

[DESCRIPTION]

[TITLE OF INVENTION]

VEHICLE ASSIGNMENT MANAGEMENT DEVICE, VEHICLE ASSIGNMENT
MANAGEMENT METHOD, AND MOBILITY SYSTEM

5 [Technical Field]

[0001]

The present invention relates to a vehicle assignment management device, a
vehicle assignment management method, a mobility system, and a program.

Priority is claimed on Japanese Patent Application Nos. 2017-069149 and
10 2017-069232, filed March 30, 2017, the content of which is incorporated herein by
reference.

[Background Art]

[0002]

In a case in which persons are transported between two points distant from each
15 other, transporting means such as a bus, a taxi, and the like are used. In addition, in
Patent Literature 1, a technology for configuring a scheduled operation service and an
on-demand operation service to coexist using an automatedly running vehicle is
disclosed.

[Citation List]

20 [Patent Literature]

[0003]

[Patent Literature 1]

Japanese Patent No. 4117964

[Summary of Invention]

25 [Technical Problem]

[0004]

In order to reduce a cost of a transportation means, it is preferable to control a transportation means using automated driving. However, a technology for transporting a transportation means to a destination safely and reliably using an automated driving
5 technology has not been established.

An objective of the present invention is to provide a vehicle assignment management device, a vehicle assignment management method, a mobility system, and a program causing a vehicle to run along a route safely and reliably using an automated driving technology.

10 [Solution to Problem]

[0005]

According to a first aspect of the present invention, a vehicle assignment management device is provided, including: a route notification unit that notifies a target vehicle of a route along which the target vehicle will run; a position-receiving unit that
15 receives position information at a plurality of timings from each of a plurality of vehicles including the target vehicle; and a range notification unit that notifies the target vehicle of a permissible range representing a range in which the target vehicle can run on the basis of the position information of the plurality of vehicles at a plurality of timings.

[0006]

20 According to a second aspect of the present invention, the vehicle assignment management device according to the first aspect further includes: a destination input unit that accepts an input of a destination; and a vehicle-determining unit that determines the target vehicle among the plurality of vehicles on the basis of the destination, in which the route notification unit may notify the target vehicle of a route toward the destination.

25 [0007]

According to a third aspect of the present invention, the vehicle assignment management device according to the second aspect further includes: a number of vehicle occupants input unit that accepts an input of the number of vehicle occupants to be transported to the destination; and a number of vehicles-determining unit that determines the number of target vehicles on the basis of the number of vehicle occupants, wherein the vehicle-determining unit may determine target vehicles corresponding to the number determined by the number of vehicles-determining unit such that all the target vehicles arrive at the destination within a predetermined time.

[0008]

According to a fourth aspect of the present invention, the vehicle assignment management device according to the second or third aspect further includes: a transit point-determining unit that determines a transit point on the basis of the destination; and a boarding-determining unit that determines whether or not boarding of vehicle occupants into the target vehicle has been completed, in which the route notification unit may notify the target vehicle of a route toward the transit point when the vehicle-determining unit determines the target vehicle and notifies the target vehicle of a route toward the destination when boarding of the vehicle occupants into the target vehicle has been completed.

[0009]

According to a fifth aspect of the present invention, the vehicle assignment management device according to the first aspect further includes: a transit point-determining unit that determines a transit point to which a vehicle is to be assigned among a plurality of transit point candidates; and a vehicle-determining unit that determines the target vehicle among the plurality of vehicles on the basis of the transit point, in which the route notification unit may notify the target vehicle of a route toward

the transit point.

[0010]

According to a sixth aspect of the present invention, the vehicle assignment management device according to the fifth aspect further includes: a destination input unit
5 that accepts an input of a destination at which vehicle occupants who have got on the target vehicle at the transit point will alight; and a boarding-determining unit that determines whether or not boarding of the vehicle occupants into the target vehicle has been completed, in which the route notification unit may notify the target vehicle of a route toward the destination when the boarding of the vehicle occupants into the target
10 vehicle has been completed.

[0011]

According to a seventh aspect of the present invention, in the vehicle assignment management device according to the fourth or sixth aspect, the boarding-determining unit may determine that the boarding of the vehicle occupants into the target vehicle has been
15 completed when the vehicle arrives at the transit point, and doors of the vehicle are closed.

[0012]

According to an eighth aspect of the present invention, a mobility system is provided, including: a plurality of vehicles; and the vehicle assignment management
20 device according to any one of aspects 1 to 7, in which each of the plurality of vehicles runs on a route and within a permissible range on the basis of the route and the permissible range received from the vehicle assignment management device.

[0013]

According to a ninth aspect of the present invention, a vehicle assignment
25 management method is provided, including: notifying a target vehicle of a route along

which the target vehicle will run; receiving position information at a plurality of timings from each of a plurality of vehicles including the target vehicle; and notifying the target vehicle of a permissible range representing a range in which the target vehicle can run on the basis of the position information of the plurality of vehicles at a plurality of timings.

5 [0014]

According to a tenth aspect of the present invention, a program is provided causing a computer to execute: notifying a target vehicle of a route along which the target vehicle will run; receiving position information at a plurality of timings from each of a plurality of vehicles including the target vehicle; and notifying the target vehicle of a permissible range representing a range in which the target vehicle can run on the basis of the position information of the plurality of vehicles at a plurality of timings.

[Advantageous Effects of Invention]

[0015]

According to at least one of the aspects described above, a vehicle assignment management device is able to allow a vehicle to run along a route safely and reliably.

[Brief Description of Drawings]

[0016]

Fig. 1 is a diagram illustrating an external view of a facility including a mobility system according to first and second embodiments.

20 Fig. 2 is a schematic view illustrating the configuration of a mobility system according to the first and second embodiments.

Fig. 3 is a schematic block diagram illustrating the configuration of a vehicle according to the first and second embodiments.

Fig. 4 is a schematic block diagram illustrating the configuration of a vehicle assignment management device according to the first embodiment.

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Fig. 5 is a flowchart illustrating an operation of a vehicle according to the first and second embodiments.

Fig. 6 is a flowchart illustrating a vehicle assignment process for large transportation vehicles using a vehicle assignment management device according to the first embodiment.

Fig. 7 is a flowchart illustrating a vehicle assignment process for small transportation vehicles using a vehicle assignment management device according to the first embodiment.

Fig. 8 is a flowchart illustrating a process of notification of a permissible range of a vehicle using a vehicle assignment management device according to the first and second embodiments.

Fig. 9 is a schematic block diagram illustrating the configuration of a vehicle assignment management device according to the second embodiment.

Fig. 10 is a flowchart illustrating a vehicle assignment process for large transportation vehicles using the vehicle assignment management device according to the second embodiment.

Fig. 11 is a flowchart illustrating a vehicle assignment process for a small transportation vehicle using the vehicle assignment management device according to the second embodiment.

Fig. 12 is a flowchart illustrating a transportation management process using the vehicle assignment management device according to the second embodiment.

Fig. 13 is a schematic block diagram illustrating the configuration of a computer according to at least one embodiment.

[Description of Embodiments]

[0017]

<First embodiment>

Hereinafter, embodiments will be described in detail with reference to the drawings.

Fig. 1 is a diagram illustrating an external view of a facility including a mobility
5 system according to a first embodiment.

The mobility system 2 according to the first embodiment is disposed in a waiting facility 1. In other words, the waiting facility 1 according to the first embodiment is one example of a facility including the mobility system 2. A terminal building 11, standby places 12, and a road 13 disposed between the terminal building 11 and the standby places 12 are disposed in the waiting facility 1. The terminal building 11 is a facility in which a passenger to board a transportation machine A performs a procedure. A plurality of gates 111 facing the road 13 are disposed in the terminal building 11. Each gate 111 identifies a name and a flight number of a passenger by authenticating a ticket or the like owned by the passenger. The standby place 12 is a
10 space in which the transportation machine A stands by. Examples of the transportation machine A include a ship, an airplane, and the like. Examples of the waiting facility 1 include a port, an airport, and the like.

In the waiting facility 1, passengers are transported between the terminal building 11 and the standby places 12 using a large transportation vehicle L1 and a small transportation vehicle L2 included in the mobility system 2. The mobility system 2 controls running of the large transportation vehicle L1 and the small transportation vehicle L2. In addition, a gate 111 for the large transportation vehicle L1 and a gate 111 for the small transportation vehicle L2 are disposed in the terminal building 11.

[0018]

25 Fig. 2 is a schematic view illustrating the configuration of a mobility system

according to the first embodiment.

The mobility system 2 includes a plurality of large transportation vehicles L1, a plurality of small transportation vehicles L2, and a vehicle assignment management device 200. Hereinafter, the large transportation vehicles L1 and the small transportation vehicles L2 will be collectively referred to as vehicles L. The mobility system 2 is connected to a boarding management system, which manages the operation of an airport, not illustrated in the drawing, and a gate system, which manages passengers passing through a gate 111 of the terminal building 11, not illustrated in the drawing, through a network.

10 [0019]

Each of the large transportation vehicles L1 and the small transportation vehicles L2 automatically runs on the basis of a route, along which the vehicle will run and a runnable permissible range transmitted from the vehicle assignment management device 200. The permissible range is a range in which the vehicle can run without being in contact with another vehicle L within a predetermined time. The large transportation vehicle L1 allows a passenger to board at a gate 111 determined for each standby place 12 from the vehicle assignment management device 200 among gates 111 of the terminal building 11 and moves to a predetermined standby place 12. The small transportation vehicle L2 allows a passenger to board at a gate 111 designated from the vehicle assignment management device 200 among gates 111 of the terminal building 11 and move to a standby place 12 designated by the passenger. For example, only limited passengers such as priority passengers may be allowed to board the small transportation vehicle L2. It can be identified whether or not a passenger is a passenger who is allowed to board the small transportation vehicle L2, for example, through reading a ticket at the gate 111 or the like.

[0020]

Fig. 3 is a schematic block diagram illustrating the configuration of a vehicle according to the first embodiment.

A vehicle L (a large transportation vehicle L1 and a small transportation vehicle L2) includes an information-receiving unit L01, a position-measuring unit L02, an opening/closing-detecting unit L03, an information-transmitting unit L04, and a running control unit L05.

The information-receiving unit L01 receives information representing a route and a permissible range from the vehicle assignment management device 200.

The position-measuring unit L02 measures a position of the vehicle L. More specifically, the position-measuring unit L02 reads an identifier enabling reading of position information disposed in a passage and measures position information using autonomous navigation using a rotational speed of a vehicle shaft or the like, a global navigation satellite system (GNSS), or the like.

The opening/closing-detecting unit L03 detects opening/closing of doors of the vehicle L.

The information-transmitting unit L04 transmits position information measured by the position-measuring unit L02 and opening/closing information detected by the opening/closing-detecting unit L03 to the vehicle assignment management device 200.

The running control unit L05 performs control such that the vehicle L runs on a route and within a permissible range on the basis of the route and the permissible range received by the information-receiving unit L01 and position information measured by the position-measuring unit L02. For example, the running control unit L05 performs control of steering and a running speed such that the vehicle L runs on a route on the basis of the route. In addition, the running control unit L05 performs control of

acceleration/deceleration of the running speed on the basis of a current position and a speed such that the position of the vehicle L does not exceed the permissible range. The running control unit L05 stops the vehicle L in a case in which the position of the vehicle L exceeds the permissible range.

5 [0021]

The vehicle assignment management device 200 notifies the vehicle L of the route and the permissible range.

Fig. 4 is a schematic block diagram illustrating the configuration of a vehicle assignment management device according to the first embodiment.

10 The vehicle assignment management device 200 includes a transportation machine database 201, a vehicle database 202, a vehicle assignment instruction-receiving unit 203, a number of vehicles-determining unit 204, a first transit point-determining unit 205, a first vehicle-determining unit 206, a second transit point-determining unit 207, a second vehicle-determining unit 208, a gate information-receiving unit 209, a
15 boarding/alighting-determining unit 210, a route notification unit 211, a position-receiving unit 212, and a range notification unit 213.

[0022]

The transportation machine database 201 stores a flight number of a transportation machine A, identification information of a standby place 12 in which the
20 transportation machine A waits, and a gate 111 of the terminal building 11 in which passengers to board the transportation machine A wait together.

The vehicle database 202 stores identification information of a vehicle L, position information of the vehicle L, and a state of the vehicle L (in the middle of waiting, in the middle of picking up, or in the middle of transportation).

25 [0023]

The vehicle assignment instruction-receiving unit 203 receives a vehicle assignment instruction from the boarding management system. A vehicle assignment instruction includes a flight number and a list of passengers. The flight number is one example of information representing a destination. In other words, the vehicle assignment instruction-receiving unit 203 is one example of a destination input unit. In addition, a list of passengers is one example of information representing the number of vehicle occupants. In other words, the vehicle assignment instruction-receiving unit 203 is also one example of a number of vehicle occupants input unit.

[0024]

10 The number of vehicles-determining unit 204 identifies the number of vehicle occupants of the vehicle L from a passenger list included in a vehicle assignment instruction and determines the number of large transportation vehicles L1 to be assigned on the basis of the number of vehicle occupants. For example, the number of vehicles-determining unit 204 can calculate the number of large transportation vehicles L1 by dividing the number of vehicle occupants by a seating capacity of the large transportation vehicle L1 and rounding up a fraction thereof.

20 The first transit point-determining unit 205 reads a gate 111 associated with a flight number included in the vehicle assignment instruction from the transportation machine database 201 and determines this as a transit point of the large transportation vehicle L1.

25 The first vehicle-determining unit 206 determines large transportation vehicles L1, which are in the middle of waiting, are closest to the position of the gate 111 determined by the first transit point-determining unit 205, and correspond to a number determined by the number of vehicles-determining unit 204 as large transportation vehicles L1 (target vehicles) that are vehicle assignment targets by referring to the

vehicle database 202. At this time, the first vehicle-determining unit 206 may determine large transportation vehicles L1 that are vehicle assignment targets on the basis of a runnable distance calculated on the basis of the amount of remaining fuel (or the amount of charging) of each large transportation vehicle L1, the number of times of use of each large transportation vehicle L1, and the like in addition to the position of each large transportation vehicle L1.

[0025]

The second transit point-determining unit 207 determines a gate 111 for small transportation vehicles L2 to which a small transportation vehicle L2 has not been assigned among a plurality of gates 111 (transit point candidates) for small transportation vehicles L2 as a transit point of the small transportation vehicle L2 by referring to the vehicle database 202.

The second vehicle-determining unit 208 determines a small transportation vehicle L2 that is in the middle of waiting and is closest to the position of the gate 111 determined by the second transit point-determining unit 207 as a small transportation vehicle L2 (target vehicle) that is a vehicle assignment target by referring to the vehicle database 202. At this time, the second vehicle-determining unit 208 may determine a small transportation vehicle L2 that is a vehicle assignment target on the basis of a runnable distance calculated on the basis of the amount of remaining fuel (or the amount of charging) of the small transportation vehicle L2, the number of times of use of the small transportation vehicle L2, and the like in addition to the position of the small transportation vehicle L2.

[0026]

The gate information-receiving unit 209 receives a name and a flight number acquired through authentication of a ticket or the like in the gate 111 from the gate

system. The flight number is one example of information representing a destination. In other words, the gate information-receiving unit 209 is one example of a destination input unit.

The boarding/alighting-determining unit 210 receives a signal representing opening/closing of doors from the vehicle L and determines whether or not boarding of a passenger into the vehicle L or alighting of a passenger from the vehicle L has been completed on the basis of the received signal. More specifically, when the vehicle L has arrived at the gate 111, and a signal indicating closing of doors is received from the vehicle L, the boarding/alighting-determining unit 210 determines that boarding of a passenger has been completed. In addition, when the vehicle L has arrived at the standby place 12, and a signal indicating closing of doors is received from the vehicle L, the boarding/alighting-determining unit 210 determines that alighting of a passenger has been completed.

[0027]

The route notification unit 211 notifies the vehicle L of a route along which it will run. More specifically, when the first vehicle-determining unit 206 determines a large transportation vehicle L1 that is a vehicle assignment target, the route notification unit 211 notifies the large transportation vehicle L1 of a route from the current position of the large transportation vehicle L1 to the gate 111 determined by the first transit point-determining unit 205. In addition, when boarding of a passenger for a large transportation vehicle L1 has been completed, the route notification unit 211 notifies the large transportation vehicle L1 of a route from the current position of the large transportation vehicle L1 to a standby place 12 identified using a flight number included in the vehicle assignment instruction. In addition, when the second vehicle-determining unit 208 determines a small transportation vehicle L2 that is a vehicle assignment target,

the route notification unit 211 notifies the small transportation vehicle L2 of a route from the current position of the small transportation vehicle L2 to the gate 111 determined by the second transit point-determining unit 207. In addition, when boarding of a passenger for a small transportation vehicle L2 has been completed, the route notification unit 211 notifies the small transportation vehicle L2 of a route to a standby place 12 identified using a flight number included in information, which is received by gate information-receiving unit 209, authenticated at the gate 111 to which the small transportation vehicle L2 is assigned.

[0028]

10 The position-receiving unit 212 receives position information representing a current position from each vehicle L and updates the vehicle database 202.

 The range notification unit 213 notifies each vehicle L of a permissible range indicating a range in which the vehicle can run without being in contact with other vehicles L. More specifically, the range notification unit 213 calculates a permissible range of each vehicle L in the following order. First, the range notification unit 213 calculates a running range of a case in which each vehicle L runs from the current position at a maximum speed for each vehicle L by referring to the vehicle database 202. Then, the range notification unit 213 calculates a permissible range by excluding a portion overlapping with running ranges of other vehicles L from the running range of the vehicle L for each vehicle L.

[0029]

An operation of a vehicle L according to the first embodiment will be described.

Fig. 5 is a flowchart illustrating an operation of a vehicle according to the first embodiment.

25 When a route is received from the vehicle assignment management device 200,

the vehicle L executes operations represented in a flowchart illustrated in Fig. 5. The information-receiving unit L01 of the vehicle L receives a permissible range from the vehicle assignment management device 200 (Step S001). Next, the position-measuring unit L02 measures a position, a speed, and an advancement direction of the vehicle L (Step S002). The information-transmitting unit L04 transmits the position, the speed, and the advancement direction that have been measured to the vehicle assignment management device 200 (Step S003).

[0030]

In addition, the running control unit L05 controls a speed and steering of the vehicle L on the basis of the position, the speed, and the advancement direction that have been measured by the vehicle L such that the vehicle L runs on a route without coming out from the permissible range (Step S004). For example, the running control unit L05 controls a speed and steering in the following order.

First, the running control unit L05 calculates a timing (a deceleration timing within the range) at which deceleration for stopping the vehicle L at a boundary of the permissible range in the advancement direction will start on the basis of the position, the speed, and the advancement direction of the vehicle L. In a case in which the deceleration timing within the range is before the current time, the vehicle L is decelerated at a speed enabling the vehicle to be stopped at the boundary of the permissible range. On the other hand, in a case in which the deceleration timing within the range is after the current time, the running control unit L05 calculates a timing (a route deceleration timing) at which deceleration needs to start for enabling the vehicle L to make a left run or a right turn in the route or to stop at the end of the route. In a case in which the route deceleration timing is before the current time, the vehicle L is decelerated such that the speed becomes a speed enabling a left turn or a right turn or a

speed enabling stopping. On the other hand, in a case in which the route deceleration timing is after the current time, the running control unit L05 accelerates the speed of the vehicle L to a maximum speed or maintains the speed.

In addition, in a case in which the position of the vehicle L approaches a point of
5 a left turn or a right turn in the route, the running control unit L05 determines whether or not the speed of the vehicle L is a speed enabling a left turn or a right turn. In the case of a speed enabling a left turn or a right turn, the running control unit L05 controls steering in accordance with the route. On the other hand, in the case of a speed not enabling a left turn or a right turn, the running control unit L05 performs control of the
10 speed and the steering of the vehicle L such that the vehicle stops within the permissible range. At this time, the running control unit L05 may perform control of running such that the vehicle avoids an emergency not only on the basis of determination of whether or not the speed is within the permissible range but also using an additional function mounted in the vehicle L. Also in this case, the running of the vehicle L is controlled
15 such that the speed does not depart from the permissible range. In addition, in a case in which the speed of the vehicle L departs from the permissible range, the running control unit L05 stops the vehicle L.

[0031]

The running control unit L05 determines whether or not the vehicle has arrived
20 at the end of the route (the gate 111 or the standby place 12) on the basis of the position of the vehicle L (Step S005). In a case in which the vehicle L has not arrived at the end of the route (Step S005: No), the information-receiving unit L01 determines whether or not a new permissible range has been received from the vehicle assignment management device 200 (Step S006). In a case in which the information-receiving unit L01 has not
25 received a new permissible range from the vehicle assignment management device 200

(Step S006: No), the vehicle L returns the process to Step S002 and continues the control of running. In a case in which the information-receiving unit L01 has received a new permissible range from the vehicle assignment management device 200 (Step S006: Yes), the information-receiving unit L01 updates the permissible range used for controlling running of the vehicle L with the new permissible range (Step S007). Then, the vehicle L returns the process to Step S002 and continues the control of running.

[0032]

On the other hand, in a case in which the vehicle L has arrived at the end of the route (Step S005: Yes), the information-transmitting unit L04 transmits arrival information indicating arrival at the end of the route to the vehicle assignment management device 200 (Step S008) and ends the process.

In this way, the vehicle L can run on the route without coming out from the permissible range. Then, the vehicle assignment management device 200 can recognize whether or not the vehicle L has arrived at the end of the route.

[0033]

Fig. 6 is a flowchart illustrating a vehicle assignment process for a large transportation vehicle using a vehicle assignment management device according to the first embodiment.

When preparation of the transportation machine A is completed, the boarding management system transmits a vehicle assignment instruction for giving an instruction of assignment of a vehicle L for transporting passengers to the transportation machine A to the vehicle assignment management device 200.

When the vehicle assignment instruction-receiving unit 203 of the vehicle assignment management device 200 receives a vehicle assignment instruction from the boarding management system (Step S101), the number of vehicles-determining unit 204

calculates the number of passengers from a list of the passengers included in the received vehicle assignment instruction and determines the number of large transportation vehicles L1 to be assigned on the basis of the calculated number of passengers (Step S102).

5 [0034]

Next, the first transit point-determining unit 205 reads a gate 111 associated with a flight number included in the received vehicle assignment instruction from the transportation machine database 201 and determines the read gate 111 as a transit point (Step S103). The first vehicle-determining unit 206 identifies a position of each large transportation vehicle L1 by referring to the vehicle database 202 (Step S104). The first vehicle-determining unit 206 determines a large transportation vehicle L1 of which a state is “in the middle of waiting” and which is the closest to the gate 111 read by the first transit point-determining unit 205 as a vehicle assignment target (Step S105). At this time, in a case in which a plurality of large transportation vehicles L1 are successively waiting, the first vehicle-determining unit 206 may extract large transportation vehicles L1 corresponding to the number of vehicles to be assigned from the plurality of large transportation vehicles L1 and determine the extracted large transportation vehicles as vehicle assignment targets. Accordingly, variations of times at which the plurality of large transportation vehicles L1 arrive at the gate 111 can be inhibited. When the large transportation vehicle L1 that is a vehicle assignment target is determined, the first vehicle-determining unit 206 rewrites the state of the large transportation vehicle L1 determined as a vehicle assignment target in the vehicle database 202 in “in the middle of picking up”.

As a response to the vehicle assignment instruction received in Step S101, the vehicle assignment instruction-receiving unit 203 notifies the boarding management

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system of identification information of the large transportation vehicle L1 determined by the first vehicle-determining unit 206 (Step S106). The boarding management system determines whether or not all the notified large transportation vehicles L1 have arrived at the standby place 12, whereby omission of boarding for the transportation machine A can be prevented.

[0035]

Next, the route notification unit 211 calculates a route from the current position of each large transportation vehicle L1 that is a vehicle assignment target to the gate 111 of the transit point determined in Step S103 (Step S107). The calculation of the route, for example, is realized using an algorithm such as a Dijkstra method. The route notification unit 211 notifies each large transportation vehicle L1 that is a vehicle assignment target of the calculated route (Step S108). Accordingly, each large transportation vehicle L1 that is a vehicle assignment target starts to run toward the gate 111.

[0036]

Thereafter, the vehicle assignment management device 200 executes the following process for each large transportation vehicle L1 that is a vehicle assignment target in parallel.

[0037]

The boarding/alighting-determining unit 210 determines whether or not arrival information has been received from the large transportation vehicle L1 (Step S109). In a case in which the arrival information has not been received (Step S109: No), the boarding/alighting-determining unit 210 continues to wait for the reception of arrival information according to Step S109. On the other hand, in a case in which the arrival information has been received (Step S109: Yes), the boarding/alighting-determining unit

210 determines whether or not opening/closing information indicating that doors are closed has been received from the large transportation vehicle L1 (Step S110). In a case in which the opening/closing information indicating that the doors are closed has not been received (Step S110: No), the boarding/alighting-determining unit 210 continues to wait for the reception of opening/closing information according to Step S110. On the other hand, in a case in which the opening/closing information indicating that the doors are closed has been received (Step S110: Yes), the boarding/alighting-determining unit 210 determines that boarding for the large transportation vehicle L1 has been completed (Step S111). At this time, the boarding/alighting-determining unit 210 changes the state of the large transportation vehicle L1 in the vehicle database 202 to “in the middle of transportation”.

[0038]

When boarding into the large transportation vehicle L1 is completed, the route notification unit 211 reads a standby place 12 associated with a flight number included in the vehicle assignment instruction from the transportation machine database 201 (Step S112). Next, the route notification unit 211 calculates a route from the current position of the large transportation vehicle L1 to the read standby place 12 (Step S113). The route notification unit 211 notifies the large transportation vehicle L1 of the calculated route (Step S114). Accordingly, the large transportation vehicle L1 into which boarding of passengers has been completed starts to run toward the standby place 12.

[0039]

Next, the boarding/alighting-determining unit 210 determines whether or not arrival information has been received from the large transportation vehicle L1 (Step S115). In a case in which the arrival information has not been received (Step S115: No), the boarding/alighting-determining unit 210 continues to wait for the reception of arrival

information according to Step S115. On the other hand, in a case in which the arrival information has been received (Step S115: Yes), the boarding/alighting-determining unit 210 determines whether or not opening/closing information indicating closing of doors has been received from the large transportation vehicle L1 (Step S116). In a case in which the opening/closing information indicating closing of doors has not been received (Step S116: No), the boarding/alighting-determining unit 210 continues to wait for the reception of the opening/closing information according to Step S116. On the other hand, in a case in which the opening/closing information indicating closing of doors has been received (Step S116: Yes), the boarding/alighting-determining unit 210 determines that alighting from the large transportation vehicle L1 has been completed (Step S117). At this time, the boarding/alighting-determining unit 210 changes the state of the large transportation vehicle L1 in the vehicle database 202 to “in the middle of waiting”.

In this way, the vehicle assignment management device 200 can control the running of the large transportation vehicle L1 on the basis of the vehicle assignment instruction such that passengers are caused to board at the gate 111, and the passengers are caused to alight at the standby place 12.

[0040]

Fig. 7 is a flowchart illustrating a vehicle assignment process for a small transportation vehicle using the vehicle assignment management device according to the first embodiment.

The vehicle assignment management device 200 regularly executes a vehicle assignment process for small transportation vehicles L2 toward the gate 111 illustrated in Fig. 7. The second transit point-determining unit 207 of the vehicle assignment management device 200 determines the presence/absence of a vacant gate 111 to which no small transportation vehicle L2 has been assigned among gates 111 for small

transportation vehicles L2 by referring to the vehicle database 202 (Step S201). In a case in which there is no vacant gate 111, in other words, in a case in which small transportation vehicles L2 are assigned to all the gates 111 for small transportation vehicles L2 (Step S201: No), the vehicle assignment management device 200 ends the vehicle assignment process for the small transportation vehicle L2 toward the gate 111. In addition, the vehicle assignment management device 200 executes the vehicle assignment process illustrated in Fig. 7 again after the elapse of a predetermined time.

[0041]

On the other hand, in a case in which there is a vacant gate 111 (Step S201: Yes), the second transit point-determining unit 207 determines the gate 111 as a transit point (Step S202). The second vehicle-determining unit 208 identifies a position of each small transportation vehicle L2 by referring to the vehicle database 202 (Step S203). The second vehicle-determining unit 208 determines a small transportation vehicle L2 of which a state is “in the middle of waiting” and which is the closest to the gate 111 read by the second transit point-determining unit 207 as a vehicle assignment target (Step S204). When the small transportation vehicle L2 that is a vehicle assignment target is determined, the second vehicle-determining unit 208 rewrites the state of the small transportation vehicle L2 determined as a vehicle assignment target in the vehicle database 202 in “in the middle of picking up”.

[0042]

Next, the route notification unit 211 calculates a route from the current position of the small transportation vehicle L2 that is a vehicle assignment target to the gate 111 of the transit point determined in Step S202 (Step S205). The route notification unit 211 notifies the small transportation vehicle L2 that is a vehicle assignment target of the calculated route (Step S206). Accordingly, the small transportation vehicle L2 that is a

vehicle assignment target starts to run toward the gate 111.

[0043]

Next, the boarding/alighting-determining unit 210 determines whether or not arrival information has been received from the small transportation vehicle L2 (Step S207). In a case in which the arrival information has not been received (Step S207: No), the boarding/alighting-determining unit 210 continues to wait for the reception of arrival information according to Step S207. On the other hand, in a case in which the arrival information has been received (Step S207: Yes), the boarding/alighting-determining unit 210 determines whether or not opening/closing information indicating that doors are closed has been received from the small transportation vehicle L2 (Step S208). In a case in which the opening/closing information indicating that the doors are closed has not been received (Step S208: No), the boarding/alighting-determining unit 210 continues to wait for the reception of opening/closing information according to Step S208. On the other hand, in a case in which the opening/closing information indicating that the doors are closed has been received (Step S208: Yes), the boarding/alighting-determining unit 210 determines that boarding for the small transportation vehicle L2 has been completed (Step S209). At this time, the boarding/alighting-determining unit 210 changes the state of the small transportation vehicle L2 in the vehicle database 202 to “in the middle of transportation”. Next, the gate information-receiving unit 209 receives names of passengers authenticated at the gate 111 to which the small transportation vehicle L2 has been distributed and a flight number from the gate system (Step S210). Although one passenger or a plurality of passengers may board the small transportation vehicle L2, each passenger is assumed to be boarded in the same transportation machine A. In other words, in a case in which a plurality of passengers are boarded, the flight numbers of the transportation machines A in which the passengers are boarded are the same.

[0044]

Next, the route notification unit 211 reads a standby place 12 associated with the flight number received in Step S210 from the transportation machine database 201 (Step S211). Next, the route notification unit 211 calculates a route from the current position of the small transportation vehicle L2 to the read standby place 12 (Step S212). The route notification unit 211 notifies the small transportation vehicle L2 of the calculated route (Step S213). Accordingly, the small transportation vehicle L2 into which boarding of passengers has been completed starts to run toward the standby place 12.

[0045]

Next, the boarding/alighting-determining unit 210 determines whether or not arrival information has been received from the small transportation vehicle L2 (Step S214). In a case in which the arrival information has not been received (Step S214: No), the boarding/alighting-determining unit 210 continues to wait for the reception of arrival information according to Step S214. On the other hand, in a case in which the arrival information has been received (Step S214: Yes), the boarding/alighting-determining unit 210 determines whether or not opening/closing information indicating closing of doors has been received from the small transportation vehicle L2 (Step S215). In a case in which the opening/closing information indicating closing of doors has not been received (Step S215: No), the boarding/alighting-determining unit 210 continues to wait for the reception of the opening/closing information according to Step S116. On the other hand, in a case in which the opening/closing information indicating closing of doors has been received (Step S215: Yes), the boarding/alighting-determining unit 210 determines that alighting from the small transportation vehicle L2 has been completed (Step S216). At this time, the boarding/alighting-determining unit 210 changes the state of the small transportation vehicle L2 in the vehicle database 202 to “in the middle of waiting”.

In this way, the vehicle assignment management device 200 can assign the small transportation vehicle L2 to the gate 111 to which the small transportation vehicle L2 has not been assigned and can cause the small transportation vehicle L2 to transport passengers to a standby place 12 corresponding to the passengers.

5 [0046]

Although the vehicle assignment control relating to Fig. 6 and 7 is vehicle assignment control when passengers are allowed to board the vehicle L at the gate 111, and the passengers are allowed to alight at the standby place 12, in other words, vehicle assignment control when the transportation machine A departs, the vehicle assignment
10 management device 200 performs similar vehicle assignment control also when the transportation machine A arrives. In such a case, the vehicle assignment management device 200 sets the standby place 12 to a transit point and sets the gate 111 to a destination.

[0047]

15 Fig. 8 is a flowchart illustrating a process of notification of a permissible range of a vehicle using a vehicle assignment management device according to the first embodiment.

The vehicle assignment management device 200 updates a permissible range of each vehicle L and gives a notification thereof at predetermined time intervals (for
20 example, at every 10 seconds). The position-receiving unit 212 of the vehicle assignment management device 200 receives a position, a speed, and an advancement direction from each vehicle L (Step S301). Next, the range notification unit 213, for each vehicle L, calculates a running range in a case in which the vehicle runs from a current position at a maximum speed for a predetermined time (Step S302). Next, the
25 range notification unit 213 selects one vehicle from among a plurality of vehicles L at

each time and executes processes of Steps S304 and S305 represented below for each vehicle (Step S303). The range notification unit 213, for the selected vehicle L, calculates a range acquired by excluding a portion overlapping with the running ranges of the other vehicles L from a running range of the vehicle L. The range notification unit
5 213 determines the range as a permissible range of the selected vehicle L (Step S304). Then, the range notification unit 213 notifies the vehicle L of the permissible range (Step S305).

In this way, a permissible range in which a vehicle can run without being in contact with the other vehicles L can be notified to the vehicle L for every predetermined
10 time.

[0048]

As above, according to the first embodiment, the vehicle assignment management device 200 notifies a vehicle L that is a vehicle assignment target of a route along which the vehicle needs to run, receives position information from each of a
15 plurality of vehicles L for every predetermined time, and notifies at least the vehicle L that is a vehicle assignment target of a permissible range representing a runnable range of the vehicle L on the basis of the received position information. Accordingly, by running on the basis of the permissible range, the vehicle L can run with a contact with the other vehicles L prevented. In addition, by running on the basis of the route, the vehicle L
20 can reliably run toward a destination. In other words, the vehicle assignment management device 200 according to the first embodiment can cause the vehicle L to run along a route along which the vehicle L needs to run safely and reliably. In addition, according to the first embodiment, although the vehicle assignment management device 200 notifies all the vehicles L of the permissible range illustrated in Fig. 8, the
25 configuration is not limited thereto. For example, in another embodiment, in a case in

which vehicles L that are not vehicle assignment targets (vehicles L that are in the middle of waiting) necessarily stop, the vehicle assignment management device 200 may identify vehicles that are vehicle assignment targets among a plurality of vehicles L (vehicles that are not in the middle of waiting) and notify only the vehicles of the
5 permissible ranges.

In addition, in another embodiment, the permissible range may not necessarily be notified for every predetermined time. In other words, the notification of a permissible range may not necessarily be periodical, as long as it is performed at a plurality of timings. Furthermore, in another embodiment, the position information of a
10 vehicle L may not necessarily be notified every predetermined time. In other words, the notification of position information may not necessarily be periodical as long as it is performed at a plurality of timings.

[0049]

In addition, according to the first embodiment, the vehicle assignment
15 management device 200 accepts an input of a flight number of the transportation machine A in which a passenger is boarded from the boarding management system and determines a target vehicle among a plurality of large transportation vehicles L1 on the basis of the input. In this way, the vehicle assignment management device 200 may assign large transportation vehicles L1 in association with the transportation machine A. In addition,
20 the vehicle assignment management device 200 determines the number of large transportation vehicles L1 to be assigned on the basis of the number of passengers to be transported to a destination. In this way, the vehicle assignment management device 200 can assign large transportation vehicles L1 corresponding to a number for the number of passengers of the transportation machine A without excess or deficiency. In
25 addition, when a large transportation vehicle L1 that is a vehicle assignment target is

determined, the vehicle assignment management device 200 notifies the large transportation vehicle L1 of a route toward a transit point and notifies the large transportation vehicle L1 of a route toward a destination when boarding into the large transportation vehicle L1 has been completed. In this way, when the transportation machine A departs, the vehicle assignment management device 200 can allow passengers to board at the gate 111 and alight at the standby place 12. In addition, when the transportation machine A arrives, the vehicle assignment management device 200 can allow passengers to board at the standby place 12 and to alight at the gate 111.

[0050]

In addition, according to the first embodiment, the vehicle assignment management device 200 determines a gate 111 to which a small transportation vehicle L2 is to be assigned among a plurality of gates 111 for small transportation vehicles L2 and determines a small transportation vehicle L2 that is a vehicle assignment target among a plurality of small transportation vehicles L2 on the basis of the gate 111. In this way, the vehicle assignment management device 200 can assign a small transportation vehicle L2 to a vacant gate 111. In addition, the vehicle assignment management device 200 receives a flight number of the transportation machine A in which passengers who have got on the small transportation vehicle L2 at the gate 111 are boarded and notifies the small transportation vehicle L2 of a route toward a standby place 12 associated with the flight number when the boarding for the small transportation vehicle L2 is completed. In this way, the vehicle assignment management device 200 can transport passengers to the standby place 12 of the transportation machine A in which the passengers are boarded using the small transportation vehicle L2.

[0051]

In addition, according to the first embodiment, when the vehicle L arrives at the

transit point, and doors of the vehicle L are closed, the vehicle assignment management device 200 determines that boarding for the vehicle L has been completed. In this way, the completion of boarding of passengers can be notified to the vehicle assignment management device 200 without a vehicle occupant of the vehicle L executing a special process. In addition, in another embodiment, the configuration is not limited thereto, and, for example, by a vehicle occupant pressing a button, not illustrated in the drawing, when all the passengers board, the completion of boarding may be notified to the vehicle assignment management device 200.

[0052]

10 As above, while one embodiment has been described in detail with reference to the drawings, a specific configuration is not limited to that described above, and various design changes, and the like can be performed.

For example, according to the first embodiment, although the mobility system 2 includes both large transportation vehicles L1 and small transportation vehicles L2, a mobility system 2 according to another embodiment may not include large transportation vehicles L1. In such a case, the mobility system 2 transports all the passengers between the gate 111 and the standby place 12 using the small transportation vehicles L2.

In addition, a mobility system 2 according to another embodiment may not include small transportation vehicles L2. In such a case, the mobility system 2 transports all the passengers between the gate 111 and the standby place 12 using the large transportation vehicles L1.

[0053]

In addition, according to the first embodiment, although the mobility system 2 is applied to the transportation of passengers of the waiting facility 1, the application is not limited thereto. For example, in another embodiment, the mobility system 2 may be

applied to a city traffic system using buses and taxis, a transportation system inside a factory, and the like. In other words, in another embodiment, a destination and a transit point may not be the standby place 12 and the gate 111, and vehicle occupants boarding the vehicle L may not be the passengers of the transportation machine A.

5 <Second embodiment>

[0054]

This embodiment is similar to the mobility system 2 according to the first embodiment except for cases that are particularly described below.

[0055]

10 Fig. 9 is a schematic block diagram illustrating the configuration of a vehicle assignment management device according to a second embodiment.

The vehicle assignment management device 200' includes a transportation machine database 201, a vehicle database 202, a vehicle assignment instruction-receiving unit 203, a number of vehicles-determining unit 204, a first transit point-determining unit 205, a first vehicle-determining unit 206, a second transit point-determining unit 207, a second vehicle-determining unit 208, a gate information-receiving unit 209, a boarding/alighting-determining unit 210, a route notification unit 211, a position-receiving unit 212, a range notification unit 213, a boarding database 214, a permission unit 215, a vehicle arrival-determining unit 216, and a passenger arrival-determining unit 217.

[0056]

The boarding database 214 stores a flight number of a transportation machine A, a passenger boarding into the transportation machine A, a boarding flag indicating whether or not the passenger gets on a vehicle L, an arrival flag indicating whether or not the passenger has arrived at a standby place 12 together. "1" is set in the boarding flag

when the passenger passes through the gate 111, and “0” is set therein when the passenger has not passed through the gate 111. “1” is set in the arrival flag when a vehicle L loaded with a passenger arrives at the standby place 12, and “0” is set when the vehicle L does not arrive at the standby place 12.

5 In addition, the boarding database 214 sets the boarding flag on the basis of a name and a flight number received by the gate information-receiving unit 209 from a gate system. In other words, the boarding database 214 sets “1” in the boarding flag recorded in the boarding database 214 in association with a name and a flight number received by the gate information-receiving unit 209. Here, the flight number is one
10 example of information representing a destination. In other words, the gate information-receiving unit 209 is one example of a destination-identifying unit. In addition, the vehicle L stops along the gate 111, and a staff of a waiting facility 1 guides a passenger to board the vehicle L stopping at the gate 111, and accordingly, it is assumed that the passenger who has passed through the gate 111 necessarily gets on the vehicle L.
15 [0057]

 The permission unit 215 determines whether or not all the boarding flags recorded in the boarding database 214 in association with the flight number of the transportation machine A included in a vehicle assignment instruction represent “1”. This is equal to the permission unit 215 determining whether or not a total number of
20 passengers boarding the vehicle L and a total number of passengers to board the transportation machine A coincide with each other. In other words, the permission unit 215 is one example of a total number-determining unit. In a case in which the total number of passengers boarding the vehicle L and the total number of passengers to board the transportation machine A coincide with each other, the permission unit 215 outputs a
25 departure permission signal used for allowing departure of a large transportation vehicle

L1 assigned on the basis of the vehicle assignment instruction. The permission unit 215 may output a departure permission signal to either the large transportation vehicle L1 or a computer disposed at the gate 111 at which the large transportation vehicle L1 is stopping. At the gate 111 at which the large transportation vehicle L1 is parked, departure (door

5 closing) of the large transportation vehicle L1 is not allowed until a departure permission signal is received. Accordingly, omission of transportation of passengers can be prevented.

[0058]

The vehicle arrival-determining unit 216 receives arrival information indicating

10 arrival at the end of a route from the vehicle L and determines whether or not the vehicle L has arrived at the gate 111 or the standby place 12 on the basis of the arrival information. In a case in which it is determined that the vehicle L has arrived at the standby place 12, the vehicle arrival-determining unit 216 rewrites the arrival flag of the boarding database 214. More specifically, in a case in which all the large transportation

15 vehicles L1 determined as vehicle assignment targets by the first vehicle-determining unit 206 on the basis of the vehicle assignment instruction have arrived at the standby place 12, the vehicle arrival-determining unit 216 sets “1” in the arrival flag associated with each passenger detected at the gate 111 determined as a transit point of the large transportation vehicle L1. In addition, when a small transportation vehicle L2 arrives at

20 the standby place 12, the vehicle arrival-determining unit 216 sets “1” in the arrival flag associated with a passenger detected at the gate 111 to which the small transportation vehicle L2 is assigned.

[0059]

The passenger arrival-determining unit 217, for the transportation machine A in

25 which arrival flags associated with all the passengers are set to “1”, determines that all

the passengers to be boarded on the transportation machine A have arrived at the standby place 12 at which the transportation machine A is waiting by referring to the boarding database 214. In a case in which it is determined that all the passengers to be boarded on the transportation machine A have arrived at the standby place 12 at which the transportation machine A is waiting, the passenger arrival-determining unit 217 transmits a departure permission signal indicating permission for the departure of the transportation machine A to the boarding management system.

[0060]

Fig. 10 is a flowchart illustrating a vehicle assignment process for large transportation vehicles using a vehicle assignment management device according to the second embodiment.

When preparation of the transportation machine A is completed, the boarding management system transmits a vehicle assignment instruction for giving an instruction of assignment of a vehicle L for transporting passengers to the transportation machine A to the vehicle assignment management device 200'. A specific destination according to this embodiment is a standby place 12 at which the transportation machine A included in a vehicle assignment instruction is waiting.

When the vehicle assignment instruction-receiving unit 203 of the vehicle assignment management device 200' receives a vehicle assignment instruction from the boarding management system (Step S101'), the number of vehicles-determining unit 204 calculates the number of passengers from a list of the passengers included in the received vehicle assignment instruction and determines the number of large transportation vehicles L1 to be assigned on the basis of the calculated number of passengers (Step S102'). In addition, at this time, the vehicle assignment instruction-receiving unit 203 registers a combination of a flight number and passengers included in the received

vehicle assignment instruction in the boarding database 214 (Step S103'). At this time, the vehicle assignment instruction-receiving unit 203 sets "0" in the boarding flag and the arrival flag.

[0061]

5 Next, the first transit point-determining unit 205 reads a gate 111 associated with a flight number included in the received vehicle assignment instruction from the transportation machine database 201 and determines the read gate 111 as a transit point (Step S104'). The first vehicle-determining unit 206 identifies a position of each large transportation vehicle L1 by referring to the vehicle database 202 (Step S105'). The

10 first vehicle-determining unit 206 determines a large transportation vehicle L1 of which a state is "in the middle of waiting" and which is the closest to the gate 111 read by the first transit point-determining unit 205 as a vehicle assignment target (Step S106'). At this time, in a case in which a plurality of large transportation vehicles L1 are successively waiting, the first vehicle-determining unit 206 may extract large transportation vehicles

15 L1 corresponding to the number of vehicles to be assigned from the plurality of large transportation vehicles L1 and determine the extracted large transportation vehicles as vehicle assignment targets. Accordingly, variations of times at which the plurality of large transportation vehicles L1 arrive at the gate 111 can be inhibited. When the large transportation vehicle L1 that is a vehicle assignment target is determined, the first

20 vehicle-determining unit 206 rewrites the state of the large transportation vehicle L1 determined as a vehicle assignment target in the vehicle database 202 in "in the middle of picking up".

As a response to the vehicle assignment instruction received in Step S101, the vehicle assignment instruction-receiving unit 203 notifies the boarding management

25 system of identification information of the large transportation vehicle L1 determined by

the first vehicle-determining unit 206 (Step S107'). The boarding management system determines whether or not all the notified large transportation vehicles L1 have arrived at the standby place 12, whereby omission of boarding for the transportation machine A can be prevented.

5 [0062]

Next, the route notification unit 211 calculates a route from the current position of each large transportation vehicle L1 that is a vehicle assignment target to the gate 111 of the transit point determined in Step S104 (Step S108'). The calculation of the route, for example, is realized using an algorithm such as a Dijkstra method. The route notification unit 211 notifies each large transportation vehicle L1 that is a vehicle assignment target of the calculated route (Step S109'). Accordingly, each large transportation vehicle L1 that is a vehicle assignment target starts to run toward the gate 111.

[0063]

15 Thereafter, the vehicle assignment management device 200' executes the following process for each large transportation vehicle L1 that is a vehicle assignment target in parallel.

[0064]

The vehicle arrival-determining unit 216 determines whether or not arrival information has been received from the large transportation vehicle L1 (Step S110'). In a case in which the arrival information has not been received (Step S110': No), the vehicle arrival-determining unit 216 continues to wait for the reception of arrival information according to Step S110'. On the other hand, in a case in which the arrival information has been received (Step S110': Yes), the gate information-receiving unit 209 receives a name of a passenger who has passed the gate 111 determined as a transit point

20

25

by the first transit point-determining unit 205 and a flight number (gate information) from the gate system (Step S111'). The gate information-receiving unit 209 sets "1" in the boarding flag recorded in the boarding database 214 in association with the name and the flight number that have been received (Step S112'). Next, the

5 boarding/alighting-determining unit 210 determines whether or not opening/closing information indicating that doors are closed has been received from the large transportation vehicle L1 (Step S113'). In a case in which the opening/closing information indicating that the doors are closed has not been received (Step S113': No), the boarding/alighting-determining unit 210 continues to wait for the reception of

10 opening/closing information according to Step S113'. On the other hand, in a case in which the opening/closing information indicating that the doors are closed has been received (Step S113': Yes), the boarding/alighting-determining unit 210 determines that boarding for the large transportation vehicle L1 has been completed (Step S114'). At this time, the boarding/alighting-determining unit 210 changes the state of the large

15 transportation vehicle L1 in the vehicle database 202 to "in the middle of transportation".

[0065]

When boarding into the large transportation vehicle L1 is completed, the route notification unit 211 reads a standby place 12 associated with a flight number included in the vehicle assignment instruction from the transportation machine database 201 (Step

20 S115'). Next, the route notification unit 211 calculates a route from the current position of the large transportation vehicle L1 to the read standby place 12 (Step S116'). The route notification unit 211 notifies the large transportation vehicle L1 of the calculated route (Step S117'). In addition, the large transportation vehicle L1 continues the waiting at the gate 111 until a permission signal is output from the vehicle assignment

25 management device 200 in the following Step S119'.

[0066]

The permission unit 215 determines whether or not all the boarding flags 1 associated with the passengers registered in Step S103' are "1" by referring to the boarding database 214 (Step S118'). In other words, the permission unit 215
 5 determines whether or not all the passengers to board one transportation machine A has got on one vehicle L. In a case in which boarding flags associated with any one passenger is "0" (Step S118': No), the permission unit 215 repeats the determination of Step S115'. On the other hand, in a case in which all the boarding flags associated with the passengers are "1" (Step S118': Yes), the permission unit 215 outputs a permission
 10 signal indicating a permission of departure of the large transportation vehicle L1 determined as the vehicle assignment target in Step S106' (Step S119'). Accordingly, the large transportation vehicle L1 for which the boarding of the passengers has been completed starts to run toward the standby place 12.

[0067]

15 Next, the vehicle arrival-determining unit 216 determines whether or not arrival information has been received from the large transportation vehicle L1 (Step S120'). In a case in which the arrival information has not been received (Step S120: No), the vehicle arrival-determining unit 216 continues to wait for the reception of arrival information according to Step S120'. On the other hand, in a case in which the arrival
 20 information has been received (Step S120: Yes), the boarding/alighting-determining unit 210 determines whether or not opening/closing information indicating closing of doors has been received from the large transportation vehicle L1 (Step S121'). In a case in which the opening/closing information indicating closing of doors has not been received (Step S121: No), the boarding/alighting-determining unit 210 continues to wait for the
 25 reception of the opening/closing information according to Step S121'. On the other

hand, in a case in which the opening/closing information indicating closing of doors has been received (Step S121': Yes), the boarding/alighting-determining unit 210 determines that alighting from the large transportation vehicle L1 has been completed (Step S122').

At this time, the boarding/alighting-determining unit 210 changes the state of the large transportation vehicle L1 in the vehicle database 202 to "in the middle of waiting".

[0068]

Next, the vehicle arrival-determining unit 216 determines whether or not all the large transportation vehicles L1 determined as vehicle assignment targets by the first vehicle-determining unit 206 in Step S106' have arrived at the standby place 12 (Step S123'). In a case in which there is a large transportation vehicle that has not arrived at the standby place 12 among the large transportation vehicles L1 that are the vehicle assignment targets (Step S123': No), the vehicle arrival-determining unit 216 executes the determination of Step S123' again.

[0069]

On the other hand, In a case in which all the large transportation vehicles L1 that are the vehicle assignment targets have arrived at the standby place 12 (Step S123': Yes), the arrival flag associated with each passenger of which the boarding flag has been updated in Step S112 is set to "1" (Step S124'). The reason for this is that a case in which all the passengers who have passed through the gate 111 board several large transportation vehicles L1, and all the large transportation vehicles L1 have arrived at the standby place 12 is equal to a case in which all the passengers have arrived at the standby place 12. In other words, the vehicle arrival-determining unit 216 can determine whether or not all the passengers passing through the gate 111 have arrived at the standby place 12 without identifying one large transportation vehicle L1 on which each passenger passing through the gate 111 gets.

[0070]

In this way, the vehicle assignment management device 200' can control the running of the large transportation vehicle L1 on the basis of the vehicle assignment instruction such that passengers are caused to board at the gate 111, and the passengers
5 are caused to alight at the standby place 12. In addition, in this way, the vehicle assignment management device 200' can appropriately reflect states of the passengers boarding the large transportation vehicle L1 on the boarding database 214.

[0071]

Fig. 11 is a flowchart illustrating a vehicle assignment process for a small
10 transportation vehicle using the vehicle assignment management device according to the second embodiment.

The vehicle assignment management device 200' regularly executes a vehicle assignment process for small transportation vehicles L2 toward a gate 111 illustrated in Fig. 11. The second transit point-determining unit 207 of the vehicle assignment
15 management device 200' determines the presence/absence of a vacant gate 111 to which no small transportation vehicle L2 has been assigned among gates 111 for small transportation vehicles L2 by referring to the vehicle database 202 (Step S201'). In a case in which there is no vacant gate 111, in other words, in a case in which small transportation vehicles L2 are assigned to all the gates 111 for small transportation
20 vehicles L2 (Step S201': No), the vehicle assignment management device 200 ends the vehicle assignment process for the small transportation vehicle L2 toward the gate 111. In addition, the vehicle assignment management device 200' executes the vehicle assignment process illustrated in Fig. 11 again after the elapse of a predetermined time.

[0072]

25 On the other hand, in a case in which there is a vacant gate 111 (Step S201':

Yes), the second transit point-determining unit 207 determines the gate 111 as a transit point (Step S202'). The second vehicle-determining unit 208 identifies a position of each small transportation vehicle L2 by referring to the vehicle database 202 (Step S203'). The second vehicle-determining unit 208 determines a small transportation vehicle L2 of which a state is "in the middle of waiting" and which is the closest to the gate 111 read by the second transit point-determining unit 207 as a vehicle assignment target (Step S204'). When the small transportation vehicle L2 that is a vehicle assignment target is determined, the second vehicle-determining unit 208 rewrites the state of the small transportation vehicle L2 determined as a vehicle assignment target in the vehicle database 202 in "in the middle of picking up".

[0073]

Next, the route notification unit 211 calculates a route from the current position of the small transportation vehicle L2 that is a vehicle assignment target to the gate 111 of the transit point determined in Step S202' (Step S205'). The route notification unit 211 notifies the small transportation vehicle L2 that is a vehicle assignment target of the calculated route (Step S206'). Accordingly, the small transportation vehicle L2 that is a vehicle assignment target starts to run toward the gate 111.

[0074]

Next, the vehicle arrival-determining unit 216 determines whether or not arrival information has been received from the small transportation vehicle L2 (Step S207'). In a case in which the arrival information has not been received (Step S207': No), the vehicle arrival-determining unit 216 continues to wait for the reception of arrival information according to Step S207'. On the other hand, in a case in which the arrival information has been received (Step S207': Yes), the boarding/alighting-determining unit 210 determines whether or not opening/closing information indicating that doors are

closed has been received from the small transportation vehicle L2 (Step S208'). In a case in which the opening/closing information indicating that the doors are closed has not been received (Step S208': No), the boarding/alighting-determining unit 210 continues to wait for the reception of opening/closing information according to Step S208'. On the other hand, in a case in which the opening/closing information indicating that the doors are closed has been received (Step S208': Yes), the boarding/alighting-determining unit 210 determines that boarding for the small transportation vehicle L2 has been completed (Step S209'). At this time, the boarding/alighting-determining unit 210 changes the state of the small transportation vehicle L2 in the vehicle database 202 to "in the middle of transportation". Next, the gate information-receiving unit 209 receives names of passengers authenticated at the gate 111 to which the small transportation vehicle L2 has been distributed and a flight number from the gate system (Step S210'). The gate information-receiving unit 209 sets "1" in the boarding flag recorded in the boarding database 214 in association with names and a flight number that have been received (Step S211'). Although one passenger or a plurality of passengers may board the small transportation vehicle L2, each passenger is assumed to be boarded in the same transportation machine A. In other words, in a case in which a plurality of passengers are boarded, the flight numbers of the transportation machines A in which the passengers are boarded are the same.

20 [0075]

Next, the route notification unit 211 reads a standby place 12 associated with the flight number received in Step S210' from the transportation machine database 201 (Step S212'). Next, the route notification unit 211 calculates a route from the current position of the small transportation vehicle L2 to the read standby place 12 (Step S213'). The route notification unit 211 notifies the small transportation vehicle L2 of the calculated

route (Step S214'). Accordingly, the small transportation vehicle L2 into which boarding of passengers has been completed starts to run toward the standby place 12.

[0076]

Next, the vehicle arrival-determining unit 216 determines whether or not arrival
 5 information has been received from the small transportation vehicle L2 (Step S215'). In
 a case in which the arrival information has not been received (Step S215': No), the
 vehicle arrival-determining unit 216 continues to wait for the reception of arrival
 information according to Step S215'. On the other hand, in a case in which the arrival
 information has been received (Step S215': Yes), the boarding/alighting-determining unit
 10 210 determines whether or not opening/closing information indicating closing of doors
 has been received from the small transportation vehicle L2 (Step S216'). In a case in
 which the opening/closing information indicating closing of doors has not been received
 (Step S216': No), the boarding/alighting-determining unit 210 continues to wait for the
 reception of the opening/closing information according to Step S216'. On the other
 15 hand, in a case in which the opening/closing information indicating closing of doors has
 been received (Step S216': Yes), the boarding/alighting-determining unit 210 determines
 that alighting from the small transportation vehicle L2 has been completed (Step S217').
 At this time, the boarding/alighting-determining unit 210 changes the state of the small
 transportation vehicle L2 in the vehicle database 202 to "in the middle of waiting".
 20 Then, the vehicle arrival-determining unit 216' sets "1" in the arrival flag recorded in the
 boarding database 214 in association with the name included in the gate information
 received in Step S210' (Step S218').

Accordingly, the vehicle assignment management device 200' can assign the
 small transportation vehicle L2 to a gate 111 to which no small transportation vehicle L2
 25 has been assigned and can transport passengers to a standby place 12 according to the

passengers using the small transportation vehicle L2. In addition, in this way, the vehicle assignment management device 200' can appropriately reflect the states of the passengers boarding the small transportation vehicle L2 on the boarding database 214.

[0077]

5 Fig. 12 is a flowchart illustrating a transportation management process using the vehicle assignment management device according to the second embodiment. The vehicle assignment management device 200' executes the transportation management process illustrated in Fig. 12 for every predetermined time.

 The passenger arrival-determining unit 217 selects one transportation machine a

10 from among the transportation machines A before departure recorded in the boarding database 214 at each time and executes processes of Steps S402 and S405 represented below for the selected transportation machine A (Step S401).

[0078]

 First, the passenger arrival-determining unit 217 determines whether or not

15 arrival flags for all the passengers recorded in the boarding database 214 in association with the selected transportation machine A are set to "1" (Step S402). In a case in which an arrival flag for any one passenger associated with the selected transportation machine A is "0" (Step S402: No), the passenger arrival-determining unit 217 determines that there is a passenger who has not arrived at the standby place 12 (Step S403).

20 [0079]

 On the other hand, in a case in which the arrival flags for all the passengers recorded in the boarding database 214 in association with the selected transportation machine A are set to "1" (Step S402: Yes), the passenger arrival-determining unit 217 determines that all the passengers to board the selected transportation machine A have

25 arrived at the standby place 12 (Step S404). Then, the passenger arrival-determining

unit 217 outputs a departure permission signal used for permitting departure of the selected transportation machine A to the boarding management system (Step S405).

[0080]

In this way, the vehicle assignment management device 200' can check that
5 there is no omission of transportation of passengers to board the transportation machine A and permit departure of the transportation machine A.

[0081]

In this way, according to the second embodiment, in a case in which a total number of passengers boarding a vehicle L that is determined to have arrived at a certain
10 standby place 12 is the same as a total number of passengers to arrive at the standby place 12, the vehicle assignment management device 200' determines that all the passengers to arrive at the standby place 12 have arrived at the standby place 12. Accordingly, the vehicle assignment management device 200' can appropriately determine whether or not passengers passing through the gate 111 have arrived at any
15 one standby place 12.

[0082]

In addition, according to the second embodiment, in a case in which a total number of passengers boarding the large transportation vehicle L1 and passengers boarding the small transportation vehicle L2 is the same as a total number of passengers
20 to arrive at the standby place 12, a departure permission signal used for permitting departure of the large transportation vehicle L1 stopping at the gate 111 for large transportation vehicles L1 is output. Accordingly, the vehicle assignment management device 200' can prevent an occurrence of omission of transportation of passengers according to departure of the large transportation vehicle L1 in spite of a passenger not
25 boarding the large transportation vehicle L1 being present.

[0083]

In addition, according to the second embodiment, the vehicle assignment management device 200' notifies a vehicle L that is a vehicle assignment target of a route along which the vehicle will run, receives position information from each of a plurality of vehicles L for every predetermined time, and notifies at least the vehicle L that is the assignment target of a permissible range indicating a range in which the vehicle L can run on the basis of the received position information. In this way, by running on the basis of the permissible range, the vehicle L can run with a contact with the other vehicles L prevented. In addition, by running on the basis of the route, the vehicle L can reliably run toward a destination. In other words, the vehicle assignment management device 200' according to the second embodiment can cause the vehicle L to run along a route along which the vehicle will run safely and reliably. In addition, in the second embodiment, although the vehicle assignment management device 200' notifies all the vehicles of the permissible range illustrated in Fig. 8, the notification is not limited thereto. For example, in another embodiment, in a case in which a vehicle L (a vehicle in the middle of waiting) that is not a vehicle assignment target necessarily stops, the vehicle assignment management device 200 may identify vehicles L (vehicles not in the middle of waiting) that are vehicle assignment targets among a plurality of vehicles L and notify only the identified vehicles of the permissible range.

20 [0084]

In addition, according to the second embodiment, the vehicle assignment management device 200' receives an input of a flight number of the transportation machine A on which passengers get from the boarding management system and determines a target vehicle among the plurality of large transportation vehicles L1 on the basis of the input flight number. Accordingly, the vehicle assignment management

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device 200' can assign a large transportation vehicles L1 in association with the transportation machine A. In addition, the vehicle assignment management device 200' determines the number of large transportation vehicles L1 to be assigned on the basis of the number of passengers to be transported to a destination. In this way, the vehicle
5 assignment management device 200' can assign large transportation vehicles L1 corresponding to a number for the number of passengers of the transportation machine A without excess or deficiency. In addition, when a large transportation vehicle L1 that is a vehicle assignment target is determined, the vehicle assignment management device 200' notifies the large transportation vehicle L1 of a route toward a transit point
10 and notifies the large transportation vehicle L1 of a route toward a destination when boarding into the large transportation vehicle L1 has been completed. In this way, when the transportation machine A departs, the vehicle assignment management device 200' can allow passengers to board at the gate 111 and alight at the standby place 12. In addition, when the transportation machine A arrives, the vehicle assignment management
15 device 200' can allow passengers to board at the standby place 12 and to alight at the gate 111.

[0085]

In addition, according to the second embodiment, the vehicle assignment management device 200' determines a gate 111 to which a small transportation vehicle
20 L2 is to be assigned among a plurality of gates 111 for small transportation vehicles L2 and determines a small transportation vehicle L2 that is a vehicle assignment target among a plurality of small transportation vehicles L2 on the basis of the gate 111. In this way, the vehicle assignment management device 200' can assign a small transportation vehicle L2 to a vacant gate 111. In addition, the vehicle assignment
25 management device 200' receives a flight number of the transportation machine A in

which passengers who have got on the small transportation vehicle L2 at the gate 111 are boarded and notifies the small transportation vehicle L2 of a route toward a standby place 12 associated with the flight number when the boarding for the small transportation vehicle L2 is completed. In this way, the vehicle assignment management device 200' can transport passengers to the standby place 12 of the transportation machine A in which the passengers are boarded using the small transportation vehicle L2.

[0086]

In addition, according to the second embodiment, when the vehicle L arrives at the transit point, and doors of the vehicle L are closed, the vehicle assignment

management device 200' determines that boarding for the vehicle L has been completed.

In this way, the completion of boarding of passengers can be notified to the vehicle

assignment management device 200' without a vehicle occupant of the vehicle L

executing a special process. In addition, in another embodiment, the configuration is

not limited thereto, and, for example, by a vehicle occupant pressing a button, not

illustrated in the drawing, when all the passengers board, the completion of boarding may be notified to the vehicle assignment management device 200'.

[0087]

Although one embodiment has been described in detail above with reference to the drawings, a specific configuration is not limited to that described above, and various

design changes and the like can be performed.

For example, according to the second embodiment, although the mobility system 2 includes both large transportation vehicles L1 and small transportation vehicles L2, a

mobility system 2 according to another embodiment may not include large transportation

vehicles L1. In such a case, the mobility system 2 transports all the passengers between

the gate 111 and the standby place 12 using the small transportation vehicles L2.

In addition, a mobility system 2 according to another embodiment may not include small transportation vehicles L2. In such a case, the mobility system 2 transports all the passengers between the gate 111 and the standby place 12 using the large transportation vehicles L1.

5 [0088]

In addition, according to the second embodiment, although the mobility system 2 is applied to the transportation of passengers of the waiting facility 1, the application is not limited thereto. For example, in another embodiment, the mobility system 2 may be applied to a city traffic system using buses and taxis, a transportation system inside a
10 factory, and the like. In other words, in another embodiment, a destination and a transit point may not be the standby place 12 and the gate 111, and transportation targets of the vehicle L may not be passengers of the transportation machine A (may be articles or the like).

[0089]

15 Fig. 13 is a schematic block diagram illustrating the configuration of a computer according to at least one embodiment.

The computer 9 includes a CPU 91, a main storage device 92, an auxiliary storage device 93, and an interface 94.

The vehicle assignment management device 200 and the vehicle L described
20 above include a computer 9. The operation of each processing unit described above is stored in the auxiliary storage device 93 in the form of a program. The CPU 91 reads the program from the auxiliary storage device 93, expands the program in the main storage device 92, and executes the process described above in accordance with the program. In addition, the CPU 91 secures a storage area corresponding to each database
25 described above in the main storage device 92 or the auxiliary storage device 93.

[0090]

Examples of the auxiliary storage device 93 include a hard disk drive (HDD), a solid-state drive (SSD), a magnetic disk, a magneto-optical disk, a compact disc read-only memory (CD-ROM), a digital versatile disc read-only memory (DVD-ROM), a semiconductor memory, and the like. The auxiliary storage device 93 may be an internal medium directly connected to a bus of the computer 9 or may be an external medium connected to the computer 9 through the interface 94 or a communication line. In addition, in a case in which this program is delivered to the computer 9 through a communication line, the computer 9 that has received the delivery may expand the program in the main storage device 92 and execute the process described above. In at least one embodiment, the auxiliary storage device 93 is a non-transitory type storage medium.

[0091]

Furthermore, the program may be used for realizing a part of the function described above. In addition, the program may be a program realizing the function described above in combination with another program stored in the auxiliary storage device 93 in advance, a so-called differential file (differential program).

[Industrial Applicability]

[0092]

According to a vehicle assignment management device, a vehicle assignment management method, a mobility system, and a program, a vehicle can be caused to run along a route safely and reliably.

[Reference Signs List]

[0093]

25 1 Waiting facility

	11 Terminal building
	111 Gate
	12 Standby place
	13 Road
5	2 Mobility system
	200, 200' Vehicle assignment management device
	201 Transportation machine database
	202 Vehicle database
	203 Vehicle assignment instruction-receiving unit
10	204 Number of vehicles-determining unit
	205 First transit point-determining unit
	206 First vehicle-determining unit
	207 Second transit point-determining unit
	208 Second vehicle-determining unit
15	209 Gate information-receiving unit
	210 Boarding/alighting-determining unit
	211 Route notification unit
	212 Position-receiving unit
	213 Range notification unit
20	214 Boarding database
	215 Permission unit
	216 Vehicle arrival-determining unit
	217 Passenger arrival-determining unit
	L Vehicle
25	L1 Large transportation vehicle

L2 Small transportation vehicle

L01 Information-receiving unit

L02 Position-measuring unit

L03 Opening/closing-detecting unit

5 L04 Information-transmitting unit

L05 Running control unit

[CLAIMS]

[Claim 1]

A vehicle assignment management device, comprising:

- 5 a route notification unit that notifies a target vehicle of a route along which the target vehicle will run;
- a position-receiving unit that receives position information at a plurality of timings from each of a plurality of vehicles including the target vehicle; and
- a range notification unit that notifies the target vehicle of a permissible range representing a range in which the target vehicle can run on the basis of the position
- 10 information of the plurality of vehicles at a plurality of timings.

[Claim 2]

The vehicle assignment management device according to Claim 1, further comprising:

- a destination input unit that accepts an input of a destination; and
 - 15 a vehicle-determining unit that determines the target vehicle among the plurality of vehicles on the basis of the destination,
- wherein the route notification unit notifies the target vehicle of a route toward the destination.

[Claim 3]

- 20 The vehicle assignment management device according to Claim 2, further comprising:

- a number of vehicle occupants input unit that accepts an input of the number of vehicle occupants to be transported to the destination; and
- a number of vehicles-determining unit that determines the number of target
- 25 vehicles on the basis of the number of vehicle occupants,

wherein the vehicle-determining unit determines target vehicles corresponding to the number determined by the number of vehicles-determining unit such that all the target vehicles arrive at the destination within a predetermined time.

[Claim 4]

5 The vehicle assignment management device according to Claim 2 or 3, further comprising:

 a transit point-determining unit that determines a transit point on the basis of the destination; and

 a boarding-determining unit that determines whether or not boarding of vehicle
10 occupants into the target vehicle has been completed,

 wherein the route notification unit notifies the target vehicle of a route toward the transit point when the vehicle-determining unit determines the target vehicle and notifies the target vehicle of a route toward the destination when boarding of the vehicle occupants into the target vehicle has been completed.

15 [Claim 5]

 The vehicle assignment management device according to Claim 1, further comprising:

 a transit point-determining unit that determines a transit point to which a vehicle is to be assigned among a plurality of transit point candidates; and

20 a vehicle-determining unit that determines the target vehicle among the plurality of vehicles on the basis of the transit point,

 wherein the route notification unit notifies the target vehicle of a route toward the transit point.

[Claim 6]

25 The vehicle assignment management device according to Claim 5, further

comprising:

a destination input unit that accepts an input of a destination at which vehicle occupants who have got on the target vehicle at the transit point will alight; and

a boarding-determining unit that determines whether or not boarding of the vehicle occupants into the target vehicle has been completed,

wherein the route notification unit notifies the target vehicle of a route toward the destination when the boarding of the vehicle occupants into the target vehicle has been completed.

[Claim 7]

The vehicle assignment management device according to Claim 4 or 6, wherein the boarding-determining unit determines that the boarding of the vehicle occupants into the target vehicle has been completed when the vehicle arrives at the transit point, and doors of the vehicle are closed.

[Claim 8]

A mobility system, comprising:

a plurality of vehicles; and

the vehicle assignment management device according to any one of Claims 1 to 7,

wherein each of the plurality of vehicles runs on a route and within a permissible range on the basis of the route and the permissible range received from the vehicle assignment management device.

[Claim 9]

A vehicle assignment management method, comprising:

notifying a target vehicle of a route along which the target vehicle will run;

receiving position information at a plurality of timings from each of a plurality

of vehicles including the target vehicle; and

notifying the target vehicle of a permissible range representing a range in which the target vehicle can run on the basis of the position information of the plurality of vehicles at a plurality of timings.