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(54) SYSTEM AND METHOD FOR ASSESSING PARKING SPACE OCCUPANCY AND FOR RESERVING SAME

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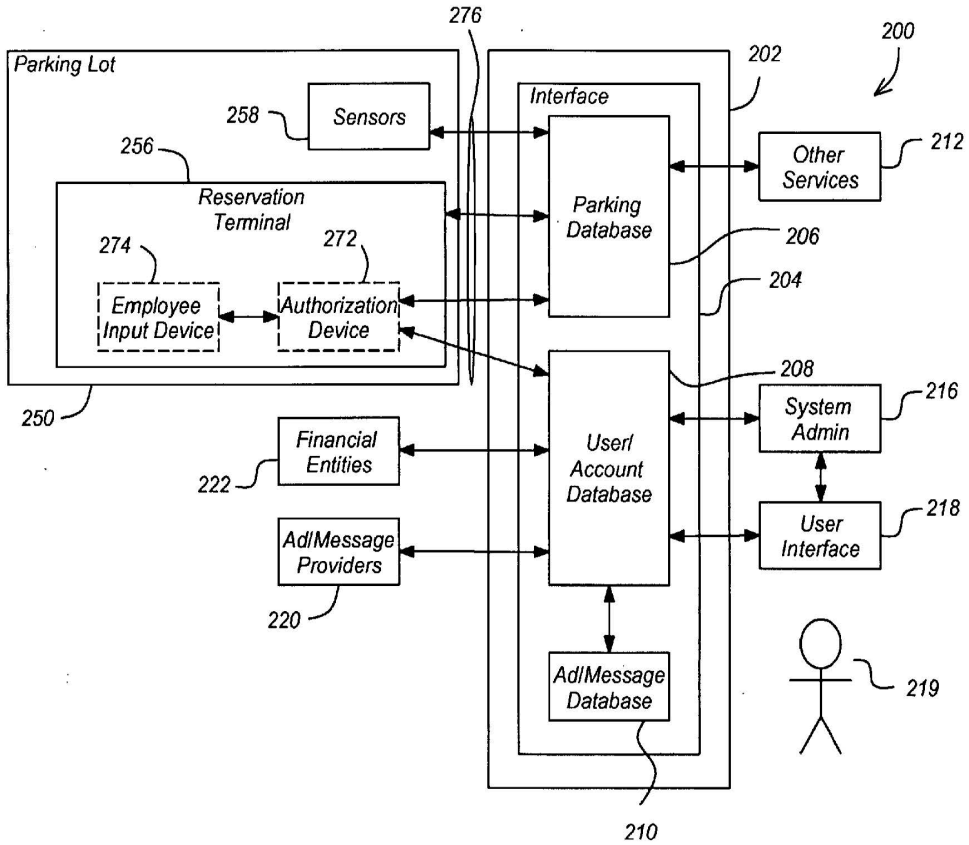
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(57) **ABSTRACT**

A method and apparatus for determining the availability of a plurality of parking spaces and of reserving one or more of such available parking spaces is disclosed. The method comprises the steps of accepting data indicating an occupancy status of at least a subset of the plurality of parking spaces; generating a parking database describing an availability of one or more of the parking spaces from the accepted data; accepting a request from a user, the request being for data describing the availability of the one or more of the parking spaces from the parking database; and providing the data describing availability of the one or more of the parking spaces to the user.



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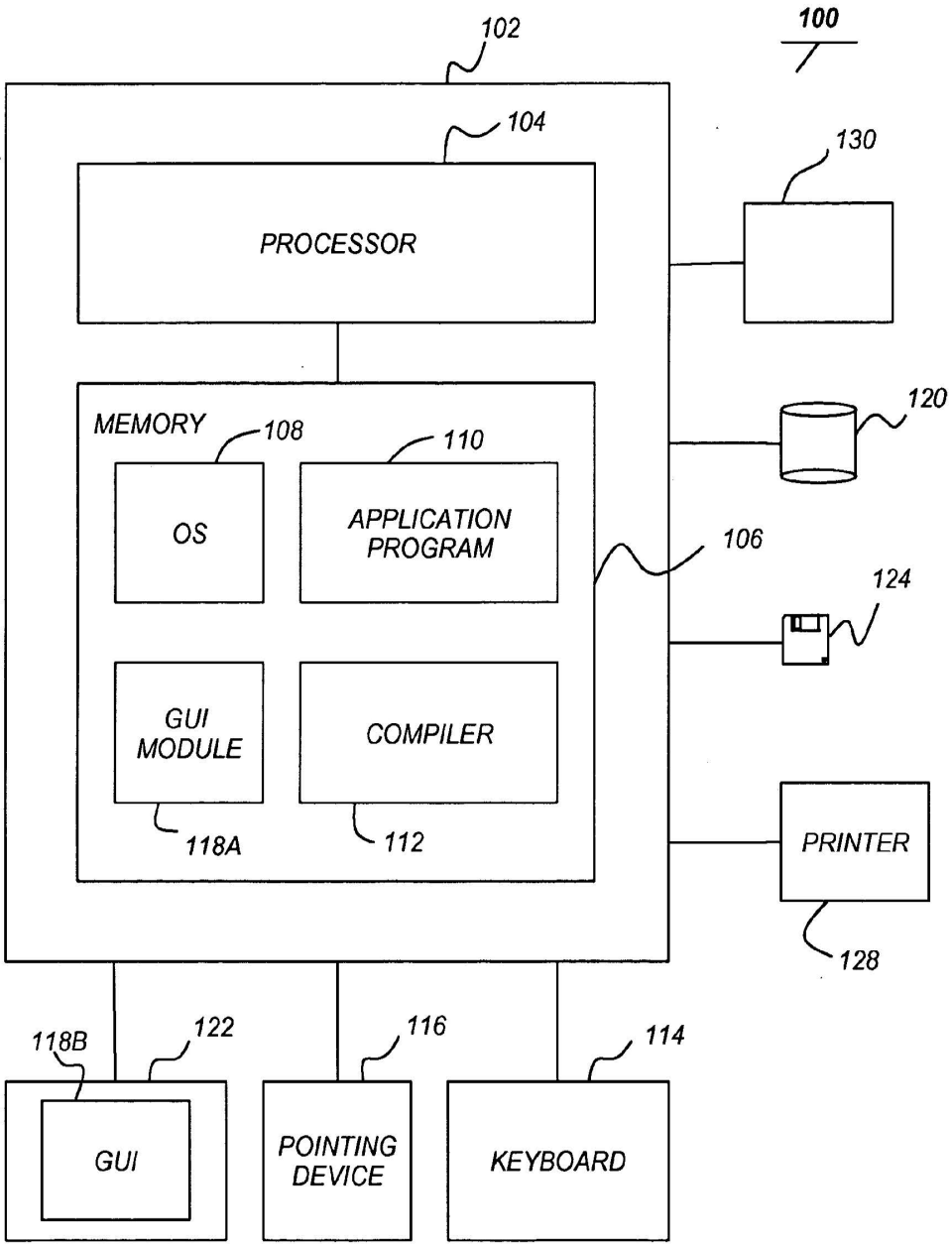

102
100
104
130
PROCESSOR
MEMORY
108
110
120
OS
APPLICATION PROGRAM
106
124
GUI MODULE
COMPILER
118A
112
PRINTER
128
118B
122
116
114
GUI
POINTING DEVICE
KEYBOARD

FIG. 1

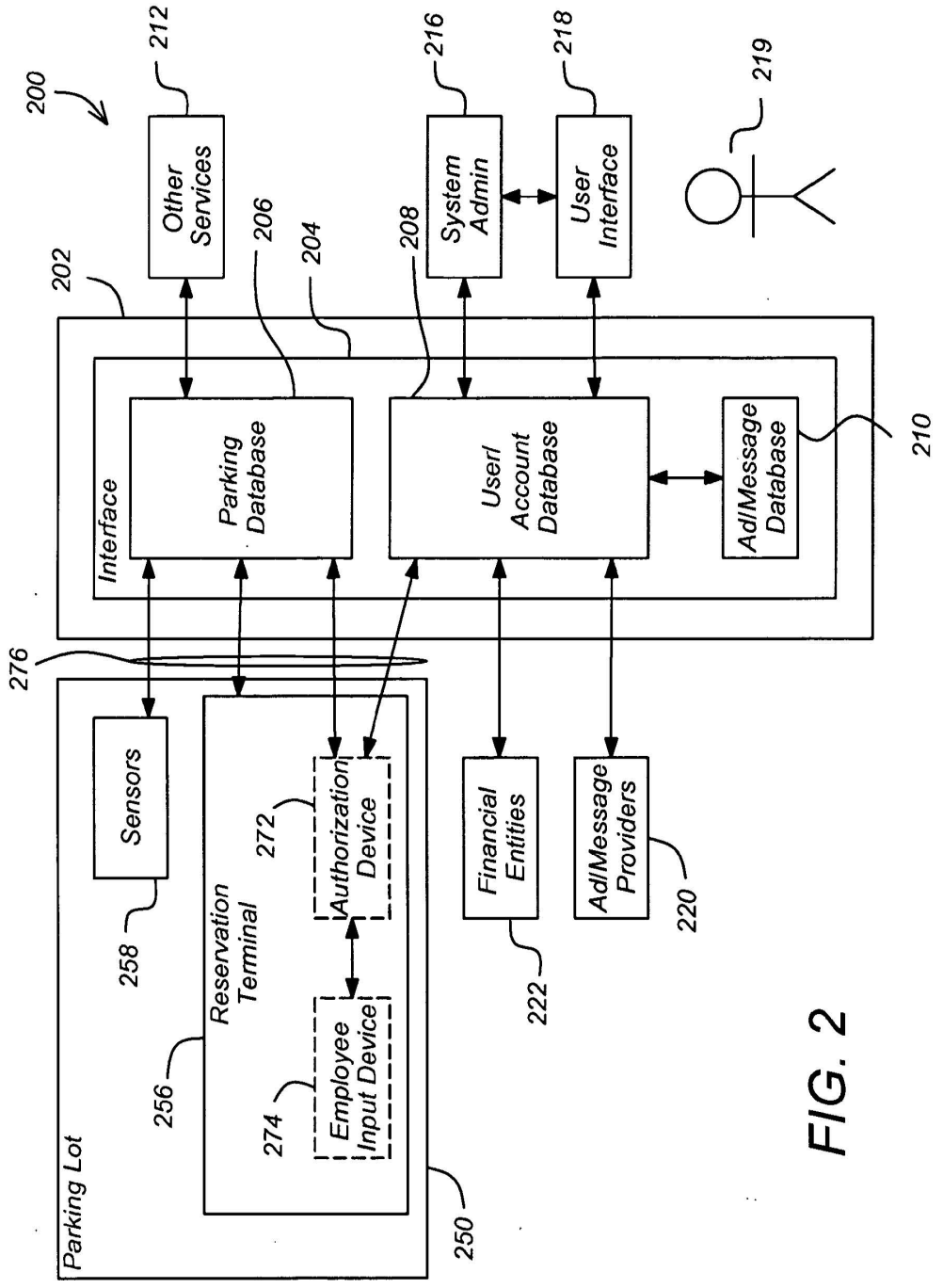
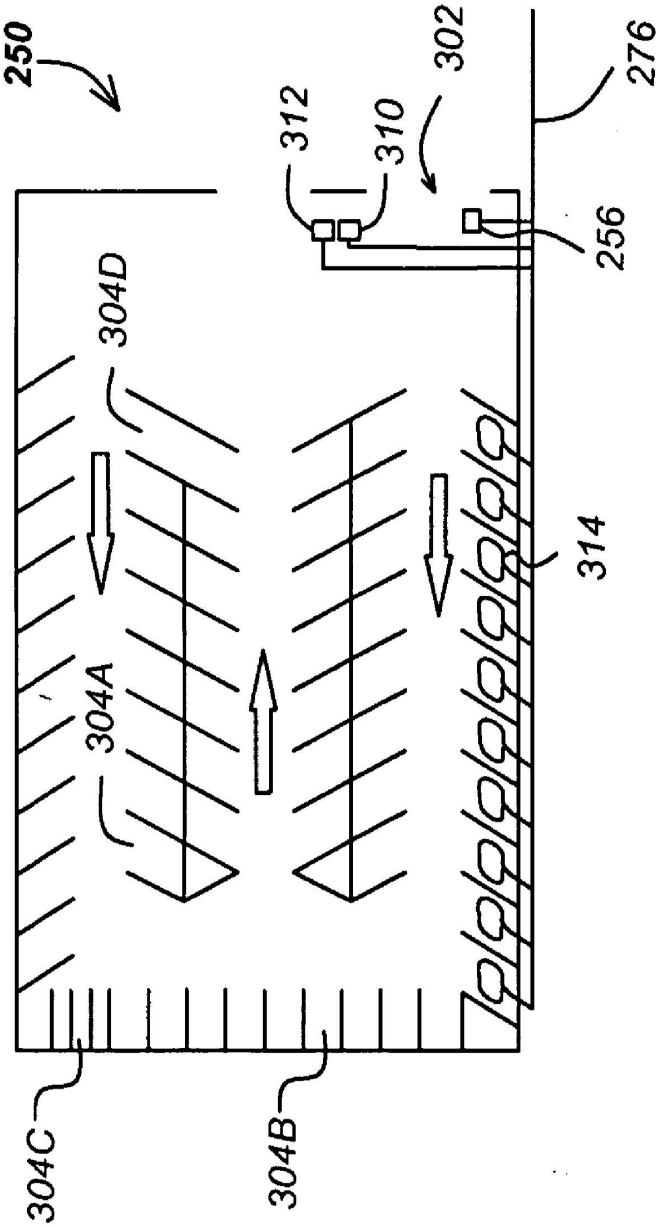

200
212
Other Services
206
204
216
System Admin
218
User Interface
219
202
208
Interface
Parking Database
User/ Account Database
Ad/Message Database
210
276
Sensors
258
Reservation Terminal
272
Authorization Device
274
Employee Input Device
256
Financial Entities
222
Ad/Message Providers
220
Parking Lot
250

FIG. 2

FIG. 3



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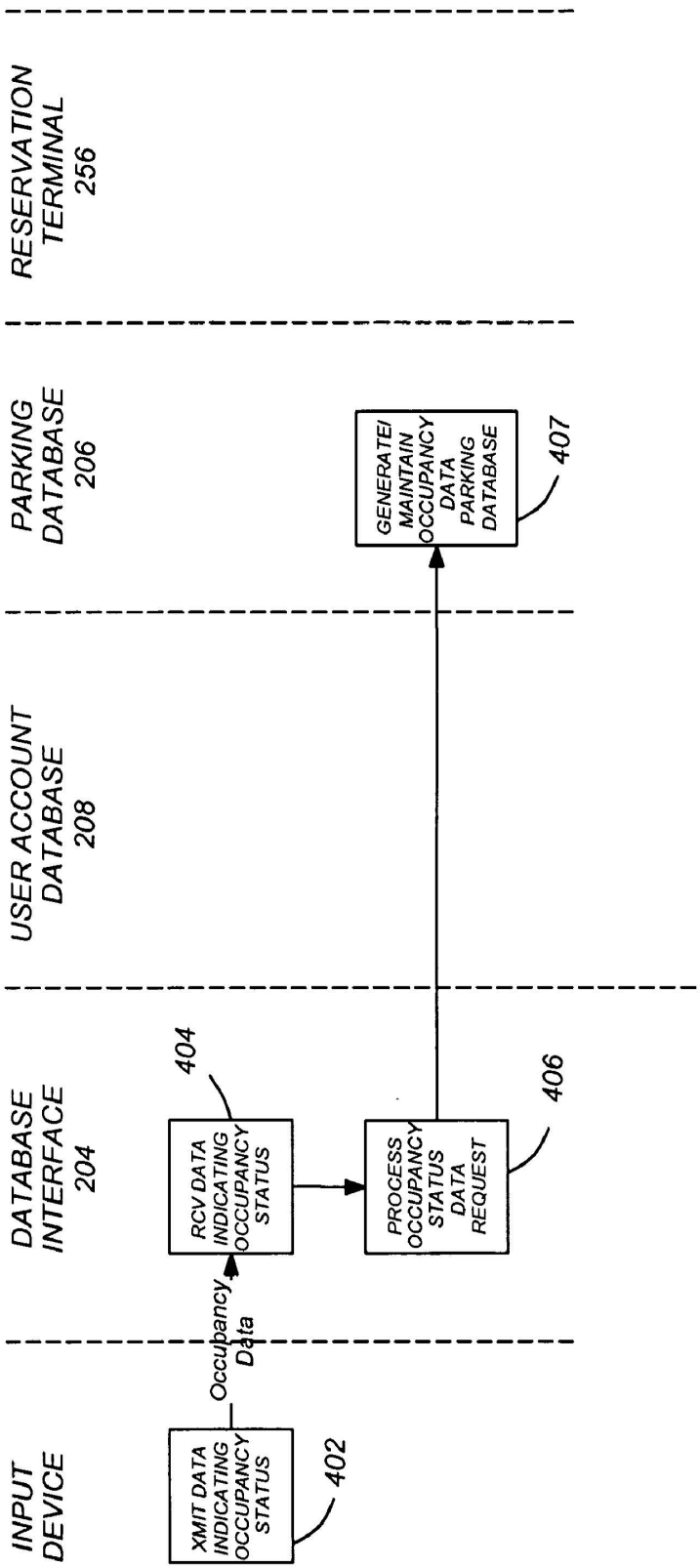

INPUT DEVICE
DATABASE INTERFACE 204
USER ACCOUNT DATABASE 208
PARKING DATABASE 206
RESERVATION TERMINAL 256
XMIT DATA INDICATING OCCUPANCY STATUS
402
Occupancy Data
RCV DATA INDICATING OCCUPANCY STATUS
404
PROCESS OCCUPANCY STATUS DATA REQUEST
406
GENERATE/ MAINTAIN OCCUPANCY DATA PARKING DATABASE
407

FIG. 4A

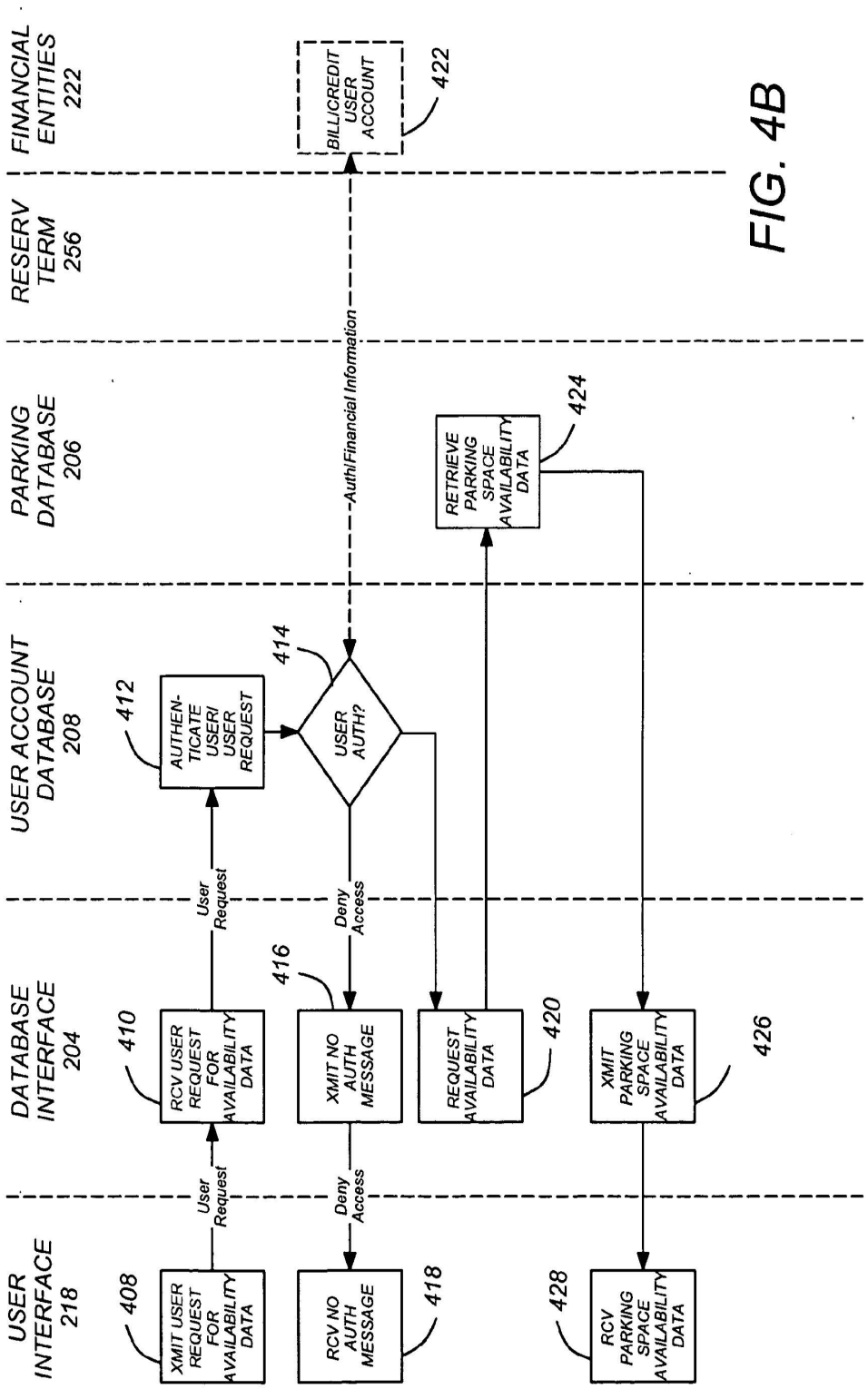

USER INTERFACE 218
DATABASE INTERFACE 204
USER ACCOUNT DATABASE 208
PARKING DATABASE 206
RESERV TERM 256
FINANCIAL ENTITIES 222
XMIT USER REQUEST FOR AVAILABILITY DATA
408
User Request
RCV USER REQUEST FOR AVAILABILITY DATA
410
AUTHEN-TICATE USER/ USER REQUEST
412
USER AUTH?
414
Deny Access
XMIT NO AUTH MESSAGE
416
RCV NO AUTH MESSAGE
418
Auth/Financial Information
BILL/CREDIT USER ACCOUNT
422
RETRIEVE PARKING SPACE AVAILABILITY DATA
424
REQUEST AVAILABILITY DATA
420
XMIT PARKING SPACE AVAILABILITY DATA
426
RCV PARKING SPACE AVAILABILITY DATA
428

FIG. 4B

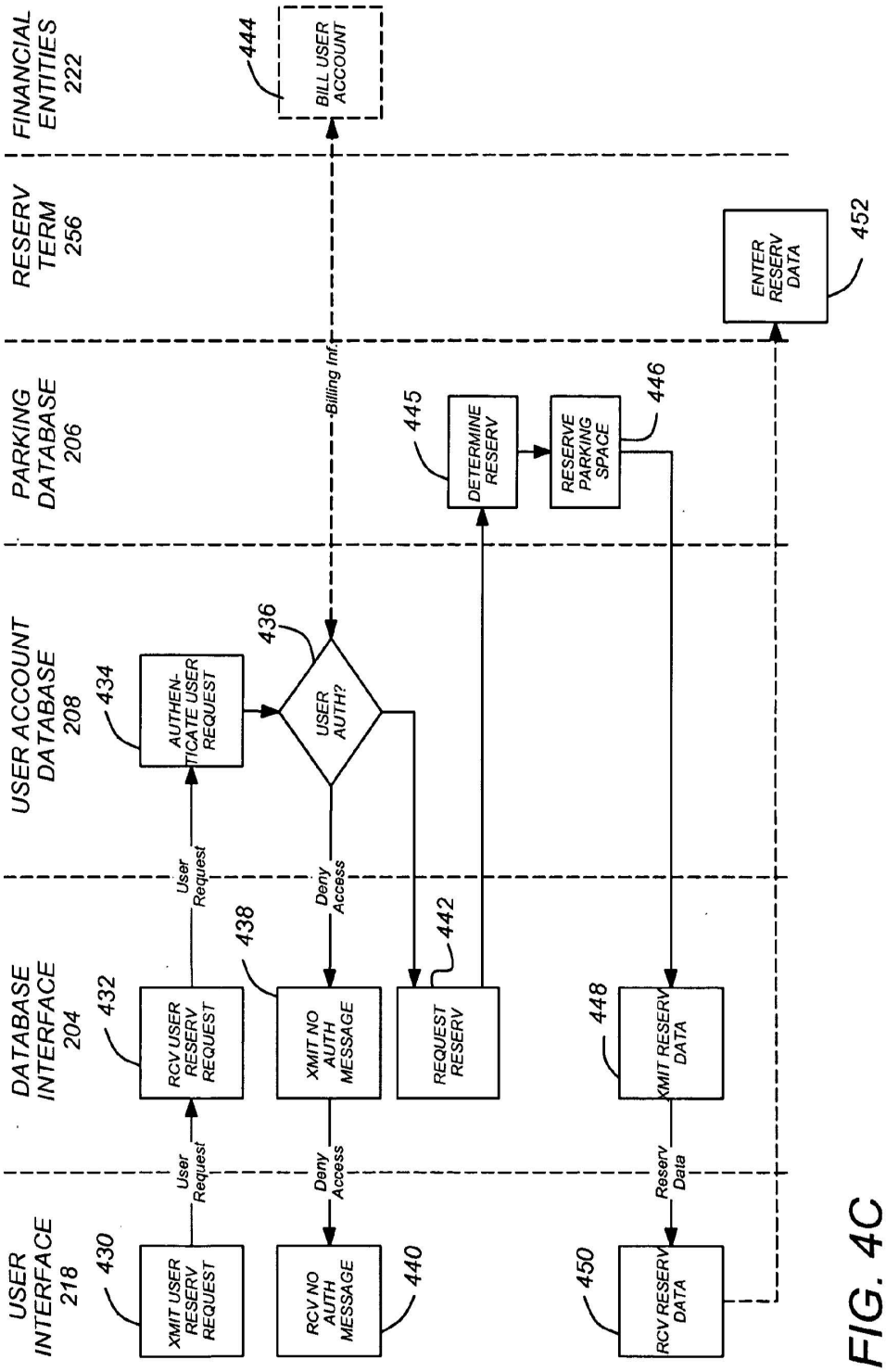

FINANCIAL ENTITIES 222
RESERV TERM 256
PARKING DATABASE 206
USER ACCOUNT DATABASE 208
DATABASE INTERFACE 204
USER INTERFACE 218
444
BILL USER ACCOUNT
Billing Inf.
452
ENTER RESERV DATA
445
DETERMINE RESERV
446
RESERVE PARKING SPACE
436
USER AUTH?
434
AUTHEN-TICATE USER REQUEST
User Request
Deny Access
438
442
432
RCV USER RESERV REQUEST
XMIT NO AUTH MESSAGE
REQUEST RESERV
448
XMIT RESERV DATA
User Request
Deny Access
Reserv Data
430
XMIT USER RESERV REQUEST
RCV NO AUTH MESSAGE
440
450
RCV RESERV DATA

FIG. 4C

SYSTEM AND METHOD FOR ASSESSING PARKING SPACE OCCUPANCY AND FOR RESERVING SAME

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to systems and methods for traffic control, and in particular to a system and method for monitoring and reserving parking spaces.

[0003] 2. Description of the Related Art

[0004] Transportation remains a formidable problem in many urban environments. Public transportation, while often convenient, is often limited in scope and operation periods, with many starting points and destinations inadequately served. Bicycles can be used for transportation, but bicycles are inconvenient in hot, cold, or wet weather, difficult traffic conditions on roads with inadequate shoulders, or where the user wants to arrive in formal clothes. As a consequence, although their use often results in substantial traffic delays, the automobile remains the most popular form of transportation in many urban and suburban environments.

[0005] Beyond traffic delays, there are other disadvantages with the popularity of the automobiles as a medium of transportation. Notable among these disadvantages is where to park the automobile at or near the destination of interest. Parking at many popular destinations is often difficult or impossible to find, particularly at events which draw large numbers of people at designated times (e.g. sporting events, concerts, etc.).

[0006] A person planning a trip downtown to a theater, say, can easily use the Internet to find the address of the theater and a preferred route to reach it. What the person cannot find is a map showing parking lots near the destination, and he or she particularly cannot find information about which parking lots have or might have available parking spaces, or where there might be available parking spaces along a curb for street parking. As a result, the person must drive to a location near his or her destination and then begin a search for a parking space. He or she may be fortunate and find an inexpensive parking space quickly, or may drive for an extended period of time before settling for an undesirable parking space (distant from the destination, unsafe, and/or costly). The uncertainty in how long it will take to find a parking space also causes wasted time. A person may arrive twenty minutes early for an appointment because they felt compelled to leave their starting point early enough to assure adequate time to find a parking space, wasting time that could have been spent on other activities. Similarly, if the person does not allow enough time for any expected search for a parking space, they will arrive late at the ultimate destination. This not only results in perhaps missing a portion of the event or meeting that the person was to attend, it can also waste the time of people who were waiting for us at the destination. Wasted time can also result in wasted money.

[0007] Searching for parking spaces also increases traffic load on many urban streets. Many cars on downtown streets are not en route to a destination, but are circling and searching for a place to park. This increases traffic congestion, energy consumption, noise, and air pollution.

[0008] What is needed is an apparatus and method for providing parking information to prospective users of those spaces, and for reserving those spaces. The present invention satisfies that need.

SUMMARY OF THE INVENTION

[0009] To address the requirements described above, the present invention discloses a method and apparatus for determining the availability of a plurality of parking spaces and of reserving one or more of such available parking spaces. In one embodiment, the method comprises the steps of accepting data indicating an occupancy status of at least a subset of the plurality of parking spaces; generating a parking database describing an availability of one or more of the parking spaces from the accepted data; accepting a request from a user, the request being for data describing the availability of the one or more of the parking spaces from the parking database; and providing the data describing availability of the one or more of the parking spaces to the user. The invention can also be embodied in a parking space management system with an operations center. The operations center has a parking database and a database interface. The parking database describes the availability of one or more of the parking spaces, and is generated using data describing an occupancy status of at least a subset of the plurality of parking spaces. The database interface accepts data indicating the occupancy status of at least a subset of the parking spaces, accepts a availability and reservation requests from users, and provides data describing the availability and reservations for the parking spaces to the user.

[0010] In one embodiment, the system uses sensors to detect empty parking spaces. This can be accomplished by counting the number of cars entering and leaving a parking lot, and using the difference to determine if there are any available spaces. In another embodiment, this is accomplished with sensors dedicated to one or more individual parking spaces. The system uses a network and computer processors to collect and classify information from these sensors and to deliver information regarding parking spaces. An interface allows authorized users to find tailored information regarding those parking spaces.

[0011] In another embodiment, authorized users can reserve parking spaces at a given lot (or particular parking spaces within that particular lot) for a given time interval, and if desired, pay for them in advance. Automatic routing software can also provide optimal routing to the parking space, based upon user input regarding the ultimate destination (and other factors, if desired). Hence, the present invention provides an system by which customers, optionally for a fee, can request and receive data on parking availability, reserve a parking space, and pay for the reserved parking space in advance.

[0012] In one embodiment, the system also presents advertising by businesses located in the vicinity of the parking lot or parking space to the user requesting parking data availability and/or a parking reservation. This permits highly specific directed advertising to be accomplished, and also allows a business model in which businesses pay for such advertising based upon customers who actually travel to the vicinity of the business, rather than simply those who view it.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Referring now to the drawings in which like reference numbers represent corresponding parts throughout:

[0014] **FIG. 1** is a block diagram showing an exemplary hardware environment for practicing the present invention;

[0015] **FIG. 2** is a diagram illustrating elements of the parking space information and reservation system; and

[0016] **FIG. 3** is a diagram is a diagram showing further details of the parking area; and

[0017] **FIGS. 4A-4C** are diagrams showing how selected embodiments of the present invention may operate.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0018] In the following description, reference is made to the accompanying drawings which form a part hereof, and which is shown, by way of illustration, several embodiments of the present invention. It is understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention.

[0019] **FIG. 1** illustrates an exemplary computer system **100** that could be used to implement selected elements of the present invention, including the operations center **202**, the user interface **218**, and the reservation terminal **256**. The computer **102** comprises a processor **104** and a memory, such as random access memory (RAM) **106**. The computer **102** is operatively coupled to a display **122**, which presents images such as windows to the user on a graphical user interface **118**B. The computer **102** may be coupled to other devices, such as a keyboard **114**, a mouse device **116**, a printer, etc. Of course, those skilled in the art will recognize that any combination of the above components, or any number of different components, peripherals, and other devices, may be used with the computer **102**.

[0020] Generally, the computer **102** operates under control of an operating system **108** stored in the memory **106**, and interfaces with the user to accept inputs and commands and to present results through a graphical user interface (GUI) module **118**A. Although the GUI module **118**A is depicted as a separate module, the instructions performing the GUI functions can be resident or distributed in the operating system **108**, the computer program **110**, or implemented with special purpose memory and processors. The computer **102** also implements a compiler **112** which allows an application program **110** written in a programming language such as COBOL, C++, FORTRAN, or other language to be translated into processor **104** readable code. After completion, the application **110** accesses and manipulates data stored in the memory **106** of the computer **102** using the relationships and logic that was generated using the compiler **112**. The computer **102** also optionally comprises an external communication device such as a modem, satellite link, Ethernet card, or other device for communicating with other computers.

[0021] In one embodiment, instructions implementing the operating system **108**, the computer program **110**, and the compiler **112** are tangibly embodied in a computer-readable medium, e.g., data storage device **120**, which could include one or more fixed or removable data storage devices, such as a zip drive, floppy disc drive **124**, hard drive, CD-ROM drive, tape drive, etc. Further, the operating system **108** and the computer program **110** are comprised of instructions which, when read and executed by the computer **102**, causes the computer **102** to perform the steps necessary to implement and/or use the present invention. Computer program **110** and/or operating instructions may also be tangibly embodied in memory **106** and/or data communications devices **130**, thereby making a computer program product or article of manufacture according to the invention. As such, the terms "article of manufacture,""program storage device" and "computer program product" as used herein are intended to encompass a computer program accessible from any computer readable device or media.

[0022] Those skilled in the art will recognize many modifications may be made to this configuration without departing from the scope of the present invention. For example, those skilled in the art will recognize that any combination of the above components, or any number of different components, peripherals, and other devices, may be used with the present invention.

Overview

[0023] **FIG. 2** is a diagram illustrating elements of the parking space information and reservation system (PSIRS) **200**. The PSIRS **200** comprises an operations center **202** which collects information regarding the parking spaces in one or more parking areas or lots **250**. The operations center **202** comprises a parking database **206**, a user account database **208** and an optional advertisement/message database **110**. These databases can be of a variety of different database types, including relational, object-relational, and object-oriented databases. The databases **206-210** can be implemented by separate processors communicatively coupled to separate memory devices, or by a single processor communicatively coupled to a single memory device, such as one or more hard drives, or separate processors and memory devices as desired. Users **219** can include subscribers who have paid a periodic charge for access to the PSIRS **200**, users **219** who pay a per-use charge, or users **219** who are provided access for free. In such cases, operating expenses and profit for the PSIRS **200** can be derived at least in part from the owners of the parking lots **250** included in the PSIRS **200**.

[0024] Database interface **204** manages the data resident in one or more of the databases **206-210**, and thus stores, retrieves, maintains, and performs the requisite processing of the data stored in the databases **206-210** as required. The database interface **204** also provides an interface so that entities external to the databases **206-210** can add or delete data, perform data processing and maintenance, and respond to database queries and commands. The interface **204** may be implemented by the same processor as the databases **206-210**, or one or more separate processors.

[0025] Users **219** access the PSIRS **200** via a user interface **218**, which typically includes some combination of hardware (H/W) and software (S/W) elements such as a the computer system illustrated in **FIG. 1**, a personal data assistant (PDA), telephone, cellphone, or similar device with analogous functionality. The user interface **218** can be disposed at the user's residence, carried by the user **219**, provided in the user's automobile and integrated with in-board navigation systems. In embodiments in which user

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access is controlled, the data used (1) to determine whether the user should be provided with access, (2) for billing purposes, and (3) specific user data (such as favorite parking lots/structures or favorite parking spaces within those lots/structures) stored, retrieved, and managed by a user/account database **208**. Data about parking availability is maintained in the parking database **206** and may come from sensors and/or attendants at the parking areas **250**. To prevent malicious inputs, employee input (e.g. via employee input device **274**) must be authorized via an authorization device **272**, such as a password-protected screen.

[0026] Initial user access can be granted by use of the interface **204**, or by access via the PSIRS **200** system administrators **216**. The database interface **204** also permits system administrators **216** to execute system administration and maintenance activities such as adding new user **219** accounts or compiling statistics on usage.

[0027] Through the database interface **204**, financial entities **222** (such as banks and credit card companies) and advertisement/message providers **200** are also given access to the user/account database **208** for purposes of conducting automated billing and credit card authorization.

[0028] The advertisement/message database **210** stores messages that can be presented to users **219** on the user interface **218**, as well as conditions under which each such message should be presented and a record of the occasions when each ad/message is actually displayed to the user. Using the database interface **204**, the user/account database **208** controls access to the advertisement/message database **210** so that only authorized advertisement message providers **220** can load or update advertisements and messages.

[0029] In embodiments of the PSIRS **200** that support reservations, reservation data is stored in the parking database **206**. One or more of the parking areas **250** may include a reservation terminal **256** that is communicatively coupled to the operations center **202** via communications link **276**. Communications link can be wireless or wired, and may include communications via the Internet.

[0030] The reservation terminal enforces reservations by controlling access to parking areas or parking spaces. For example, in cases where physical access to the parking lot **250** is controlled by an electronic gate, the reservation terminal **256** might be a keypad where the subscriber enters a reservation code or a terminal that accepts and reads printed vouchers. In embodiments where physical access to the parking area **250** is monitored and/or controlled by an on-site attendant, the reservation terminal **256** might comprise a computer (such as computer **100**) having display **122** showing which slots are reserved, the name of the user **219** that reserved each one, whether that user **219** has paid in advance, and the time the user **219** is scheduled to leave the parking space **304**. The display may also show, for each parking space, at what times it is reserved, and by whom. Parking area(s) **250** optionally also include one or more sensors **258**, which provide information regarding the occupancy of the parking spaces within the parking area **250** to the operations center **202** via communications link **276** or through an independent communications link.

[0031] The operations center **202** can also provide access to other services **212**, which can include a wide variety of services available on the Internet, e.g. routing provided by an automated routing source such as MAPQUEST a, pinpoint forecast for weather near the parking area, or a geographical information system (GIS) that shows the user a representation of the place he's trying to find, as well as click-through access to advertiser web sites. Revenue can be generated from any of these provided services.

[0032] **FIG. 3** is a diagram showing further details related to the parking area **250**. The parking area **250** includes a plurality of parking spaces **304**, which can include one or more full-sized parking spaces **304**A, one or more compact sized parking spaces **304**B, one or more motorcycle parking spaces **304**C, and one or more recreation vehicle or large sport utility vehicle parking spaces **304**D.

Operation

[0033] **FIGS. 4A-4C** are process flow charts illustrating the operation of selected embodiments of the invention. As shown in block **402**, an input device transmits data indicating the occupancy status of one or more parking spaces in a parking area **250**. That data is received by the database interface **204**, as shown in block **404**. The data may be transmitted/received over an Internet connection, dedicated telephone line, or wireless transmission.

[0034] The input device can take a variety of forms. In one embodiment, the input device is a sensor **258** disposed at or adjacent to each parking space **304**, or the parking area **250**. The PSIRS **200** uses a common interface between the parking database **206** and the sensors **258**, so data from a wide range of sensor **258** types can be used without special modification. Likely sensors **258** include optical sensors such as cameras, magnetic or ferrous sensors embedded in the parking surface (such as ferrous loops **414**), ultrasonic sensors, radio detection and ranging (RADAR) sensors, light detection and ranging (LIDAR) sensors, and (where access is controlled by gates) sensors that count of vehicles entering and exiting the parking area **250**.

[0035] Since each type of sensor **258** may produce a unique form of raw data, the PSIRS **200** combines each sensor **258** with appropriate processing and formatting mechanisms to produce data that comply with database interface **204** requirements. When used with appropriate processing and formatting, the physical sensors **258** can be viewed as "logical" sensors that use physically sensed observables to arrive at a logical conclusion regarding whether the parking space **304** serviced by the sensor(s) is occupied or not.

[0036] For example, one example of logical sensor is a digital camera connected to a processor that runs software which identifies empty parking spaces **304** in the camera images, loads the results into a properly formatted internet protocol (IP) packet, and provides the packet to the parking database **206**.

[0037] The sensors **258** can send data when the system polls the sensor **258**, when the sensed parking space **304** occupancy changes, or at periodic or aperiodc intervals. Most sensors **258** are fixed in place, but the PSIRS **200** may be implemented with mobile sensors such as cameras mounted on GPS-equipped vehicles. Further, users **219** who provide parking data from their vehicles to the system may earn a reduced fee.

[0038] The PSIRS **200** may also use predictive models to help users **219** find parking where no current sensor **258** data

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is available. For example, prior data for a particular parking lot may show that it's 98% likely to have an empty space starting at 5:00 PM on weekdays except during baseball home games. Likewise, prior data might show that the mean lifetime of an empty spot on 15th street between 1:00 and 3:00 PM on weekdays is 45 seconds; this can help users **219** decide whether to grab the first parking space **304** they find or keep looking for a better one. Prior data can come from mobile sensors **258** that are not currently on the scene, from temporary sensors **258** used specifically to gather statistical data, from sensors **258** that are currently off line or occluded, or from human estimates in areas where no measured data are available.

[0039] Input devices for counting the number of vehicles entering and leaving the parking area may comprises an entry counter **310** for sensing the entry of vehicles into the parking area **250** and an exit counter **312** for sensing the exit of vehicles from the parking area **250**. Although such devices cannot determine the availability of a particular parking space, these devices permit the number of available parking spaces within the parking area **250** to be determined, and thus, permits reservation of a parking space **304** within the parking area **250**.

[0040] The input device may also comprise a magnetic card issuer and reader, PROX card interface, USB interface, or any other device which can be used to regulate the entry and exit of vehicles from the parking area **250**.

[0041] It is noted that the occupancy status of the parking spaces **304** in the parking area **250** can be determined by a combination of the above as well. For example, the occupancy status of selected parking spaces **304** such as "end" parking spaces can be determined by an attendant, while the number of available parking spaces for the entire parking area **250** can be determined by entry and exit sensors (**310**, **312**).

[0042] As shown in block **406** of **FIG. 4A**, the occupancy status data is processed, and provided to the parking database **206** The parking database **206** generates and maintains availability data and other information using the accepted occupancy data. This is shown in block **407**. The parking database **206** may also be generated and managed by the database interface **204** or cooperative operation of the database interface **204** and the parking database **206**.

[0043] **FIG. 4B** is a diagram illustrating an exemplary process implicated when the user **219** requests parking availability data. Using user interface **218**, the user **219** transmits a user request message to the data interface **204** to request availability data describing the availability of one or more of the parking spaces **304**, as shown in lock **408**. The database interface **204** receives and processes the request, as shown in block **410**.

[0044] The present invention can be practiced in several embodiments. In one embodiment, only authorized users **219** are permitted to obtain availability data and to reserve parking spaces. In another embodiment, all users **219** are permitted to obtain availability data, but only authorized users **219** are permitted to reserve parking spaces. In another embodiment, all users **219** are permitted to obtain availability data, and to reserve parking spaces. Users may be "authorized" by enrolling in the PSIRS **200**. Enrollment and billing for PSIRS **200** services can be as one-time use basis, a renewable subscription basis, or a lifetime subscription.

[0045] **FIG. 4B** illustrates an embodiment in which the user must be enrolled order to obtain parking space availability data and is billed for accessing that data.

[0046] The user request may simply indicate the user's destination. In this case, the PSIRS **200** will return data for currently available parking spaces **304** of parking areas **250** in the PSIRS **200** that are within a "reasonable" distance from the destination, and may also present availability data extending forward in time for a baseline time period (such as six hours). The PSIRS **200** can also use predicted weather and other information to determine the "reasonable" distance. For example, if the weather is dry and temperate, a "reasonable" distance may be a tenth of a mile, but if the weather is snowy and cold, the baseline "reasonable" distance may change to a lower value. In another embodiment, the user request indicates the user's destination and the acceptable distance from the destination to the parking areas of interest, and the PSIRS **200** limits the responses to parking spaces within that distance. In another embodiment, once the user enters the destination, the user is provided with a list of available parking areas **250** for user selection, and the data provided by the PSIRS **200** is limited to those selected parking areas **250**.

[0047] Users **219** can also be allowed to set priorities among many attributes of parking spaces, enabling the system to automatically recommend a parking space **304** that best meets the user's need. For example, some users may put priority on inexpensive parking even if it's far from their destination; others may prefer a short walk regardless of cost. Attributes of parking spaces **304** can include cost, proximity to the trip destination, elevators, or public conveyances, size (important to people with large vehicles or who tow a trailer), security (e.g. is it lit at night and/or have an attendant), indoor vs. outdoor, and (for outdoor) shade vs. no shade. Users may also assign default priorities that vary depending on the time of day or on current or forecast weather (temperature, wind, precipitation). This avoids the inconvenience of setting different priorities for each trip to accommodate changing conditions. Users may also specify categories of parking spaces (e.g. compact versus full size).

[0048] The user request may also specify a particular time interval for which parking space availability information is sought. Alternatively, if a time interval is not specified, a timeline of parking space availability can be provided as a function of the time of day.

[0049] The user/account database **208** may store additional data about each user, including, for example (1) the user's preferred interface settings, (e.g. English vs. Spanish, or high vs. low resolution graphics) (2) priorities of parking space **304** attributes as described above (3) a history file that lists recent destinations and provides an option to clear all or part of the history, (4) history of advertisements displayed to this subscriber and his click-through responses. Items (1)-(3) improve convenience for the subscriber, while item (4) improves value for advertisers **220**.

[0050] The database interface **204** provides the user request to the user account database **208**, where the user or user request is authenticated, as shown in block **312**. If the user or user request is not authenticated, a message indicating that access has been denied is generated and transmitted by the database interface **204** to the user interface **218**, where it is provided to the user **219**. If the user **219** or use

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request is authorized, the database interface **204** transmits a message to the parking database **206** requesting parking space availability data, as shown in blocks **420** and **424**.

[0051] User authorization can be provided by use of information from financial entities **222** and the user account database **208**. For example, if the user **219** has provided a credit card number for a one-time use of the system, that credit card information is provided to the financial entities **222**, and if approved, the user account is billed as shown in block **422**, and an indicia of the approval is transmitted to the user account database **208**. Although direct communications between the user account database **208** and the financial entities **222** are shown in **FIG. 3B**, such communications can also be made through the database interface **204**.

[0052] Returning to **FIG. 4B**, block **424** illustrates the parking database **206** retrieving parking space availability data. This data is provided to the database interface **204**, which transmits the information to the user interface, as shown in blocks **426** and **428**.

[0053] **FIG. 4C** is a diagram illustrating exemplary process steps used to reserve a parking space within the PSIRS **200**. Using the user interface **218**, the user **219** transmits a reservation request to the database interface **204**, as shown in block **430**. The reservation request may have the same parameters as the availability request. That is, it typically include destination and time interval for which a parking space is needed (e.g. from 2 PM to 4 PM) near the Metropolitan Concert Hall. The reservation request may also include parking preference parameters, and other information. In one embodiment, the reservation request is submitted simply by selecting attributes of the parking space availability data presented in block **428** of **FIG. 4B**. This can be accomplished, for example, by selecting a parking space **304** and a time interval which has been indicated as available.

[0054] The reservation request is received by the database interface **204**, as shown in block **432**. If the user or user request for a reservation requires authentication (e.g. because the user has not yet been authenticated, or has not been enrolled in the PSIRS **200** to permit reservations to be made), blocks **434-440** and **444** present processes analogous to those shown in **FIG. 4B**. If the user is authorized to request a reservation, the database interface **204** requests a reservation from the parking database **206**, as shown in block **442**. Using the information resident in the parking database **206**, and the reservation request parameters provided in the reservation request, the parking database **206** determines which parking spaces **304** meeting the reservation request parameter are available, as shown in block **445**. If one or more parking spaces **304** meeting the user's requirements are available, the requisite number of such parking spaces are reserved, and the reservation information is transmitted to the user interface **218**, where it is received and presented to the user **219**, as shown in blocks **446-450**.

[0055] If parking space(s) **304** meeting the user's requirements are not available, this information is provided to the user **219** via the database interface **204**. Suggested changes to the reservation request may also be provided which will result in an available parking space **304** (e.g. a different time of day, or a parking area more remote from the destination). After the user **219** provides updated user requirements, the system repeats the operations of blocks **445-450**.

[0056] If a plurality of parking spaces **304** meet the user's requirements, this information may be transmitted to the user interface **218** to allow the user **219** to select a desired parking space. Upon selection, the selected parking space(s) **304** are reserved **446**. Reservation information is provided to the user **219** via the database interface **204** as described above.

[0057] In any of the above cases, the user **219** can then be prompted to affirm that they wish to reserve a parking space **304** with the current parking space parameters before billing, if desired.

[0058] The reservation information can include, for example, information describing the precise location of the parking area **250** and perhaps the location of a particular parking space **304**, as well as driving directions from the user's location to the parking area **250** and/or space **304**. The location information can provide (1) an address (2) a location relative to the destination, e.g. "three blocks north of your destination, on the right", (3) a location relative to the user's current location, e.g. "two blocks east, one block west", (4) the name of a parking location that is familiar to this user, e.g. "the Diamond lot at 5th and Pine", (5) a latitude and longitude, or (5) as a marked location on a digital map display. Further, all these choices or subsets thereof may be made available to the user **219**.

[0059] This reservation information is also useful for confirming the reservation of the parking space **304**. For example, the reservation information may comprise a voucher which can be offered by the user **219** as proof of the reservation and the pertinent reservation information (e.g. the parking area **250**, duration of the parking reservation, and any other parameters, such as the identity or location of the reserved parking space **304**). The voucher may be printed by the user **219** using printer **128** and taken to the parking area **250** to confirm the reservation. The voucher may be a sequence of numbers that are entered into a reservation terminal **256** at or near the parking area entrance **302** via a keypad or other device, may be a printed bar code that is read by a device at the parking area entrance **302**. The voucher also may be provided to an attendant at the parking area entrance **302**. This is shown in block **452**.

[0060] Once the user is permitted into the parking area **250**, they drive to a reserved parking space (or, in embodiments in which specific parking spaces are reserved, the reserved parking space), and park their vehicle.

[0061] The PSIRS **200** can also be used to regulate where users park their vehicles in the parking are **250**. For example, it is possible to use the sensors **258** to determine if a vehicle has taken more than one parking space **304**. An attendant can be alerted, or if the identity of the user **219** can be ascertained (e.g. from the reservation), and the offender can be billed for both parking spaces.

[0062] The parking area **250** can be arranged to enforce vehicle size limitations if desired. That is, compact parking spaces **304**B may be grouped together and securely delineated from full-size parking spaces **304**A (e.g. by separate entrances and fencing). Sensors **258** can be used to confirm that the size of the vehicle is not in excess of what is permissible in a compact space and corresponds to what was reserved. The user may also be asked to provide a license number when making the reservation, and this information

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can be compared to a database of registered vehicles to confirm that the vehicle is the size as claimed. Upon arrival, the vehicle's license plate can be read by an attendant or a camera coupled to a computer with character recognition capabilities to assure that the vehicle entering the parking space is the one for which the reservation was made.

[0063] To assure that other user's reservations can be honored, it is important to assure that users **219** evacuate their vehicles from the parking spaces **304** when the reserved time expires. This may include towing the vehicles which overextend their stay in the parking space **304** (users **219** may be required to explicitly provide permission to have their car towed if they exceed the reservation period). It may also include assessing additional parking fees and perhaps fines if the vehicle is not timely removed. This can be accomplished via further billing of their account. Such additional fees and/or fines can be graduated (e.g. at a higher rate for exceeding the amount of time that was reserved).

[0064] The PSIRS **200** can also be implemented without sensors **258** at all. For example, if entrants to the parking area **250** is limited to only those using the PSIRS **200** to reserve or obtain a space, the PSIRS **200** can determine the number of available parking spaces by a simple calculation comparing the number of spaces to the difference between the number of vehicles entering the parking area **250** and the number of vehicles leaving the parking area **250**.

[0065] The PSIRS **200** can also be used to reserve only a percentage of the available parking spaces, to assure nearly 100% availability for users with reservations, even if some users do not promptly evacuate their vehicles. Payment for access to the PSIRS to allow reservation of parking spaces **304**, or for access to the parking spaces **304** themselves, may be effected by the user (or a third party) via a range of options. Individual users **219** may pay a flat monthly subscription rate, a fee-per-service with monthly billing, or a payment at time of use via online credit card data or services like PAYPAL. Corporations and groups may enroll their employees or members. Third parties may pay for advertising that accompanies the service. This is especially advantageous for local businesses as advertising is highly directed to potential customers, and can be time-sensitive. Parking area **250** owners may pay to be listed by the PSIRS **200**, or may pay a percentage of fees collected from drivers routed to the owner's parking area **250** (a business model similar to the relationship between airlines and travel agents, wherein each airline formerly paid travel agents who booked flights on that airline).

Additional Services

[0066] In a preferred embodiment, the system may be operated with varying levels of service available to different subscribers, just as phone service or cable TV operate now. For example, some may subscribe to a basic text-only service with a limited number of events per month during certain times each day, paying extra for cases where they request a digital map, a human conversation, more than the allowed number of events, or events outside the allowed hours. Others may subscribe for an unlimited number of service events with full graphics and speech support for an extended period of time. When a camera view of the parking space **304** is available, subscribers with appropriate authorization may request and receive a current image of the parking space **304**. A few users may choose a premium service where a vehicle-mounted GPS receiver continuously sends the subscriber's location to the system, and the system continuously responds with the location of the nearest available parking space.

[0067] Similarly, advertisers **220** may choose varying levels of service. For example, some may pay for a premium service where they can upload large new graphic images every minute and where their ads get top priority for display to people parking in certain areas at certain times. Others may pay for a basic service where they get one mid-sized graphic per month, with ads displayed to random subscribers. Others may use the service as an adjunct to their standard on-line advertising. For example, a retailer's web site would include a "find parking" button that invokes the service to help a potential customer find, and perhaps reserve, a parking place near the store.

[0068] A further auxiliary service may be used to provide a reminder of where the user **219** parked. The system keeps a record of the most recent recommended parking space **304**. If the user **219** emerges from a day of meetings and can't remember where the user **219** found parking in the maze of streets near the user's destination, the user **219** can access the service for a reminder. A premium service makes this information available to other authorized people so they can find the user's vehicle. This can be useful for couples who share a car, or for companies that provide off-site automobile maintenance or repair.

Conclusion

[0069] This concludes the description of the preferred embodiments of the present invention. In summary, the present invention describes a method, apparatus, and article of manufacture for determining the availability of parking spaces and for reserving available parking spaces. The foregoing description of the preferred embodiment of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto. The above specification, examples and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

What is claimed is:

1. A method of managing a plurality of parking spaces, comprising the steps of:

accepting data indicating an occupancy status of at least a subset of the plurality of parking spaces;

generating a parking database describing an availability of one or more of the parking spaces from the accepted data;

accepting a request from a user, the request being for data describing the availability of the one or more of the parking spaces from the parking database; and

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providing the data describing availability of the one or more of the parking spaces to the user.

2. The method of claim 1, wherein the data is accepted in an operations center physically remote from the parking spaces.

3. The method of claim 1, further comprising the step of determining the occupancy status of the subset of the parking spaces.

4. The method of claim 3, wherein the subset of the parking spaces comprises a group of parking spaces together defining a parking area, and the occupancy status of the subset of the parking spaces is determined by a capacity of the parking area and a difference between a count of vehicles entering the parking area and a count of vehicles leaving the parking area.

5. The method of claim 3, wherein the occupancy status of the subset of parking spaces is determined from the accepted data according to a predictive model based on historical accepted data.

6. The method of claim 3, wherein the occupancy status of each of the parking spaces of the subset of parking spaces is determined by a sensing device proximate the parking space associated therewith.

7. The method of claim 6, wherein the sensing device comprises a ferrous sensor.

8. The method of claim 6, wherein the sensing device comprises an optical sensor.

9. The method of claim 6, wherein the sensing device comprises an infrared sensor.

10. The method of claim 6, wherein the occupancy status is continuously detected and provided to the operations center if the occupancy status changes.

11. The method of claim 1, wherein:

the request from the user comprises a destination;

the provided data describing the availability of the one or more parking spaces identifies parking spaces within a distance of the destination.

12. The method of claim 11, wherein:

the request from the user further comprises a preferred parking space attribute; and

the provided data describing the availability of the one or more parking spaces identifies parking spaces meeting the preferred parking space attribute.

13. The method of claim 12, wherein the attributes are selected from the group comprising:

a proximity of the parking space to the destination;

size of the parking space;

a security level of the parking space;

a cost of the parking space;

illumination of the parking space; and

exposure of the parking space to the Sun.

14. The method of claim 1, further comprising the steps of:

accepting a reservation request from the user;

reserving at least one of the parking spaces in the subset of parking spaces in response to the accepted reservation request.

15. The method of claim 14, wherein:

the reservation request comprises a selection of a category of parking spaces in the subset of parking spaces.

16. The method of claim 15, wherein:

the data describing availability of the one or more parking spaces to the user includes availability data for each individual parking space; and

the reservation request comprises a request for a particular one of the individual parking spaces in the subset of parking spaces.

17. The method of claim 14, further comprising the step of providing a voucher documenting the reserved at least one of the parking spaces to the user at the user's remote location.

18. The method of claim 17, wherein the voucher comprises an authorization code.

19. The method of claim 14, further comprising the step of:

providing a reminder of the location of the reserved at least one of the parking spaces.

20. A parking space management system, comprising:

an operations center, having:

a parking database, describing an availability of one or more of the parking spaces generated using data describing an occupancy status of at least a subset of the plurality of parking spaces; and

a parking database interface, for accepting the data indicating the occupancy status of at least a subset of the parking spaces, for accepting a request from a user, the request being for the data describing the availability of one or more of the parking spaces, and for providing the data describing the availability of the one or more of the parking spaces to the user.

21. The apparatus of claim 20, wherein the availability of the one or more of the parking spaces is determined according to a predictive model using historical data describing the occupancy status of at least a subset of the plurality of parking spaces.

22. The apparatus of claim 20, further comprising a plurality of occupancy sensors, for detecting an occupancy status of a parking space associated therewith.

23. The apparatus of claim 20, wherein the subset of the parking spaces comprises a group of parking spaces together defining a parking lot, and the occupancy status of the subset of the parking spaces is determined by a difference between a count of vehicles entering the parking lot and a count of vehicles leaving the parking lot.

24. The apparatus of claim 22, wherein the occupancy sensors are selected from the group comprising:

a ferrous detector;

an optical detector; and

an infrared detector.

25. The apparatus of claim 22, wherein each occupancy sensor is associated with one of the plurality parking spaces and detects an occupancy status of the one of the parking spaces.

26. The apparatus of claim 20, wherein the operations center is remote from the parking spaces.

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27. The apparatus of claim 20, wherein:

the request from the user comprises a destination;

the provided data describing the availability of the one or more parking spaces consists of data describing parking spaces within a specified distance of the destination.

28. The apparatus of claim 27, wherein the specified distance is user-specified.

29. The apparatus of claim 27, wherein:

the request from the user further comprises a preferred parking space attribute; and

the provided data describing the availability of the one or more parking spaces identifies parking spaces meeting the preferred parking space attribute.

30. The apparatus of claim 29, wherein the attributes are selected from the group comprising

a proximity of the parking space to the destination;

size of the parking space;

a security level of the parking space;

a cost of the parking space;

illumination of the parking space; and

exposure of the parking space to the Sun.

31. The apparatus of claim 20, wherein the parking database interface further comprises:

a module for accepting a reservation request from the user and for reserving at least one of the parking spaces in the subset of parking spaces in response to the accepted reservation request.

32. The apparatus of claim 31, wherein the reservation request comprises a selection of a category of parking spaces in the subset of parking spaces.

33. The apparatus of claim 31, wherein the parking database interface further provides a voucher documenting the reserved at least one of the parking spaces to the user at the user's remote location.

34. The apparatus of claim 31, wherein the module further provides a reminder of the location of the reserved at least one of the parking spaces.

35. The apparatus of claim 32, wherein:

the data describing availability of the one or more parking spaces to the user includes availability data for each individual parking space; and

the reservation request comprises a request for a particular one of the individual parking spaces in the subset of parking spaces.

36. An apparatus for managing a plurality of parking spaces, comprising:

means for accepting data indicating an occupancy status of at least a subset of the plurality of parking spaces;

means for generating a parking database describing an availability of one or more of the parking spaces from the accepted data;

means for accepting a request from a user, the request being for data describing the availability of the one or more of the parking spaces from the parking database; and

means for providing the data describing availability of the one or more of the parking spaces to the user.

37. The apparatus of claim 36, wherein the data is accepted in an operations center physically remote from the parking spaces.

38. The apparatus of claim 36, further comprising means for determining the occupancy status of the subset of the parking spaces.

39. The apparatus of claim 38, wherein the occupancy status of the subset of parking spaces is determined from the accepted data according to a predictive model using historical accepted data.

40. The apparatus of claim 38, wherein the occupancy status of each of the parking spaces of the subset of parking spaces is determined by a sensing device proximate the parking space associated therewith.

41. The apparatus of claim 40, wherein the sensing device comprises a ferrous detector.

42. The apparatus of claim 40, wherein the sensing device comprises an optical detector.

43. The apparatus of claim 40, wherein the sensing device comprises an infrared detector.

44. The apparatus of claim 40, wherein the occupancy status is continuously detected and provided to the operations center if the occupancy status changes.

45. The apparatus of claim 38, wherein the subset of the parking spaces comprises a group of parking spaces together defining a parking lot, and the occupancy status of the subset of the parking spaces is determined by a difference between a count of vehicles entering the parking lot and a count of vehicles leaving the parking lot.

46. The apparatus of claim 36, wherein:

the request from the user comprises a destination;

the provided data describing the availability of the one or more parking spaces identifies parking spaces within a distance of the destination.

47. The apparatus of claim 46, wherein:

the request from the user further comprises a preferred parking space attribute; and

the provided data describing the availability of the one or more parking spaces identifies parking spaces meeting the preferred parking space attribute.

48. The apparatus of claim 47, wherein the attributes are selected from the group comprising:

a proximity of the parking space to the destination;

size of the parking space;

a security level of the parking space;

a cost of the parking space;

illumination of the parking space; and

exposure of the parking space to the Sun.

49. The apparatus of claim 36, further comprising:

means for accepting a reservation request from the user;

means for reserving at least one of the parking spaces in the subset of parking spaces in response to the accepted reservation request.

50. The apparatus of claim 49, wherein:

the reservation request comprises a selection of a category of parking spaces in the subset of parking spaces.

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51. The apparatus of claim 50, wherein:

the data describing availability of the one or more parking spaces to the user includes availability data for each individual parking space; and

the reservation request comprises a request for a particular one of the individual parking spaces in the subset of parking spaces.

52. The apparatus of claim 49, further comprising means for providing a voucher documenting the reserved at least one of the parking spaces to the user at the user's remote location.

53. The apparatus of claim 52, wherein the voucher comprises an authorization code.

54. The apparatus of claim 49, further comprising the step of:

providing a reminder of the location of the reserved at least one of the parking spaces.

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