AUTOMATED VEHICLE PARKING SYSTEM

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ABSTRACT

The present disclosure provides an automated vehicle parking system. The automated vehicle parking system includes at least one parking facility structure including a plurality of vehicle storage cells, a vehicle entrance/exit arrangement, and a vehicle transporting mechanism. The vehicle transporting mechanism transports one or more vehicles between the entrance/exit arrangement and the at least one parking facility. The vehicle transporting mechanism is operable to redistribute the one or more vehicles between the storage cells within the at least one parking facility structure so that the one or more vehicles are more rapidly accessible when they are required to be delivered to the entrance/exit arrangement for collection thereat.
Fig. 3
Fig. 4
START

RECEIVE INFORMATION INDICATIVE OF ESTIMATED TIMES OF COLLECTION OF VEHICLES

REDISTRIBUTE ONE OR MORE VEHICLES BETWEEN THE STORAGE CELLS BASED ON RECEIVED INFORMATION

STOP

Fig. 6
AUTOMATED VEHICLE PARKING SYSTEM

[0001] The present disclosure generally relates to vehicle parking systems, and more specifically, to managing delivery logistics of an automated vehicle parking system. Further, aspects of the disclosure are also directed to software products recorded on machine-readable data storage media, wherein such software products are executable upon computing hardware, to implement the methods of the disclosure.

BACKGROUND

[0002] Multi-level vehicle parking systems are quite common nowadays as they facilitate parking of a large number of vehicles in a limited space. Such parking systems include a vehicle storage space, and multiple pick up and drop locations, where a vehicle user can leave and/or pick up their vehicle. The vehicle is moved between the pickup/drop location and the vehicle storage space using automatic lifts and movers.

[0003] However, a major problem associated with the multi-level vehicle parking systems is waiting time associated with pick up of a vehicle. It is likely that some users have to wait for their vehicle when there are many vehicles parked in the storage space and a limited number of pick up locations. When there is one user, the average waiting time for the pick up depends on an operating speed of the delivery mechanism and distance of the vehicle from the pick up location. When there are multiple users, each user is served in a sequence and waiting time of a given user depends on the number of users already requesting for their vehicles prior to the given user.

[0004] A conventional technique to reduce the waiting time in the vehicle parking system is to increase the number of pick up locations and to speed up the delivery mechanism, and further to employ modeling of the average waiting time using mathematical models such as an Erlang distribution. For example, an Erlang C distribution may be used to estimate how long it takes for the vehicle to be delivered to a pick up location. Alternatively, an Engset equation may be used to determine a probability of a user to wait for their vehicle. However, the conventional techniques have not proved to be very efficient in significantly reducing the waiting time, especially when the number of pickup requests are large.

[0005] Hence, there exists a need for a vehicle parking system, which eliminates or reduces the waiting time for the delivery of the vehicle to a user and results in a more robust delivery, irrespective of number of pickup requests.

SUMMARY

[0006] The present disclosure provides an automatic vehicle parking system and a method for operating the same.

[0007] In one aspect, embodiments of the present disclosure provide an automated vehicle parking system that includes at least one parking facility structure including a plurality of vehicle storage cells, a vehicle entrance/exit arrangement, and a vehicle transporting mechanism. The vehicle transporting mechanism transports vehicles between the entrance/exit arrangement and the at least one parking facility.

[0008] The vehicle transporting mechanism is operable to redistribute the vehicles between the storage cells within the at least one parking facility structure so that the vehicles are more rapidly accessible when they are required to be delivered to the entrance/exit arrangement for collection thereat. A vehicle is redistributed to a vehicle storage cell close to an entrance/exit arrangement just before their pick up, to reduce a waiting time experienced by the user when retrieving their vehicle from the vehicle parking system.

[0009] The redistribution of the one or more vehicles is executed based upon user-entered information indicative of estimated times of collection of the vehicles and/or a predictive model provided with identification information for identifying the vehicles. The user may provide estimated times of collection of vehicles and their identification information through a control panel at the entrance/exit arrangement.

[0010] In accordance with an embodiment of the present disclosure, the automated vehicle parking system is associated with an airport facility, and redistribution of the vehicles is executed based upon flight information pertaining to the airport facility. The vehicles are redistributed on behalf of users passing through the airport facility. For example, based on the arrival information of a passenger, the vehicle of the passenger parked in the automated vehicle parking system is moved to either an entrance/exit or a storage cell close to the entrance/exit to minimize the waiting time of the passenger.

[0011] In accordance with another embodiment of the present disclosure, a sub-set of users of the system are provided with a privileged status, and redistribution of the vehicles is executed as a function of the privileged status to reduce waiting times of the users having the privileged status relative to other users of the system. For example, the vehicles of the passengers with priority card (Gold card) may be moved to a storage cell close to an entrance/exit and the vehicles of the passengers with priority card (Platinum card) may be moved directly to an entrance/exit before their scheduled pick up.

[0012] In accordance with yet another embodiment of the present disclosure, one or more communications is provided to the users of the system indicative of when their vehicles stored in the system are estimated to be available at the entrance/exit arrangement. For example, a message such as Short message service (SMS), e-mail, and the like, may be sent to the passenger indicative of when their vehicles are estimated to be available at the entrance/exit arrangement.

[0013] In another aspect, embodiments of the present disclosure provide a method of operating the automated vehicle parking system.

[0014] Embodiments of the present disclosure substantially reduce the waiting time for the delivery of a vehicle and result in a more robust delivery, irrespective of total number of pick up requests in an automated vehicle parking system. The vehicles are moved closer to an entrance/exit just before their pick up, based on information indicative of one or more estimated times of collection of the vehicles, and/or a predictive model provided with identification information for identifying the vehicles. The automated vehicle parking system may be implemented in an airport facility or an elevator system of a building to reduce the waiting time of passengers/residents.

[0015] Additional aspects, advantages, features and objects of the present disclosure would be made apparent from the drawings and the detailed description of the illustrative embodiments construed in conjunction with the appended claims that follow.

[0016] It will be appreciated that features of the invention are susceptible to being combined in various combinations without departing from the scope of the invention as defined by the appended claims.
BRIEF DESCRIPTION OF THE DRAWINGS

0017 The summary above, as well as the following detailed description of illustrative embodiments, is better understood when read in conjunction with the appended drawings. For the purpose of illustrating the present disclosure, exemplary constructions of the disclosure are shown in the drawings. However, the invention is not limited to specific methods and instrumentalities disclosed herein. Moreover, those in the art will understand that the drawings are not to scale. Wherever possible, like elements have been indicated by identical numbers.

0018 FIG. 1 is an illustration of an automated vehicle parking system that is suitable for practicing various implementations of the present disclosure;

0019 FIG. 2 is an illustration of a vehicle entrance/exit, in accordance with the present disclosure;

0020 FIG. 3 is an illustration of a plurality of floors and a plurality of entrance/exits of an automated vehicle parking system, in accordance with the present disclosure;

0021 FIG. 4 is an illustration of an automated vehicle parking system associated with an airport facility, in accordance with the present disclosure;

0022 FIG. 5 is an illustration of an automated vehicle parking system integrated with an elevator system of a building, in accordance with the present disclosure; and

0023 FIG. 6 is an illustration of steps of a method of operating the automated vehicle parking system, in accordance with the present disclosure.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

0024 The following detailed description illustrates embodiments of the disclosure and ways in which it can be implemented. Although the best mode of carrying out the invention has been disclosed, those in the art would recognize that other embodiments for carrying out or practicing the invention are also possible.

0025 The present disclosure provides an automated vehicle parking system. The automated vehicle parking system includes at least one parking facility structure, a vehicle entrance/exit arrangement and a vehicle transporting mechanism. The parking facility structure includes a plurality of vehicle storage cells and the vehicle transporting mechanism redistributes the vehicles between the storage cells so that the vehicles are more rapidly accessible when they are required to be delivered to the entrance/exit arrangement for collection thereat. The redistribution of the vehicles is executed based upon user-entered information indicative of estimated times of collection of the vehicles and/or a predictive model provided with identification information for identifying the vehicles to reduce a waiting time experienced by users when retrieving vehicles from the system.

0026 The automated vehicle parking system may be associated with an airport facility, and redistribution of the vehicles is executed based upon flight information pertaining to the airport facility. Further, a sub-set of users of the system and airport facility are optionally provided with a privileged status, and redistribution of the vehicles is executed as a function of the privileged status to reduce waiting times of the users having the privileged status relative to other users of the system. The automated vehicle parking system may further provide communications in form of SMS, email, and the like to users indicative of when their vehicles stored in the system are estimated to be available at the entrance/exit arrangement.

0027 Referring now to the drawings, particularly by their reference numbers, FIG. 1 is an illustration of an automated vehicle parking system 100 that is suitable for practicing various implementations of the present disclosure. The automated vehicle parking system 100 includes parking facility structures 102a and 102b, hereinafter collectively referred to as parking facility 102. Each parking facility 102 includes a plurality of parking floors and the plurality of parking floors include a plurality of vehicle storage cells 104a, 104b, 104c, and 104d, hereinafter collectively referred to as vehicle storage cells 104 for parking vehicles 106a, 106b, 106c and 106d respectively, hereinafter collectively referred to as vehicles 106. Examples of vehicles 106, include, but are not limited to, automobiles, cars, vans, and buses.

0028 A vehicle transporting mechanism 108 transports the vehicles 106 between the at least one vehicle entrance/exit (not shown in figure) and the parking facility 102. Examples of the vehicle transporting mechanism 108 include, but are not limited to, automated lifts and movers. The vehicle transporting mechanism 108 also moves the vehicles 106 among the vehicle storage cells 104.

0029 FIG. 2 is an illustration of a vehicle entrance/exit 200 of the automated vehicle parking system 100, and is explained in conjunction with FIG. 1. The vehicle entrance/exit 200 is a room, hereinafter referred to as room 200, where a vehicle user 206 leaves and/or picks up their vehicle 106. The vehicle entrance/exit 200 has an automatic door 202 which can be opened for example after identifying the vehicle 106 based on its license plate. The vehicle user 206 drives the vehicle 106 in the room 200 and leaves the vehicle 106 therein.

0030 After leaving the vehicle 106 in the room 200, the user 206 may use a control panel 204 to enter a personal code and other instructions such as an estimated time of picking up the vehicle 106. The door 202 is closed, when the user 206 has entered the information through the control panel 204. After the door 202 is closed, the vehicle transporting mechanism 108 transports the vehicle 106 to an available vehicle storage cell 104. In an embodiment of the present invention, the vehicle storage cell 104 may be predefined for the user 206. In another embodiment of the present invention, the vehicle storage cell 104 is dynamically decided by a control logic of the automated vehicle parking system 100.

0031 In an embodiment of the present invention, the control panel 204 may be coupled to the control logic of the automated vehicle parking system 100 and may include an interactive graphical user interface (GUI) and an input module for receiving a plurality of instructions from the vehicle user 206. For example, the control panel 204 may receive the identification information of the vehicle 106, the estimated pick up time of the vehicle 106 and a request from the user 206 for picking up the vehicle 106. The vehicle transporting mechanism 108 transports the vehicle 106 from the vehicle storage cell 104 to the room 200 when a request for pick up of the vehicle 106 is received. The door 202 is opened and the user 206 may drive the vehicle 106 out of the room 200.

0032 FIG. 3 is an illustration of an automated vehicle parking system 300, which is an example of the automated vehicle parking system 100 and is explained in conjunction with FIGS. 1 and 2. The system 300 includes parking floors A, B, C, D and three entrance/exits 302a, 302b and 302c, hereinafter collectively referred to as entrance/exits 302. Each
floor A, B, C and D, include multiple vehicle storage cells, similar to vehicle storage cells 104, for parking the vehicles, namely similar to the vehicles 106. A vehicle user, namely similar to vehicle user 206, may leave a vehicle at any of the entrance/exit 302 and a vehicle transporting mechanism, namely similar to vehicle transporting mechanism 108, may move the vehicle automatically to any of the parking floors A, B, C, D based on the availability of the vehicle storage cells and/or user preferences.

[0033] The vehicle transporting mechanism may deliver the vehicle back to an entrance/exit 302, when the user submits a request for pick up of the vehicle. In an embodiment of the present invention, the vehicle transporting mechanism is operable to redistribute the one or more vehicles among the storage cells so that the one or more vehicles are more rapidly accessible when they are required to be delivered to the entrance/exit 302 for collection thereon. The redistribution of the one or more vehicles is executed for reducing a waiting time experienced by one or more users when retrieving one or more vehicles from the system 300.

[0034] For example, the delivery time of a vehicle from floor D to an entrance/exit 302 is 3 minutes, from floor C is 6 minutes, from floor B is 9 minutes and from floor A is 12 minutes. The average time is thus equal to (3+6+9+12)/4=7.5 minutes. In addition, it takes approximately 1 minute for a user to enter into the vehicle and drive out of the entrance/exit 302. The vehicle transporting mechanism may redistribute a vehicle parked at floor A to floor D close to an entrance/exit 302, just before a pick up of the vehicle is requested, thereby reducing the waiting time to 3 minutes. In one embodiment of the present invention, the vehicle transporting mechanism redistributes one or more vehicles among the vehicle storage cells at parking floors A, B, C and D based upon user-entered information indicative of one or more estimated times of collection of the one or more vehicles. In another embodiment, the redistribution of vehicles among the parking floors A, B, C and D is executed based upon a predictive model provided with identification information of the one or more vehicles. As discussed above, the user may provide estimated times of collection of the vehicles and their identification information through a control panel, namely similar to control panel 204, at the entrance/exit 302.

[0035] FIG. 3 is merely an example, which should not unduly limit the scope of the claims herein. One of ordinary skill in the art would recognize many variations, alternatives, and modifications of embodiments herein.

[0036] FIG. 4 is an illustration of an automated vehicle parking system 400 associated with an airport facility 404, in accordance with the present disclosure.

[0037] The parking system 400 is located at or close to an airport 404. A car rental organization associated with the parking system 400 stores the rental information in a first database DB1. A ticketing organization associated with the airport 404 stores global ticket information in a second database DB2. The arrival information of passengers at the airport 404 is stored in a fourth database DB4. An airport server system 406 is configured to request and receive information from the first, second, and fourth databases DB1, DB2, and DB4 respectively.

[0038] The automated vehicle parking system 400 is an example of the automated vehicle parking system 100. The automated vehicle parking system 400 includes parking floors A, B, C, D, and three entrance/exits 402a, 402b, and 402c, hereinafter collectively referred to as entrance/exits 402, and is controlled by a control logic 408. A third database DB3 is linked to the control logic 408, and stores information indicative of a location of parked vehicles in the system 400. The control logic 408 is linked to the server system 406 by way of a communication network. Examples of the communication network include, but are not limited to Ethernet, Internet, Local Area Network and the like.

[0039] The control logic 408 uses information from the first, second, third and fourth databases DB1, DB2, DB3 and DB4, to formulate instructions for either delivering vehicles to entrance/exits 402 or redistributing the vehicles among the parking floors A, B, C and D. For example, based on the arrival information of a passenger stored in the fourth database DB4, the control logic 408 may initiate delivery process of corresponding vehicle to either an entrance/exit 402 or floor C/D close to the entrance/exit 402 to minimize the waiting time of the passenger. Thus, the redistribution of the vehicles among the parking floors A, B, C and D is executed based upon flight information pertaining to the airport 404.

[0040] In another example, based on the information regarding rented cars in the first database DB1, the control logic 408 may initiate delivery process of a rented car parked in the system 400 at an entrance/exit 402a at an approximate time of pick up of rented car, and also instruct the user picking up the rented car to wait outside the entrance/exit 402a. The control logic 408 may be configured to send a message such as Short message service (SMS), e-mail, and the like to the passenger to inform about the entrance/exit 402a.

[0041] In another example, based on the second database DB2, the control logic 408 may move the vehicles of the passengers with priority card, for example Gold card holders, to floor D close to an entrance/exit 402 and move the vehicles of the passengers with priority card, for example Platinum card holders, directly to an entrance/exit 402. Thus, redistribution of the vehicles among the parking floors A, B, C and D is executed based upon privilege status of one or more users.

[0042] FIG. 4 is merely an example, which should not unduly limit the scope of the claims herein. One of ordinary skill in the art would recognize many variations, alternatives, and modifications of embodiments herein.

[0043] FIG. 5 is an illustration of an automated vehicle parking system 500 integrated with an elevator system 508 of the building 506, in accordance with the present disclosure. The building 506 may be a residential building or an office building, and includes first through eighth floors. The elevator system 508 of the building 506 is controlled by a first control logic 510.

[0044] The automated vehicle parking system 500 is an example of the automated vehicle parking system 100 and includes parking floors A, B, C, D, and three entrance/exits 502a, 502b, and 502c, hereinafter collectively referred to as entrance/exits 502. The automated vehicle parking system 500 is controlled by a second control logic 512. A database DB3 is linked to the second control logic 512 and stores location information of vehicles parked in the system 500. The database DB3 can also include other statistical information of the residents of the building 506 such as normal pick up times of the vehicles from the system 500.

[0045] In one embodiment of the present invention, the first control logic 510 is connected to the second control logic 512 by way of a communication network. In another embodiment of the present invention, the first and second control logics 510 and 512 are integrated in a single hardware unit.
The first control logic 510 includes information on requests for elevator system 508 to go to one or more floors. For example, when a resident of the 7th floor of the building 506 requests the elevator system 508 to the 7th floor, he/she presses a button next to a door of the elevator system 508. The pressing of the button is registered by the first control logic 510 and the elevator system 508 is delivered to the 7th floor.

In an exemplary embodiment of the present invention, if the resident of the 7th floor has parked his/her vehicle in the system 500 and the first control logic 510 indicates that the elevator system 508 has been ordered to the 7th floor, the second control logic 512 may initiate delivery process of the vehicle of resident of the 7th floor to either floor D or to an entrance/exit 502. When there is more than one residence at the 7th floor, the second control logic 512 may be configured to move vehicles of all residents of 7th floor to floor D to reduce statistical waiting time. Alternatively, the second control logic 512 may initiate delivery process of the vehicle of resident of the 7th floor whose house is locked based on a lock status of the doors of the houses at the 7th floor. Alternatively, the second control logic 512 may initiate delivery process of the vehicle of resident of the 7th floor based on normal pick up times of vehicles registered in the database D13.

In another exemplary embodiment, the second control logic 512 may send a request to the first control logic 510 to request the elevator system 508 to ground floor (floor 0) for a user, when the user leaves their vehicle at an entrance/exit 502, thereby reducing the waiting time for the elevator system 508.

FIG. 5 is merely an example, which should not unduly limit the scope of the claims herein. One of ordinary skill in the art would recognize many variations, alternatives, and modifications of embodiments herein.

FIG. 6 is an illustration of steps of a method of operating the automated vehicle parking system 100, in accordance with the present disclosure. The method is depicted as a collection of steps in a logical flow diagram, which represents a sequence of steps that can be implemented in hardware, software, or a combination thereof. At a step 602, the automated parking system 100 may receive information indicative of estimated times of collection of vehicles parked in the system 100 or identification information of the vehicles.

At a step 604, the automated parking system 100 may redistribute one or more vehicles between the storage cells based on received information so that the one or more vehicles are more rapidly accessible when they are required to be delivered to an entrance/exit for collection thereof. The redistribution of one or more vehicles is executed for reducing a waiting time experienced by one or more users when retrieving one or more vehicles from the system 100.

It should be noted here that the steps 602 to 604 are only illustrative and other alternatives can also be provided where one or more steps are added, one or more steps are removed, or one or more steps are provided in a different sequence without departing from the scope of the claims herein.

Although embodiments of the current invention have been described comprehensively, in considerable detail to cover the possible aspects, those skilled in the art would recognize that other versions of the invention are also possible.

What is claimed is:
1. An automated vehicle parking system, including at least one parking facility structure including a plurality of vehicle storage cells, a vehicle entrance/exit arrangement, and a vehicle transporting mechanism for transporting in operation one or more vehicles between the entrance/exit arrangement and the at least one parking facility, wherein the vehicle transporting mechanism is operable to redistribute the one or more vehicles between the storage cells within the at least one parking facility structure so that the one or more vehicles are more rapidly accessible when they are required to be delivered to the entrance/exit arrangement for collection thereof.

2. The automated vehicle parking system as claimed in claim 1, wherein redistribution of the one or more vehicles is executed based upon user-entered information indicative of one or more estimated times of collection of the one or more vehicles.

3. The automated vehicle parking system as claimed in claim 1, wherein redistribution of the one or more vehicles is executed based upon a predictive model provided with identification information for identifying the one or more vehicles.

4. The automated vehicle parking system as claimed in claim 1, wherein the system is associated with an airport facility, and redistribution of the one or more vehicles is executed based upon flight information pertaining to the airport facility, wherein the one or more vehicles are redistributed on behalf of one or more users passing through the airport facility.

5. The automated vehicle parking system as claimed in claim 1, wherein redistribution of the one or more vehicles is executed for reducing a waiting time experienced by one or more users when retrieving one or more vehicles from the system.

6. The automated vehicle parking system as claimed in claim 1, wherein a sub-set of users of the system are provided with a privileged status, and redistribution of the one or more vehicles is executed, at least in part, as a function of the privileged status to reduce waiting times of the users having the privileged status relative to other users of the system.

7. The automated vehicle parking system as claimed in claim 1, wherein the system is operable to provide one or more communications to one or more users of the system indicative of when their one or more vehicles stored in the system are estimated to be available at the entrance/exit arrangement.

8. A method of operating an automated vehicle parking system, wherein the system includes at least one parking facility structure including a plurality of vehicle storage cells, a vehicle entrance/exit arrangement, and a vehicle transporting mechanism for transporting in operation one or more vehicles between the entrance/exit arrangement and the at least one parking facility, wherein the method includes:

using the vehicle transporting mechanism to redistribute the one or more vehicles between the storage cells within the at least one parking facility structure so that the one or more vehicles are more rapidly accessible when they are required to be delivered to the entrance/exit arrangement for collection thereof.

9. The method as claimed in claim 8, wherein the method includes redistributing the one or more vehicles based upon user-entered information indicative of one or more estimated times of collection of the one or more vehicles.
10. The method as claimed in claim 8, wherein the method includes redistributing the one or more vehicles based upon a predictive model provided with identification information for identifying the one or more vehicles.

11. The method as claimed in claim 8, wherein the system is associated with an airport facility, and the method includes redistributing the one or more vehicles based upon flight information pertaining to the airport facility, wherein the one or more vehicles are redistributed on behalf of one or more users passing through the airport facility.

12. The method as claimed in claim 8, wherein the method includes redistributing the one or more vehicles for reducing a waiting time experienced by one or more users when retrieving one or more vehicles from the system.

13. The method as claimed in claim 8, wherein the method includes providing a sub-set of users of the system with a privileged status, and redistributing the one or more vehicles, at least in part, as a function of the privileged status to reduce waiting times of the users having the privileged status relative to other users of the system.

14. The method as claimed in claim 8, wherein the method includes operating the system to provide one or more communications to one or more users of the system indicative of when their one or more vehicles stored in the system are estimated to be available at the entrance/exit arrangement.

15. A software product recorded on machine-readable data storage media, wherein the software product is executable upon computing hardware for implementing the method as claimed in claim 8.

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