US 20150066545A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2015/0066545 A1

(43) Pub. Date: Mar. 5, 2015

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(54) **MOBILE PARKING SYSTEMS AND METHODS FOR PROVIDING REAL-TIME PARKING GUIDANCE**

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(21) Appl. No.: **14/017,248**

(22) Filed: **Sep. 3, 2013**

Publication Classification

(51) **Int. Cl.**

G06Q 10/02 (2006.01)

G08G 1/14 (2006.01)

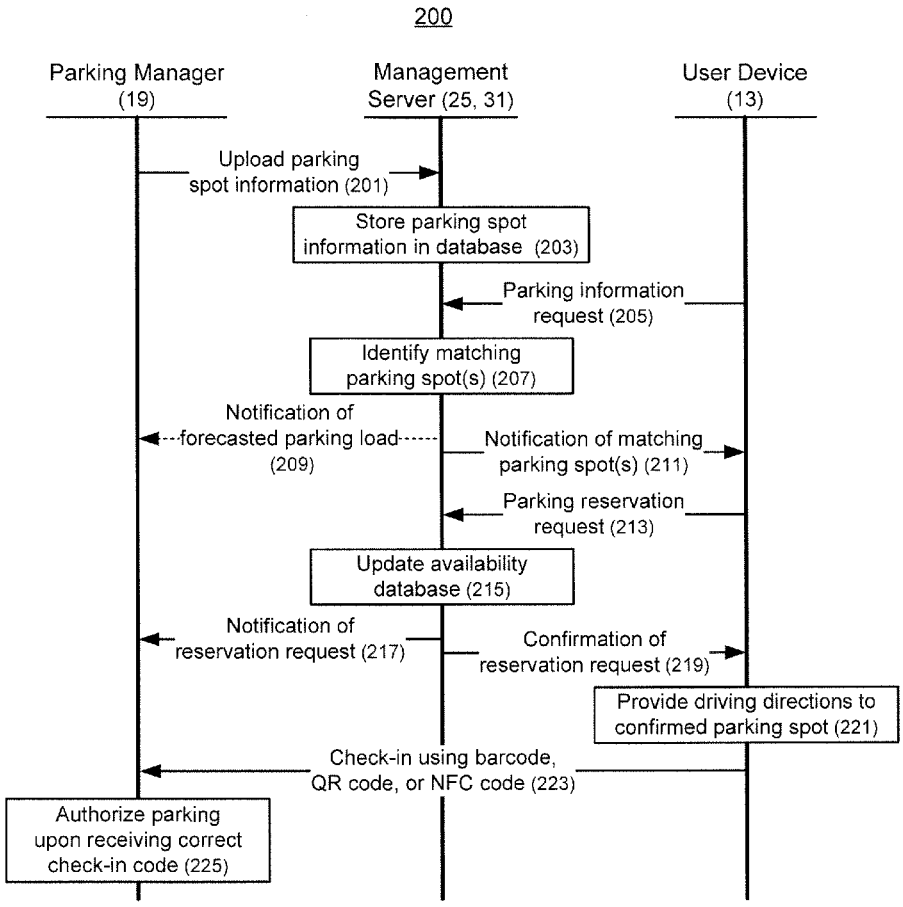
(52) **U.S. Cl.**

CPC . ***G06Q 10/02*** (2013.01); ***G08G 1/14*** (2013.01)

USPC **705/5**

(57) **ABSTRACT**

Parking guidance is provided to a user of a mobile device requesting information on parking spots at a requested location for a requested time. In response to receiving a parking information request, parking spots having locations proximate to the requested location and having availability at the requested time are identified in a database of parking spot information of a parking management server. A notification of the identified parking spots is transmitted to the user device from which the information request was received. In response to receiving a reservation request identifying a parking spot to be reserved from the user device, the database is updated to identify the identified parking spot as being unavailable at the requested time. Additionally, a notification of the reservation request is transmitted to a parking manager associated with the identified parking spot, the notification identifying the particular parking spot and the requested time.



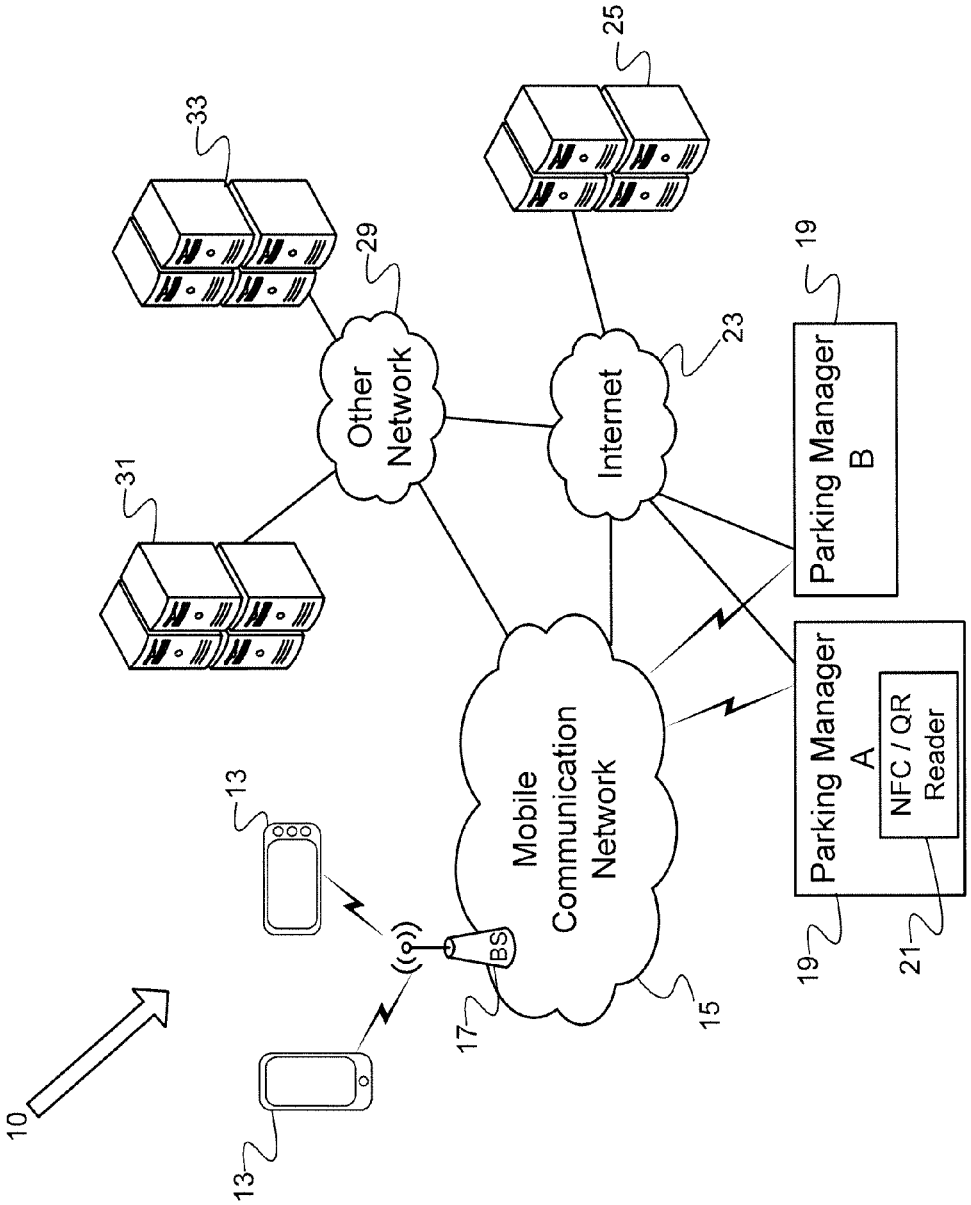

10
13
13
BS
17
Mobile Communication Network
15
Other Network
29
Internet
23
25
33
31
Parking Manager A
NFC / QR Reader
19
21
Parking Manager B
19

FIG. 1

FIG. 2

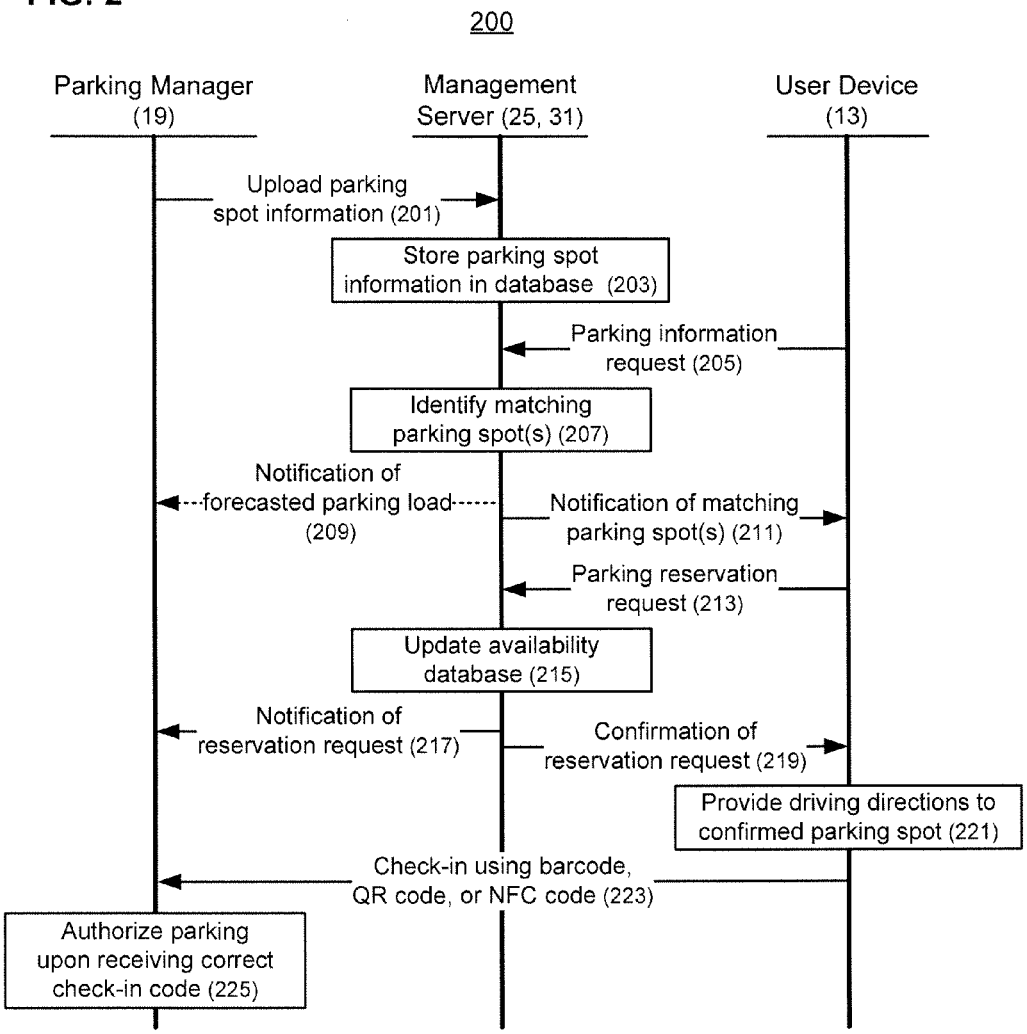

200
Parking Manager (19)
Management Server (25, 31)
User Device (13)
Upload parking spot information (201)
Store parking spot information in database (203)
Parking information request (205)
Identify matching parking spot(s) (207)
Notification of forecasted parking load (209)
Notification of matching parking spot(s) (211)
Parking reservation request (213)
Update availability database (215)
Notification of reservation request (217)
Confirmation of reservation request (219)
Provide driving directions to confirmed parking spot (221)
Check-in using barcode, QR code, or NFC code (223)
Authorize parking upon receiving correct check-in code (225)

FIG. 3A

300

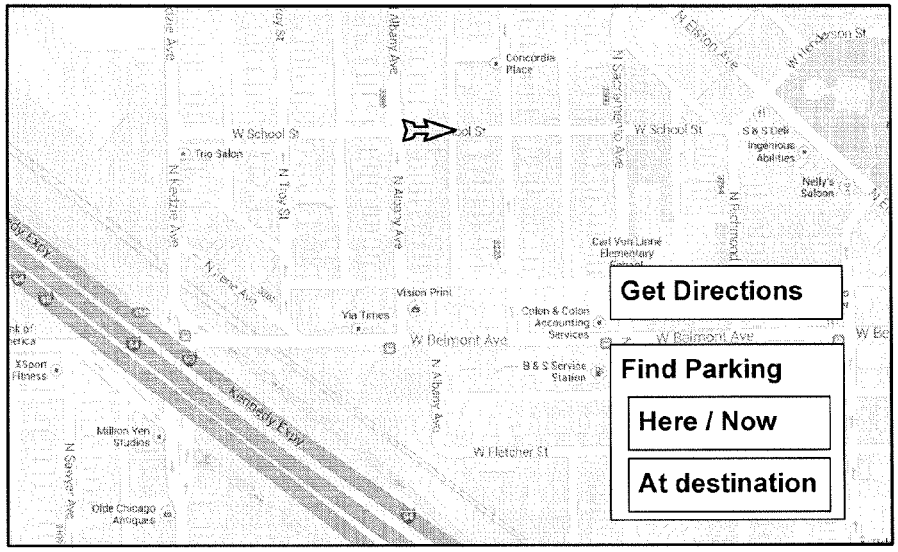


FIG. 3B

330

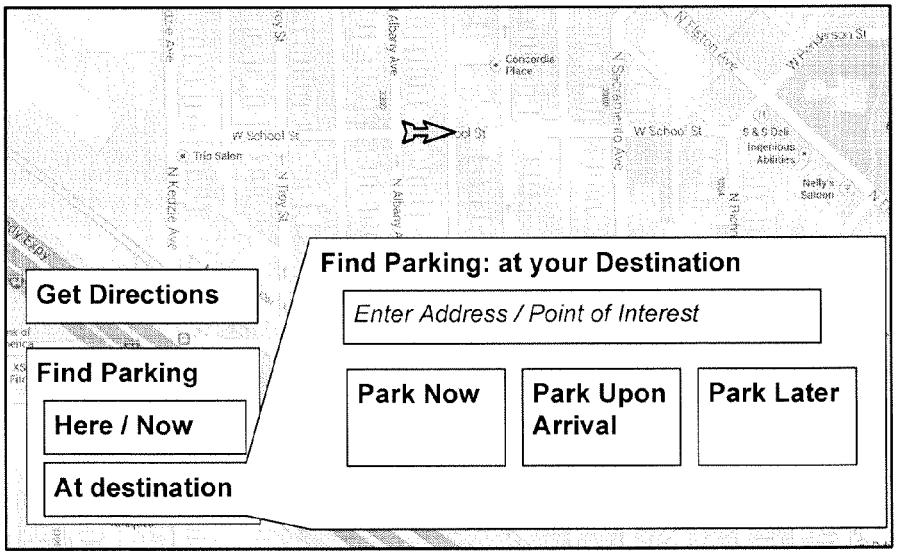


FIG. 3C

360

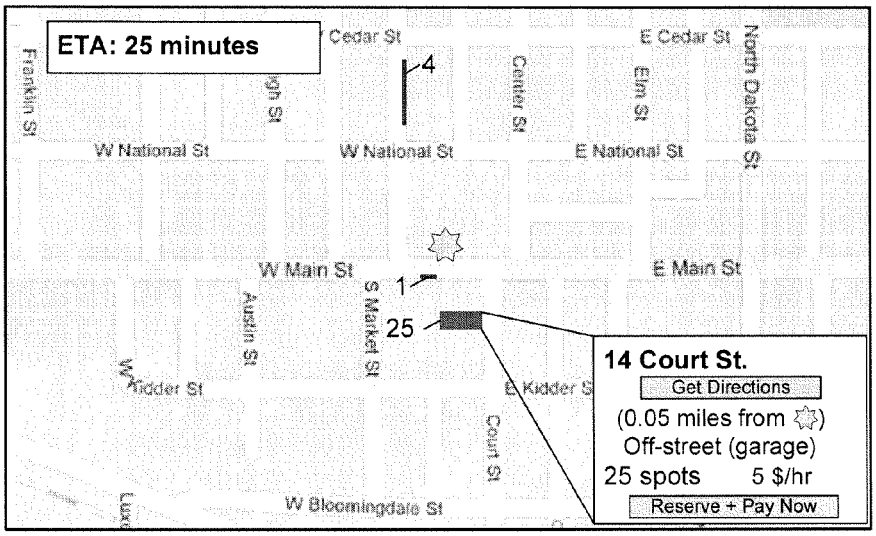
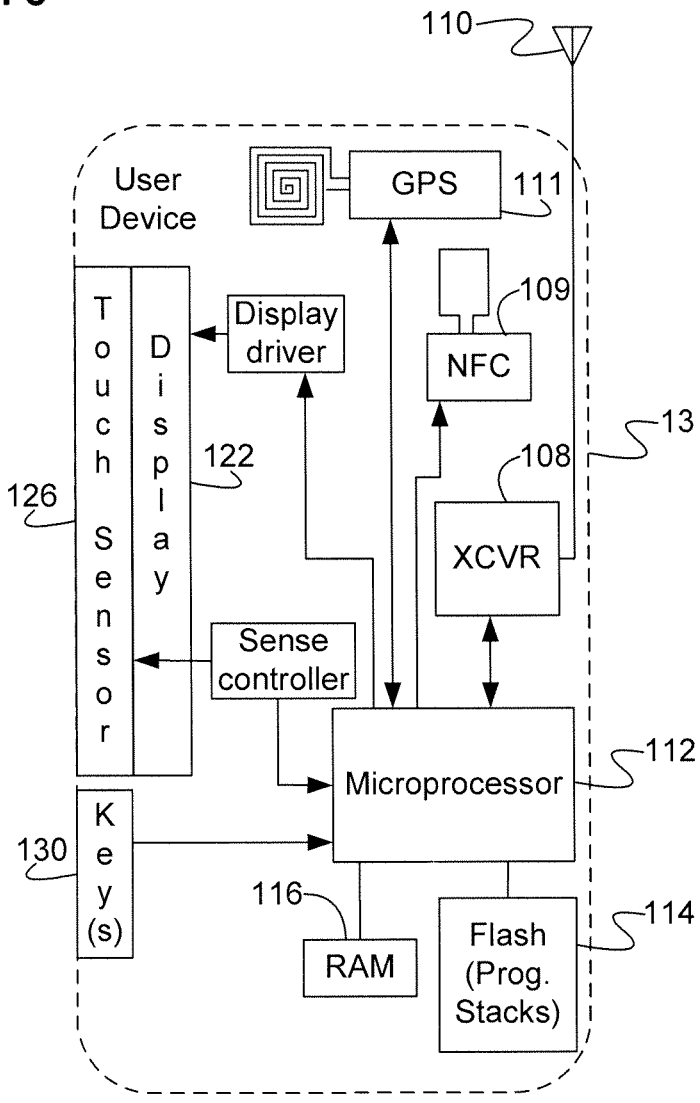


FIG. 4

400

Parking Spot ID	Location	Parking Manager ID	Availability
x012384	3 W Main St	m00001	...
x123941	14 Court St.	m02344	...
x123942	14 Court St.	m02344	...
x123943	14 Court St.	m02344	...
...	...	...	...

FIG. 5


110
User Device
GPS
111
109
NFC
Display driver
Touch Sensor
Display
122
126
13
108
XCVR
Sense controller
112
Microprocessor
130
Key (s)
116
RAM
114
Flash (Prog. Stacks)

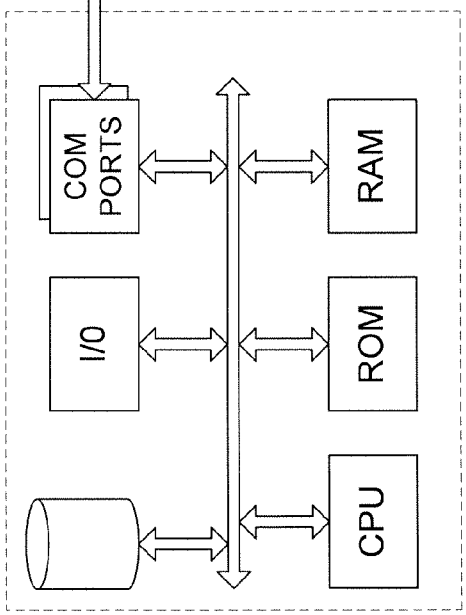

To/From a Network
COM PORTS
RAM
I/O
ROM
CPU

FIG. 6

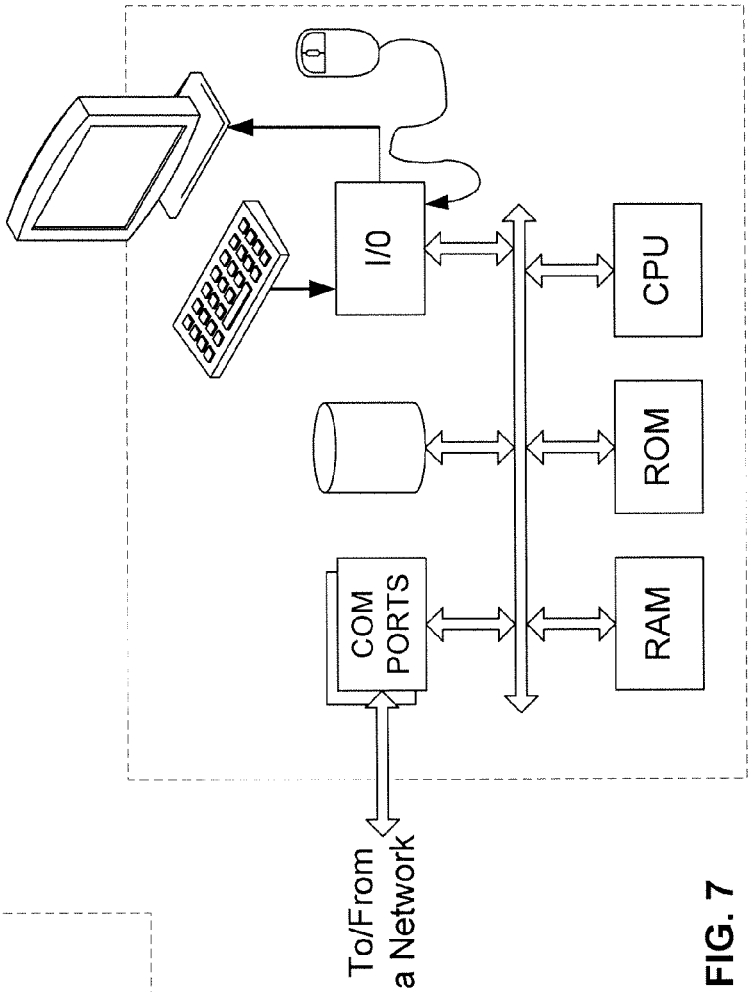

I/O
CPU
ROM
COM PORTS
RAM
To/From a Network

FIG. 7

MOBILE PARKING SYSTEMS AND METHODS FOR PROVIDING REAL-TIME PARKING GUIDANCE

BACKGROUND

[0001] In recent years, vehicle navigation devices providing turn-by-turn directions guiding drivers to their destinations have expanded and increased in popularity. In addition, applications providing navigation services and turn-by-turn directions have been developed for user mobile devices such as cell-phones. As a result, users now commonly use their mobile devices to guide them to their intended destinations.

[0002] In addition to turn-by-turn directions, vehicle navigation devices and applications can provide information on landmarks and amenities located within a user's vicinity, such as nearest gas stations, restaurants, hospitals, or the like. The vehicle navigation devices and applications can thus be used to obtain information about and guide users to nearby landmarks and amenities.

[0003] The vehicle navigation devices and applications, however, generally do not provide current parking information to users. In particular, the navigation devices and applications do not provide real-time parking information to users, such as information on current and future parking availability at a location. As a result, users cannot rely on navigation devices and applications to locate and select parking garages or parking spots, and must instead drive around in search of open parking spots or parking garages with availability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The drawing figures depict one or more implementations in accord with the present teachings, by way of example only, not by way of limitation. In the figures, like reference numerals refer to the same or similar elements.

[0005] FIG. **1** is a high-level functional block diagram of a system of networks/servers/devices that provide the real-time parking guidance service to users.

[0006] FIG. **2** is a communication flow diagram illustratively showing processing and communications performed as part of providing a real-time parking guidance service.

[0007] FIGS. **3**A-**3**C are illustrative displays of a real-time parking guidance application running on a user device.

[0008] FIG. **4** shows an illustrative data structure used for storing parking spot information in a database of a parking management server providing a real-time parking guidance service.

[0009] FIG. **5** is a high-level functional block diagram of a user device as may utilize the real-time parking guidance service through a system like that shown in FIG. **1**.

[0010] FIG. **6** is a simplified functional block diagram of a computer that may be configured as a host or server, for example, to function as the parking management server in the system of FIG. **1**.

[0011] FIG. **7** is a simplified functional block diagram of a computer, work station, or terminal device that may function as a parking manager in the system of FIG. **1**.

DETAILED DESCRIPTION

[0012] In the following detailed description, numerous specific details are set forth by way of examples in order to provide a thorough understanding of the relevant teachings. In other instances, methods, procedures, components, and/or circuitry have been described at a relatively high-level, without detail, in order to avoid unnecessarily obscuring aspects of the present teachings.

[0013] The various methods and systems disclosed herein relate to real-time parking guidance for enabling users having mobile communication devices to efficiently locate, reserve, and check-in to parking spots.

[0014] The real-time parking guidance may be provided, in part, by a parking management server storing a database of parking spots. The parking management server receives information on parking spots from parking managers. Each parking manager provides to the server information on the location and availability of parking spots that the manager is responsible for. In turn, a user requests parking information from the parking management server through an application running on a user device such as a smart-phone. In response to the request, the user is provided with information on available parking spots located within the vicinity of a requested location at a requested time. If a user reserves a parking spot, the parking manager is notified by the management server.

[0015] Reference now is made in detail to the examples illustrated in the accompanying drawings and discussed below.

[0016] FIG. **1** illustrates a system **10** for providing real-time parking guidance to users of mobile communication devices. The system **10** includes a mobile communication network **15** providing mobile communication services to a plurality of mobile user devices **13**. The network **15** offers a variety of mobile communication services, including data communication services for communication between mobile user devices **13** and servers connected to one or more packet data networks (PDNs) **23**, **29**. The system **10** additionally includes a plurality of parking managers **19** each responsible for managing one or more parking spots. The parking managers **19** communicate through the mobile communication network **15** and the PDNs **23**, **29** with the mobile user devices **13** and a parking management server (e.g., server **25** or **31**).

[0017] The user devices **13** shown in FIG. **1** are examples of devices that may be used for providing real-time parking guidance services. The example shows simply two mobile user devices **13** as well as a single base station **17** of the mobile communication network **15**. However, the network will provide similar communications for many other similar users and devices **13** through additional base stations **17**. The devices **13** are capable of data communications through the particular type of network **15**. The devices **13** may include smart-phones, tablets, and vehicle navigation devices configured for communication across network **15**. More generally, the devices **13** can take the form of portable handsets and personal digital assistants, although they may be implemented in other form factors. The devices **13** may optionally be capable of voice telephone communications and/or messaging communication services through the network **15**. The devices **13** may optionally include location capabilities such as global positioning system (GPS)-based location capabilities for receiving and processing signals received from GPS satellites.

[0018] The parking managers **19** generally are computers or servers of persons responsible for parking spots. In a first example (e.g., parking manager A of FIG. **1**), the parking manager **19** is a server associated with a parking garage or parking lot and that is tasked with managing the parking garage or parking lot. The parking manager **19** may thus store information on parking spots located in the parking garage or

parking lot, control access to and egress from the garage or lot (e.g., through control of a door or gate), and process payments from users of the garage or lot. In a second example (e.g., parking manager B of FIG. **1**), the parking manager **19** is a computer, tablet, or smart-phone of an individual providing access to one or more parking spots (e.g., a homeowner having parking spot(s) in his driveway). The parking manager **19** of the second example may provide information on the parking spot(s) through a display screen to the individual and/or to users of the parking spot(s). In other examples, the parking manager **19** is a computer or server tasked with managing one or more parking meters or one or more muni-meters associated with on-street or other parking spots, such as a server of a department of motor vehicle (DMV) tasked with managing on-street parking in a city or county. In some examples, the parking manager **19** may provide parking both to users of the parking guidance service and to users driving up to the parking garage, parking lot, parking meter, or muni-meter. In some examples, the parking manager **19** includes an NFC/QR reader **21** for enabling users of the parking guidance service to check-in to a parking spot using a barcode, a quick response (QR) code, or a near-field communication (NFC) code.

[0019] A parking management server (e.g., server **25** or **31**) stores and maintains a database of information relating to the location and availability of parking spots. The parking management server (**25**, **31**) receives parking spot information from the parking managers **19**, and updates the database using the received parking spot information. In the database, each parking spot is identified by a unique identifier, and is associated with location and availability information for the parking spot. Each parking spot further has a parking manager **19** associated therewith. The availability of each parking spot is determined based on information provided by the parking manager **19** to the parking management server (**25**, **31**). For example, the parking spot may initially be available anytime, available during operating hours of a parking garage or lot (e.g., Monday through Friday, between 7 am and 7 pm), or available during specific time periods (e.g., for a period of time extending from two hours prior to the start of a sports team's home game, to two hours following the end of the home game). The availability information may be updated in response to the parking management server (**25**, **31**) receiving a reservation request for a parking spot from a user device **13**, and/or in response to the parking management server (**25**, **31**) receiving updated availability information from a parking manager **19** (e.g., in response to a driver entering a parking garage or paying for parking at a muni-meter communicatively coupled to the parking manager **19**).

[0020] The user devices **13**, parking managers **19**, and parking management server (e.g., server **25** or **31**) are in communication with each other through mobile communication network **15**. The present techniques may be implemented in any of a variety of available mobile networks **15** and/or on any of a variety of mobile user devices compatible with such a network **15**. The network **15** offers a variety of mobile communication services, including voice and messaging services for communication between two or more mobile user devices **13**. The wireless mobile communication network **15** might be implemented as a network conforming to the code division multiple access (CDMA) IS-95 standard, the 3rd Generation Partnership Project 2 (3GPP2) wireless IP network standard or the Evolution Data Optimized (EVDO) standard, the Global System for Mobile (GSM) communication standard, a time division multiple access (TDMA) standard or other standards used for public mobile wireless communications. The mobile communication network **15** can be implemented by a number of interconnected networks.

[0021] The network **15** typically offers a variety of data services via the Internet **23**, such as downloads, web browsing, email, etc. By way of example, a user device **13** may communicate with a server **25** connected to the Internet **23**, and/or with a variety of other types of devices or systems capable of data communications through various interconnected networks. The devices **13** of users of the real-time parking guidance services also can receive and execute applications written in various programming languages, as discussed more later.

[0022] An operator or carrier of the network **15** operates a number of systems that provide ancillary functions in support of the communications services and/or application services provided through the network **15**, and those elements communicate with other nodes or elements of the network **10** via one or more private IP type packet data networks **29** (sometimes referred to as an Intranet), i.e. a private network. Generally, such systems are part of or connected for communication via the private network **29**. Systems outside of the private network could serve the same functions as well. Examples of such systems, in this case operated by the network service provider as part of the overall network **10**, which communicate through the intranet type network **29**, include one or more application servers **31** and a related authentication server **33** for the application service of server **31**.

[0023] If the mobile service carrier offers the real-time parking guidance service, the service may be hosted on a carrier operated application server **31**, for communication via the networks **15** and **29**. In such a situation, the parking management server **31** communicates with user devices **13** and parking managers **19** through the private network **29**. Alternatively, the real-time parking guidance service may be provided by a separate entity (alone or through agreements with the carrier), in which case, the service may be hosted on an application server such as server **25** connected for communication via the networks **15** and **23**. In the alternative situation, the parking management server **25** communicates with user devices **13** and parking managers **19** through the Internet **23**.

[0024] Additionally, parking managers **19** are generally configured for communication through the Internet **23**, and communicate with the parking management server (**25**, **31**) through the Internet **23**. In some examples, however, parking managers **19** can be configured for wireless communication through the mobile communication network **15**, and may thus communicate with the parking management server (**25**, **31**) through the mobile communication network **15**.

[0025] To ensure that the application service offered by server **31** is available to only authorized devices/users, the provider of the application service also deploys an authentication server **33**. The authentication server **33** could be a separate physical server as shown, or authentication server **33** could be implemented as another program module running on the same hardware platform as the application server **31**. When the application server (server **31** in our example) receives a service request from a client application on a user device **13**, the application server provides appropriate information to the authentication server **33** to allow the server **33** to authenticate the user device **13**. Upon successful authentication, the server **33** informs the application server **31**, which in turn provides access to the service via data communication

through the various communication elements (e.g. **29**, **15** and **17**) of the network system **10**. A similar authentication function may be provided for real-time parking guidance services offered via the server **25**, either by the server **33** if there is an appropriate arrangement between the carrier and the operator of server **25**, by a program on the server **25** or via a separate authentication server (not shown) connected to the Internet **23**.

[0026] More detailed information relating to the processing and communications involved in providing the real-time parking guidance service are described below in relation to FIG. **2**.

[0027] FIG. **2** is a communication flow diagram illustratively showing processing and communications performed as part of a real-time parking guidance method **200**.

[0028] The method **200** begins with the populating or updating of a parking spot information database of the parking management server (**25**, **31**). Specifically, in step **201**, parking managers **19** generate and transmit to the parking management server (**25**, **31**) parking spot information for one or more parking spot(s) associated with the parking managers **19**. A parking manager **19** provides parking spot information to the parking manager server (**25**, **31**) upon the parking manager **19** joining the parking guidance system, upon a new parking spot being associated with the parking manager **19**, and/or when updated parking information is obtained for a parking spot.

[0029] The parking spot information of each parking spot includes location and availability information of the parking spot. The parking management server (**25**, **31**) receives parking spot information from a plurality of parking managers **19**, including from parking managers **19** associated with different types of parking spots. For example, the parking management server (**25**, **31**) can receive information on parking spots located in a garage or lot (e.g., multiple spots having a same street address), on parking spots located on-street or at a curb-side (e.g., parking spots each having a different street address), on parking spots located in a homeowner's driveway, or the like. The received parking spot information includes information on the availability of each parking spot. For example, the availability information may indicate that the parking spot is available at all times, is available only during certain time periods (e.g., Monday through Friday, between 7 am and 7 pm) or for particular events (e.g., for a period of time extending from two hours prior to the start of a sports team's home games, to two hours following the end of the home games). The availability information may further indicate that the parking spot is not available at one or more times (e.g., a user has previously scheduled a parking session in the parking spot for July 14th between 2 pm and 4 pm).

[0030] The parking management server (**25**, **31**) stores the received parking spot information in the parking spot information database, and/or updates the database with updated parking spot information received from the parking managers **19**, in step **203**. The updating of the database can take place in response to a driver scheduling a parking session directly with a parking manager **19**, such as when a driver enters a parking garage or lot associated with the parking manager **19** or pays for parking at a parking meter or muni-meter associated with the parking manager **19**. In such situations, the parking manager **19** sends updated availability information to the parking management server (**25**, **31**) that indicates that a parking spot is currently occupied (and, optionally, information indicating that the parking spot will remain occupied for the period of time paid-for by the user). An update of parking spot information may not include location information of the parking spot, but may instead include a unique identifier for locating the parking spot's information in the database and information for updating the availability information for the parking spot. Each record of parking spot information in the database includes a unique identifier for the record of the parking spot, location and availability information for the parking spot, and an identifier for a parking manager **19** associated with the parking spot.

[0031] Once the parking spot information database is populated and updated, the parking management server (**25**, **31**) can provide real-time parking guidance services. To this end, a user of the real-time parking guidance service may generate and send a parking information request message from a user device **13** (step **205**). The user may use a parking guidance application, a vehicle navigation application, or other appropriate application running on the user device **13** to generate the parking information request message. The request can be transmitted from the user device **13** to the parking management server (**25**, **31**) using packet-based data communications or using a messaging service (e.g., a short message service (SMS)). The information request includes a requested location and a requested time for a parking spot, as well as an identifier for the user and/or for the user device **13** submitting the request. The requested location may be a street address, GPS coordinates, a name or identifier for a landmark, or the like. The requested time may include a start time and, optionally, a time interval or period following the start time. The start time may be expressed as time of day (e.g., 11:05 am) or as a time relative to a current time (e.g., "now," or "in 15 minutes"). The time interval or period may be expressed as an amount of time (e.g., 2 hours) or as an end time (e.g., until 1:05 pm).

[0032] Upon receiving the parking information request, the parking management server (**25**, **31**) identifies at least one parking spot in the database of parking spot information that has a location proximate to the requested location and has availability at the requested time (step **207**). The proximity between a parking spot location and a requested location can be determined based on a straight-line distance between the two locations (i.e., a distance "as the bird flies" between the two locations), and/or based on a distance between the two locations along streets, sidewalks, walkways, and/or other pathways (i.e., a distance corresponding to an actual travel distance between the two locations). The at least one parking spot may include all parking spots within a particular proximity to the requested location (e.g., less than 0.1 miles), or a limited number of the closest parking spots to the requested location (e.g., the 10 closest parking spots, in order of proximity). In general, only parking spots that are available at the requested start time (and for the time interval or period included in the requested time) are identified.

[0033] In some examples, the parking management server (**25**, **31**) identifies parking spot(s) in step **207** based on location, availability, as well as on additional factors. The additional factors can include one or more of user reviews or other rating information for parking spots, such that parking spot(s) having good reviews or high ratings are preferentially selected. The additional factors can include characteristics of parking spots, including parking spot size, height, ease of entry/exit into the spot, or the like, such that parking spot(s) suitable for parking small or large vehicles are preferentially selected (e.g., based on characteristics of a user's own

vehicle) or such that parking spots requiring parallel parking can be excluded (e.g., based on a user's parking preferences). The additional factors can further include a user's parking history, which may be stored in the management server (**25**, **31**) and used to identify parking spots, garages, or lots that the user has previously used are preferentially identified. The additional factors can further include promotions or coupons, such that parking spots, garages, or lots currently offering a promotion or for which the user has a coupon are preferentially identified. The additional factors can be used both to identify parking spot(s) in step **207**, and/or to select an order in which to present identified parking spot(s) to the user.

[0034] Following identification of the at least one parking spot, the parking management server (**25**, **31**) can optionally send a notification to parking manager(s) **19** associated with the identified parking spot(s) regarding forecasted parking load (step **209**). For example, the parking management server (**25**, **31**) can provide a notification to the parking manager(s) **19** that an information request was received for a parking spot in the vicinity of the requested location. In particular, the parking management server (**25**, **31**) may determine whether multiple information requests for parking spots within a vicinity have been received during a limited time period (e.g., the last hour), and notify parking manager(s) **19** in the vicinity of the increased interest in parking spots at the location. The notification can be used to forecast future parking load, and to enable garage attendants or other parking administrators to adjust parking prices or restrict users that have not reserved parking through the parking guidance service from using the parking spots.

[0035] Following identification of the at least one parking spot, the parking management server (**25**, **31**) sends a notification identifying the at least one parking spot to the user device from which the information request was received (step **211**). The notification can include detailed information on the location of the identified parking spot(s), on the availability of the parking spot(s), and on price and payment options for the parking spot. In general, the notification will further include an option for the user to reserve and/or pre-pay for the parking spot.

[0036] In response to receiving the notification of matching parking spot(s), the user device **13** displays information for the identified at least one parking spot(s) to the user. The information may be overlaid on a map showing the requested location and the locations of each of the identified parking spot(s), or the information may be displayed in a list or grid format. In general, the information is processed and displayed by the parking guidance application, the vehicle navigation application, or other appropriate application running on the user device **13**.

[0037] Upon reviewing the information for the identified at least one parking spot(s), the user may select an option to reserve one (or more) of the identified parking spot(s). In response to the selection, the user device **13** generates and transmits to the parking management server (**25**, **31**) a parking reservation request identifying the parking spot selected by the user (step **213**). In some examples, the parking reservation request includes payment information in the form of credit card information, and/or information for charging payment for the parking spot reservation to an account of the user.

[0038] The parking management server (**25**, **31**) receives the parking reservation request, and confirms whether the parking spot selected by the user is still available at the requested time. Upon confirming that the parking spot selected by the user is available at the requested time, the parking management server (**25**, **31**) processes the reservation request by updating the database of parking spot information to identify the selected parking spot as being unavailable at the requested time (step **215**). Additionally, the parking management server (**25**, **31**) transmits a notification of the completed reservation request to the parking manager **19** associated with the selected parking spot in the database (step **217**). The notification of the completed reservation identifies the selected parking spot, the requested time, and identification information for identifying the user having made the reservation. The identification information can include information on the vehicle of the user (e.g., make, model, color, vehicle type, and/or license plate), and/or a unique confirmation identifier for use by the user during check-in, such as a confirmation number, a barcode, a QR code, an NFC code, or the like.

[0039] Finally, the parking management server (**25**, **31**) transmits a confirmation of the completed reservation request to the user device **13** (step **219**). The confirmation of the completed reservation provides confirmation to the user that the selected parking spot has successfully been reserved for the user. The confirmation can further include a unique confirmation identifier (e.g., a confirmation number, a barcode, a QR code, an NFC code, or the like) that the user can present to a garage or lot attendant, to an automated gate, or the like, in order to check-in to or gain access to the reserved parking spot. For example, upon arriving at the reserved parking spot, the user may present the unique confirmation identifier in step **223**. If the presented identifier matches the unique confirmation identifier received by the parking manager **19** from the parking management server (**25**, **31**), the user is authorized to park (step **225**).

[0040] In one example, the unique confirmation identifier is a barcode or QR code that can be displayed on a screen of the user device **13**. In the example, the parking manager **19** includes a barcode or QR code reader **21** operative to read the barcode or QR code displayed by the user device **13**, and to determine whether the displayed code matches the code received in step **217** from the parking management server (**25**, **31**). In another example, the unique confirmation identifier is an NFC code that can be loaded into and transmitted through an NFC antenna of the user device **13**. In the example, the parking manager **19** includes an NFC reader **21** operative to read the NFC code from the user device **13**, and to determine whether the code that is read matches the code received from the parking management server (**25**, **31**). In other examples, the user punches the unique confirmation code into a keypad of the parking manager **19** or of an associated parking gate, or provides the unique confirmation code to a parking attendant, in order to be authorized to park. In examples including parking meters and muni-meters, the parking meters and muni-meters can include NFC/QR readers for checking users in.

[0041] The real-time parking guidance service can additionally be integrated with a vehicle guidance device or application of the user. In such a situation, once the user has selected a parking spot (e.g., in step **213**), a vehicle guidance device or application of the user may automatically be provided with the location information of the selected parking spot. The vehicle guidance device or application then provides turn-by-turn directions to guide the user to the selected parking spot (step **221**). In general, the location of the selected parking spot differs from the requested location, and the

vehicle guidance device or application may thus override a previous request for directions to the requested location with a new request for directions to the selected or reserved parking spot.

[0042] In some examples, the user device **13** is provided with detailed information on the location of the selected/reserved parking spot, including information on the location of the parking spot within a parking lot. The user device **13** may then provide directions to guide the user to the parking lot and, upon entering the parking lot, to the particular spot within the parking lot. In instances in which a vehicle navigation application of the user device **13** is not operative to provide directions within a parking lot (e.g., in situations in which the vehicle navigation application does not have access to a map of the parking lot), the parking management server (**25**, **31**) provides the user device **13** with data or instructions to guide the user to the parking spot within the parking lot. The detailed information on the location of the selected parking spot can be provided in the confirmation of the reservation request transmitted to the user device **13** from the parking management server (**25**, **31**), and/or in the notification of matching parking spot(s) received by the user device **13**. In some examples, a vehicle navigation application may additionally show available and/or unavailable parking spots on a display for consideration by the user. For example, as a user drives, the vehicle navigation application may show currently available parking spots (e.g., identified with a green flag) within the user's vicinity on a map or navigation display provided to the user. Parking spots forecasted to become available within a predetermined time interval may also be identified (e.g., with a purple flag), while unavailable spots that are not forecasted to become available may not be identified (or identified with a red flag).

[0043] The parking information request generated and transmitted by the user device **13** in step **205** includes a requested location and a requested time for a parking spot. In addition, in situations in which the requested time corresponds to a current time, the parking information request can additionally include a current location of the user device **13**. If the current location information is included, the parking management server (**25**, **31**) can additionally estimate a time required to travel from the current location of the user device **13** to the requested location, and use the estimated travel time (which may or may not include traffic conditions and take into account roadwork or closures among other conditions affecting travel time) to adjust the start time of the time period for which parking is requested. For example, the parking management server (**25**, **31**) can identify parking spots that have availability at a future time determined based on the estimated travel time. For instance, upon determining that the user device **13** is a 25 minute drive away from the requested location, the parking management server (**25**, **31**) can identify in step **207** at least one parking spot that is available 25 minutes from a current time, instead of identifying a parking spot that is available at the requested start time.

[0044] In addition, the parking management server (**25**, **31**) may be configured to forecast the future availability of parking spots. The forecasting may be performed using historical information on the availability of a parking spot and/or of neighboring parking spots. In particular, the historical information can include the average parking time for a particular parking spot or for parking spots in an area for which forecasting is being performed, and/or the average parking time of a user currently occupying the parking spot. The historical information can further include statistics regarding the average number of cars entering or exiting a parking lot or parking garage, or parking lots or garages within the area for which forecasting is performed. The forecasting can further control for current and historical variables including weather and other environmental conditions, time of day, day of the week, and/or day of the year (e.g., on a federal holiday, or during the Christmas shopping season), event schedules (e.g., schedules of events at a neighboring stadium or other venue), or the like. The forecasting of future parking load can be used by the parking management server (**25**, **31**) as part of identifying parking spot(s) that have availability in step **207**. In particular, as part of step **207**, the parking management server (**25**, **31**) may identify parking spot(s) that have availability at the requested time and/or parking spot(s) that are forecasted to have availability at the requested time. In addition, the parking management server (**25**, **31**) may exclude from consideration parking spot(s) that are forecasted not to have availability at the requested time.

[0045] Furthermore, the parking management server (**25**, **31**) may preferentially identify parking spot(s) having availability (or that are forecasted to have availability) that are located close to other parking spot(s) having availability, such that if an identified parking spot becomes occupied, a user of the parking guidance system can readily be guided to another available parking spot nearby. As such, the parking management server (**25**, **31**) may preferentially identify parking spot(s) located in a garage having multiple available spots, instead of identifying a parking spot in a similarly situated garage having only one available spot. Similarly, the parking management server (**25**, **31**) may not identify parking spot(s) that do not have other parking spot(s) available nearby, or may provide such parking spot(s) with a lower priority order.

[0046] The information on available parking spots that is provided by the user device **13** can be updated in real-time. The real-time updating provides users with continuously updated information on available parking spots within the vicinity of a requested location. In one example, the user device **13** provides the updated information by periodically sending requests to the parking management server (**25**, **31**) for updated parking information in the vicinity of the requested location (e.g., by periodically performing step **205**), and by updating a display provided to the user and indicating available parking spots based on the updated information. In the one example, updates may be obtained every minute, for instance. The real-time updates can be used by a user driving in the vicinity of the requested location and looking for parking spots to open up in that vicinity. In another example, the parking management server (**25**, **31**) automatically provides the updated information to the user device **13** in response to determining that a parking spot previously identified to the user as being available (e.g., a spot previously identified to the user in the notification of step **211**) is no longer available at the requested time. In the other example, the parking management server (**25**, **31**) continues to provide the real-time updates until it receives a parking reservation request from the user device **13**.

[0047] In some examples, the parking information request generated and transmitted by the user device **13** in step **205** includes information on a seating location of a ticket-holder to an event. For example, the parking information request may include information on a seating section (e.g., section 204) in which the user will be seated in a stadium or other facility, or information on the user's preferred exit door from

the stadium or other facility. In addition to manual entry, the seating location may be obtained through short-range interaction between the mobile device and ticket, such as by the mobile device scanning a QR code on the ticket. Alternatively or additionally, the seating location may be sent to the mobile device by a ticket provider (e.g., Ticketmaster, Stub Hub, or the like), for example in situations in which a user provides a mobile device number, email address, or other identification information at the time of purchase of a ticket. If the seating location information is included, the parking management server (**25**, **31**) can identify parking spot(s) that have locations in the vicinity of the identified seating section, exit door, or the like, which may be different from that associated with the general entry point or overall venue itself. To this end, the parking management server (**25**, **31**) may store a map of a venue including seating arrangements and sections numbers, locations of entry and exit gates, walkways through parking lots and/or to venue, or the like. In one example, the seating location information is used to identify a parking spot that is located close to the seating location, even if that parking spot is located further from an entrance to the facility than other available parking spots. Similarly, the seating location information can be used to identify parking spots that are located close to a particular exit door of the facility, close to an exit from a parking lot or garage, or the like, even if those parking spots are located further from an entrance to the facility or further from a street address for the facility than other available parking spots. For instance, the parking management server (**25**, **31**) may identify the seating location within a map of the venue, identify the exit from the venue nearest the seating location, identify walkways emanating from the identified exit, and finally identify parking spots that are available and nearest to the seating location along the identified walkways.

[0048] FIGS. **3**A-**3**C are illustrative display screens of a real-time parking guidance application running on a user device **13**. The display screens **300**, **330**, and **360** each show display screens of different steps involved in a user obtaining parking guidance.

[0049] FIG. **3**A shows a display screen **300** as may be presented to a user who has just turned on a user device **13** providing the parking guidance service. The display screen **300** shows a map including an arrow indicating the user's current location. The display screen **300** also includes various on-screen buttons corresponding to guidance functionalities available for use by the user. A "Get Directions" on-screen button can be activated to obtain vehicle guidance services to a particular destination. Alternatively, a "Find Parking" on-screen button provides access to the parking guidance service. As shown, the "Find Parking" button includes two options: a "Here/Now" option for finding currently available parking spots located near the user's current location; and a "At destination" option for finding parking spots at a location other than the user's current location and/or at a time other than a current time.

[0050] FIG. **3**B shows a display screen **330** as may be presented to a user having selected the "At destination" on-screen menu option of display screen **300**. In response to selecting the "At destination" option, the user is presented with a menu box including a field for entering an address or point of interest near which the user would like to find parking. The user may select the "Enter Address/Point of Interest" field in order to enter a requested location near which the user wishes to park. The requested location can be entered as an address or as a name of a point of interest using an on-screen keyboard, using voice recognition, or the like. The requested location may alternatively be retrieved by the user device **13** through short-range interaction, such as by the user device **13** scanning a QR code on a ticket, by the user device **13** retrieving the requested location from another device operative to communicate a destination address using NFC to the user device **13**, or the like. Once the correct requested location is entered, the user selects a "Park Now" option in order to find parking spots near the requested location that are currently available, a "Park Upon Arrival" option to find parking spots near the requested location that will be available (or are forecasted to be available) at the user's estimated time of arrival at the address, or a "Park Later" option for finding parking spots at a later date or time to be entered by the user into the user device **13**. In response to the user selecting one of the "Park Now," "Park Upon Arrival," and "Park Later" options, the user device **13** generates and transmits a parking information request to the parking management server (**25**, **31**) (e.g., as shown in step **205** of FIG. **2**).

[0051] FIG. **3**C shows a display screen **360** as may be presented to a user having selected the "Park Upon Arrival" on-screen menu option of display screen **330**. The display **360** shows a map that may be shown in response to the user device **13** receiving a notification of matching parking spots (e.g., following step **211** of method **200**). As shown in display **360**, real-time parking information is overlaid on a map showing the requested location (identified by a grey star) identified in the parking information request transmitted from the user device **13**. Three different sets of parking spots are identified on the map in the vicinity of the requested location: one on-street parking spot is available across the street from the requested location; twenty-five off-street parking spots are available 0.05 miles from the requested location; and an additional four on-street spots are available further from the requested location.

[0052] As shown in the top-left corner of the display **360**, the parking information displayed is based on the user's estimated time of arrival (ETA) at the requested location. Because the user is estimated to arrive at the requested location in 25 minutes, the parking information presented shows parking spots scheduled to be available at the ETA. In response to the user selecting one of the sets of parking spots on the display screen, additional information relating to the selected set is displayed. As shown in FIG. **3**C, the user has selected the set of twenty-five off-street parking spots. As such, an address for the parking spots and pricing and distance information are provided to the user. Additionally, options for automatically getting directions to the parking spots and for reserving and paying for the parking spots are available for selection.

[0053] FIG. **4** shows an illustrative data structure **400** that may be used for storing parking spot information in the database of the parking management server (**25**, **31**). In the example shown, the database includes a separate line entry for each parking spot that is registered for use through the real-time parking guidance service. Each line entry includes a parking spot identifier that is unique to the parking spot, location information for the parking spot (e.g., a street address), a parking manager identifier that identifies the parking manager **19** associated with the parking spot, and a field for storing availability information for the parking spot. The parking spot identifier, location information, and parking manager identifier are stored in the database in response to

receiving, at the parking management server (**25**, **31**), information relating to a new parking spot not previously identified in the database. The availability information for each parking spot is then continuously updated by the parking management server (**25**, **31**) based on information received from the parking manager **19** associated with the parking spot and based on parking reservation requests received from user devices **13** for the corresponding parking spot.

[0054] FIG. **5** provides a block diagram illustration of an exemplary user device **13**. Although the user device **13** may be a smart-phone, a tablet, or another type of device, the illustration shows the user **13** is in the form of a handset (although many components of the handset, such as a microphone and speaker, are not shown).

[0055] For digital wireless communications, the user device **13** includes at least one digital transceiver (XCVR) **108** connected to an antenna **110**. The transceiver **108** provides two-way wireless communication of information, such as digital information, in accordance with the technology of the network **15**. The transceiver **108** also sends and receives a variety of signaling messages in support of the various services provided via the user device **13** and the communication network. The user device **13** also includes an NFC interface **109** having an associated antenna and configured for communicating using near-field communication with other devices such as with an NFC reader **21** of a parking manager **19**.

[0056] The user device **13** includes a display **122** for displaying messages, menus or the like, parking-guidance related information for the user, etc. A touch sensor **126** and keypad **130** enables the user to generate selection inputs, for example.

[0057] A microprocessor **112** serves as a programmable controller for the user device **13**, in that it controls all operations of the user device **13** in accord with programming that it executes, for all normal operations, and for operations involved in the real-time parking guidance service. In the example, the user device **13** includes flash type program memory **114**, for storage of various program routines and configuration settings. The user device **13** may also include a non-volatile random access memory (RAM) **116** for a working data processing memory. In a present implementation, the flash type program memory **114** stores any of a wide variety of applications, such as a vehicle navigation application software and parking guidance application software. The memories **114**, **116** also store various data, such as input by the user or received from the parking management server (**25**,**31**). Programming stored in the flash type program memory **114** is loaded into and executed by the microprocessor **112** to configure the processor **112** to perform various desired functions, including functions involved in providing real-time parking guidance.

[0058] In some examples, the user device **13** further includes a GPS interface **111** coupled to a GPS antenna designed to receive GPS location signals transmitted by satellites. The GPS interface **111** is communicatively coupled to the microprocessor **112**, and is operative to provide location information to the microprocessor based on the received location signals.

[0059] In addition to relying on user devices **13**, the real-time parking guidance service uses a parking management server (**25**, **31**) and parking managers **19** for operation. Although special purpose devices may be used to implement the management server (**25**, **31**) and the parking managers **19**, the server and managers may be implemented using a general class of data processing device. FIGS. **6** and **7** provide functional block diagram illustrations of general purpose computer hardware platforms. FIG. **6** illustrates a network or host computer platform, as may typically be used to implement a server. FIG. **7** depicts a computer with user interface elements, as may be used to implement a parking manager or other type of terminal device.

[0060] A server or other general purpose computer platform includes a data communication interface for packet data communication. The server or other general purpose computer platform also includes a central processing unit (CPU), in the form of one or more processors, for executing program instructions. The server and platform typically include an internal communication bus, program storage and data storage for various data files to be processed and/or communicated by the server, although the server and platform often receive programming and data via network communications. The server and platform functions may be implemented in a distributed fashion on a number of similar platforms, to distribute the processing load.

[0061] The scope of protection is limited solely by the claims that now follow. That scope is intended and should be interpreted to be as broad as is consistent with the ordinary meaning of the language that is used in the claims when interpreted in light of this specification and the prosecution history that follows and to encompass all structural and functional equivalents. Notwithstanding, none of the claims are intended to embrace subject matter that fails to satisfy the requirement of Sections 101, 102, or 103 of the Patent Act, nor should they be interpreted in such a way. Any unintended embracement of such subject matter is hereby disclaimed.

[0062] Except as stated immediately above, nothing that has been stated or illustrated is intended or should be interpreted to cause a dedication of any component, step, feature, object, benefit, advantage, or equivalent to the public, regardless of whether it is or is not recited in the claims.

[0063] It will be understood that the terms and expressions used herein have the ordinary meaning as is accorded to such terms and expressions with respect to their corresponding respective areas of inquiry and study except where specific meanings have otherwise been set forth herein. Relational terms such as first and second and the like may be used solely to distinguish one entity or action from another without necessarily requiring or implying any actual such relationship or order between such entities or actions. The terms "comprises," "comprising," or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus. An element proceeded by "a" or "an" does not, without further constraints, preclude the existence of additional identical elements in the process, method, article, or apparatus that comprises the element.

[0064] The Abstract of the Disclosure is provided to allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, it can be seen that various features are grouped together in various embodiments for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim.

Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separately claimed subject matter.

[0065] While the foregoing has described what are considered to be the best mode and/or other examples, it is understood that various modifications may be made therein and that the subject matter disclosed herein may be implemented in various forms and examples, and that the teachings may be applied in numerous applications, only some of which have been described herein. It is intended by the following claims to claim any and all applications, modifications and variations that fall within the true scope of the present teachings.

What is claimed is:

1. A method comprising:

receiving from a user device an information request for a parking spot, the request including a requested location and a requested time;

in response to receiving the information request, identifying in a database of parking spot information a parking spot having a location proximate to the requested location and having availability at the requested time;

transmitting a notification of the identified parking spot to the user device from which the information request was received;

receiving from the user device a reservation request identifying the parking spot for reservation; and

in response to receiving the reservation request, performing steps of:

updating the database of parking spot information to identify the parking spot identified in the reservation request as being unavailable at the requested time; and

transmitting a notification of the reservation request identifying the parking spot identified in the reservation request and the requested time to a parking manager associated with the parking spot identified in the reservation request.

2. The method of claim **1**, wherein in response to receiving the reservation request, the method further comprises:

transmitting a confirmation of the reservation request to the user device from which the reservation request was received,

wherein the confirmation of the reservation request transmitted to the user device and the notification of the reservation request transmitted to the parking manager include at least one of a barcode, a quick response (QR) code, and a near-field communication (NFC) code for authentication of the user to the parking manager.

3. The method of claim **1**, wherein in response to receiving the reservation request, the method further comprises transmitting a confirmation of the reservation request to the user device from which the reservation request was received, so as to cause the user device to provide driving directions for a user to the location of the parking spot identified in the reservation request.

4. The method of claim **3**, wherein the confirmation of the reservation request transmitted to the user device includes information to cause the user device to provide driving directions to a user to guide the user through a parking lot to the reserved parking spot within the parking lot.

5. The method of claim **1**,

wherein the information request for a parking spot received from the user device includes a current location of the user device,

wherein the method further comprises:

estimating a time required to travel from a current location of the user device included in the information request to the requested location included in the information request, and

wherein identifying the parking spot includes identifying a parking spot having availability at a future time determined based on the estimated travel time.

6. The method of claim **1**,

wherein the information request for the parking spot includes information on a seating location of a ticket-holder to an event, and

wherein identifying the parking spot includes identifying a parking spot having a location proximate to the seating location of the ticket-holder to the event.

7. The method of claim **1**, further comprising:

receiving from a plurality of parking managers parking spot information of a plurality of parking spots, wherein the parking spot information of each parking spot includes location and availability information of the parking spot; and

storing the received parking spot information in the database of parking spot information,

wherein each parking spot information is stored in the database in association with an identifier for a parking manager responsible for the parking spot.

8. The method of claim **7**, wherein the database of parking spot information includes at least one parking spot corresponding to a homeowner's driveway.

9. The method of claim **1**, further comprising, in response to identifying the parking spot, transmitting a notification to a parking manager associated with the parking spot including information on forecasted parking load determined based at least in part on the information request received from the user device.

10. A system comprising:

a communication network;

a user device communicatively coupled to the communication network;

a parking manager associated with a parking spot and communication coupled to the communication network; and

a parking management server coupled to the communication network for communication with the user device and with the parking manager, wherein the parking management server is configured to perform functions to:

receive from the user device an information request for a parking spot, the request including a requested location and a requested time;

in response to receiving the information request, identify in a database of parking spot information a parking spot having a location proximate to the requested location and having availability at the requested time;

transmit a notification of the identified parking spot to the user device from which the information request was received;

receive from the user device a reservation request identifying the parking spot for reservation; and

in response to receiving the reservation request, performing steps of:

update the database of parking spot information to identify the parking spot identified in the reservation request as being unavailable at the requested time;

transmit a notification of the reservation request identifying the parking spot identified in the reservation request and the requested time to the parking manager associated with the parking spot identified in the reservation request.

11. The system of claim **10**, wherein in response to receiving the reservation request, the parking management server is further configured to:

transmit a confirmation of the reservation request to the user device from which the reservation request was received,

wherein the confirmation of the reservation request transmitted to the user device and the notification of the reservation request transmitted to the parking manager include at least one of a barcode, a QR code, and an NFC code for authentication of the user to the parking manager.

12. The system of claim **10**, wherein in response to receiving the reservation request, the parking management server is further configured to transmit a confirmation of the reservation request to the user device from which the reservation request was received, so as to cause the user device to provide driving directions for a user to the location of the parking spot identified in the reservation request.

13. The system of claim **12**, wherein the confirmation of the reservation request transmitted to the user device includes information to cause the user device to provide driving directions to a user to guide the user through a parking lot to the reserved parking spot within the parking lot.

14. The system of claim **10**,

wherein the information request for a parking spot received from the user device includes a current location of the user device,

wherein the parking management server is further configured to:

estimate a time required to travel from a current location of the user device included in the information request to the requested location included in the information request, and

wherein identifying the parking spot includes identifying a parking spot having availability at a future time determined based on the estimated travel time.

15. The system of claim **10**,

wherein the information request for the parking spot includes information on a seating location of a ticket-holder to an event, and

wherein identifying the parking spot includes identifying a parking spot having a location proximate to the seating location of the ticket-holder to the event.

16. The system of claim **10**, wherein the parking management server is further configured to:

receive from a plurality of parking managers parking spot information of a plurality of parking spots, wherein the parking spot information of each parking spot includes location and availability information of the parking spot; and

store the received parking spot information in the database of parking spot information,

wherein each parking spot information is stored in the database in association with an identifier for a parking manager responsible for the parking spot.

17. The system of claim **16**, wherein the database of parking spot information includes at least one parking spot corresponding to a homeowner's driveway.

18. The system of claim **10**, wherein the parking management server is further configured to, in response to identifying the parking spot, transmit a notification to a parking manager associated with the parking spot including information on forecasted parking load determined based at least in part on the information request received from the user device.

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