignee of the present invention and incorporated by reference herein.

The GPS utilizes signals transmitted by a number of in-view satellites to determine the location of a GPS antenna which is connected to a receiver. Each GPS satellite transmits two coded L-band carrier signals which enable some compensation for propagation delays through the ionosphere. Each GPS receiver contains an almanac of data describing the satellite orbits and uses ephemeris corrections transmitted by the satellites themselves. Satellite to antenna distances may be deduced from time code or carrier phase differences determined by comparing the received signals with locally generated receiver signals. These distances are then used to determine antenna position. Only those satellites which are sufficiently above the horizon can contribute to a position measurement, the accuracy of which depends on various factors including the geometrical arrangement of the satellites at the time when the distances are determined.

Distances measured from an antenna to four or more satellites enable the antenna position to be calculated with reference to the global ellipsoid WGS-84. Local northing, easting and elevation coordinates can then be determined by applying appropriate datum transformation and map projection. By using carrier phase differences in any one of several known techniques, the antenna coordinates can be determined to an accuracy on the order of ±1 cm.

Although U.S. Pat. No. 5,528,248 describes how a GPS receiver can be integrated with a PDA to display navigation information for a user, it does not describe how positioning information provided to the PDA can be used in other ways.

SUMMARY OF THE INVENTION

According to one embodiment, a computer assisted method of scheduling tasks is provided. The method allows a task description to be stored in a database accessible by a mobile computer system. The mobile computer system receives positioning information corresponding to its geographic location and indexes the database based on the positioning information when the information indicates that the mobile computer system is in a geographic location that facilitates completion of a task associated with the task description.

The database may be resident in the mobile computer system or accessible in other ways, for example, via the Internet. The task description preferably includes a geocode which corresponds to the geographic location at which completion of the task may be facilitated. The task description may also include textual, voice or other messages which can be displayed and/or played back to a user. The positioning information may be obtained from a GPS satellite, a GLONASS satellite or a pseudolite. The mobile computer system may be a portable unit, such as a PDA, or integrated within a vehicle.

A second embodiment provides a computer assisted method of using a geocoded database. In this embodiment, a mobile computer system is transported to a first location having first geographic coordinates at a first time. At the first location, RF signals which contain information indicative of the location of a source of their transmission are received and processed to derive the geographic coordinates of the first location. The geographic coordinates of the first location are associated with a descriptor indicative of the first location in a database associated with the mobile computer system so as to form a geocoded entry in the database and a task to be accomplished at the first location is similarly associated with the geocoded entry in the database.

The mobile computer system is transported to a second location at a second time and RF signals containing information indicative of the source of the signals are received and processed to determine the geographic coordinates of the second location. The geographic coordinates of the second location are analyzed to determine whether the second location is within a predetermined range of the first location and, if so, a user is alerted. The user may be alerted by displaying an alert message, such as a task description corresponding to the task to be accomplished at the first location, on a display associated with the mobile computer system.

A further embodiment provides a mobile computer system having a location determination unit configured to receive and process RF signals containing information indicative of the location of a source of the signals, a database coupled to the location determination unit and including location coordinates indicative of a location of interest and a database interface unit configured to access the database according to the location of the mobile computer system.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not limitation in the figures of the accompanying drawings in which:

FIG. **1** illustrates a digital system configured with a mobile computer system, a location determination unit and a database according to one embodiment; and

FIG. **2** illustrates a vehicle configured in accordance with the present invention located near a pick-up location.

DETAILED DESCRIPTION

The following description of a position based personal digital assistant sets forth numerous specific details in order to provide a thorough understanding of the present invention. However, after reviewing this specification, it will be apparent to those skilled in the art that the present invention may be practiced without some or all of these specific details. In other instances, well known structures, programming techniques and devices have not been described in detail in order not to unnecessarily obscure the present invention.

Some portions of the detailed description which follows are presented in terms of operations on data within a computer memory. These descriptions are the means used by those skilled in the relevant arts to most effectively convey the substance of their work to others skilled in the art. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared and otherwise manipulated. It has proven 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. 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, it will be appreciated that throughout the description of the present invention, use of terms such as "processing", "computing", "calculating", "determining", "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.

Referring to the accompanying FIG. **1**, a digital system **5** having a database **10**, a mobile computer system **20** and a location determination unit **30** is shown. Database **10** may be a separate database maintained at some location remote from mobile computer system **20** or it may be a local database maintained within mobile computer system **20**. Mobile computer system **20** may be a personal digital assistant or other mobile computer system (e.g., a notebook or other personal computer) or it may be an integrated computer system within a vehicle. Location determination unit **30** may be a Global Positioning System (GPS) receiver of other unit capable of determining a geographic location of an accompanying antenna **32**.

It should be appreciated that although database **10**, mobile computer system **20** and location determination unit **30** are illustrated as distinct units, in some embodiments these items may comprise a single unit, such as a personal digital assistant or notebook computer. In such embodiments, location determination unit **30** may be housed within a card (PC Card) compatible with the Personal Computer Memory Card International Association PC Card Standard, release 2.0, published by the Personal Computer Memory Card Interface Association (PCMCIA), September 1991. In other embodiments, location determination unit **30** may comprise a GPS Smart Antenna or other GPS receiver.

In yet other embodiments, elements of digital system **5** may form an integrated system within a vehicle, aircraft, boat or other mobile unit and database **10** may be stored within a memory device housed in a PC Card or on another transportable computer readable media such as a disk or CD ROM. Database **10** is preferably a geocoded database and will be described in further detail below. In some cases, mobile computer system **20** may share some circuitry with location determination unit **30**. For example, the two units may share a digital signal processor or other microprocessor which performs the computations required to derive the geographic location of the digital system **5** (i.e., antenna **32**) using signals transmitted by GPS satellites or other sources (e.g., GLONASS satellites and/or pseudolites).

Mobile computer system **20** typically includes a microprocessor **21** and a system bus **22**. Microprocessor **21** is coupled to system bus **22**, allowing microprocessor **21** to communicate with the other elements which make up mobile computer system **20**, location determination unit **30** and database **10**. Mobile computer system **20** may also include a ROM **23** which typically stores computer readable instructions to be executed by microprocessor **21** upon power up. Such instructions may further include an operating system for mobile computer system **20** where such an operating system is not stored within another nonvolatile memory. Mobile computer system **20** may further include a memory (Mem) **24** which may be a volatile memory (i.e., a random access memory or RAM) for use during periods when mobile computer system **20** is powered up. The Mem **24** may also include a hard disk or other long term, nonvolatile memory for storage of application programs and/or data when mobile computer system **20** is not powered up. In other cases, these application programs may be stored in ROM **23**. ROM **23** and Mem **24** are typically coupled to system bus **22** to allow access by microprocessor **21**. In some embodiments, ROM **23** and Mem **24** may be coupled to microprocessor **21** over a separate memory bus (not shown).

To facilitate use of mobile computer system **20** by an operator, user interface **25** and display **26** are provided and each are coupled to system bus **22**. User interface **25** may include a familiar keyboard and mouse (or other pointing device such as a pen). In addition, some mobile computer systems **20** may have a voice synthesizer included as part of user interface **25** to allow activation of various functions by voice command. In other embodiments, the user interface **25** may be a touch sensitive screen which also forms part of a visual display **26**. Other user interfaces may also be used. Display **26** may be a visual display such as a liquid crystal display screen, or other screen. In other embodiments, display **26** will include alert lights, such as those commonly found on automobile dashboards. Where mobile computer system **20** is integrated within a vehicle, display **26** may form part of a heads up display or dashboard display within the vehicle. When display **26** forms part of a heads up display, the heads up display may provide information such as the vehicle's current speed and location (e.g., latitude and longitude). The heads up display may further include an area for displaying text messages, such as the task description stored in database **10**. Alternatively, the heads up display may only provide an alert indication (such as an icon or an alert symbol, etc.). Such a heads up display may be displayed on an appropriate section of the vehicle's windshield, such as a corner of the windshield near the driver's position or directly above the steering wheel, so as to allow for easy use by the driver without obstructing the driver's view of the road. Display **26** may also include a voice synthesizer (optionally shared with user interface **25**) and speaker system to allow for playback of voice messages. This arrangement may allow for voice messages to be played back through the vehicle's existing sound system (e.g., an AM/FM stereo system). Other displays may also be used.

Mobile computer system **20** also includes interface **27** which allows mobile computer system **20** to communicate with location determination unit **30**. Interface **27** provides an electrical connection between mobile computer system **20** and location determination unit **30** and may correspond to an RS-232 or RS-422 interface. In some embodiments, where location determination unit **30** comprises a GPS server located as a unit on a vehicle bus system, interface **27** allows for proper electrical coupling between mobile computer system **20** and a vehicle communication bus. As such, interface **27** will be configured according to the protocol for message exchange across the bus.

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