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Control method and control device

Abstract

According to the present disclosure, a control method of a vehicle including a communication circuit capable of communicating with a computer via a network includes: acquiring, from the computer via the communication circuit, first reservation information including first boarding area information indicating a first boarding area, first seat information indicating a first seat, and first color information indicating a first color; causing the vehicle to travel to the first boarding area based on the first boarding area information; and causing, in the first boarding area, at least two lighting devices to emit light of the first color based on the first color information, the at least two lighting devices being selected from a group consisting of a first door light indicating a first door, a first seat light indicating the first seat, and a first baggage light indicating an installation position or a lock.

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References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
10527428	12/2019	Mehta	N/A	G05D 1/0027
11067983	12/2020	Kentley-Klay	N/A	G07C 5/00
12118588	12/2023	MacNeille	N/A	G01C 21/3476
2004/0201277	12/2003	Hentsch	307/10.1	G07C 9/00309
2017/0213308	12/2016	Wellborn	N/A	G01C 21/3453
2018/0218470	12/2017	Belwafa	N/A	G06Q 50/40
2020/0070715	12/2019	Krause	N/A	B60Q 3/76
2020/0116503	12/2019	Salter	N/A	B61L 15/009
2020/0294173	12/2019	Shah	N/A	G06Q 10/02
2021/0350046	12/2020	Bosson	N/A	G06Q 50/40
2022/0108235	12/2021	Schulz	N/A	G06Q 10/025
2022/0155086	12/2021	Woo	N/A	G01C 21/365
2022/0265881	12/2021	Kakuchi	N/A	A61L 9/16
2022/0292850	12/2021	Muroi	N/A	N/A
2022/0390938	12/2021	Villar	N/A	B60K 35/81
2023/0010445	12/2022	Alspach	N/A	B60N 2/0025

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
2021-086307	12/2020	JP	N/A
2021-146893	12/2020	JP	N/A

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Background/Summary

FIELD
(2) The present disclosure relates to a control method and a control device.
BACKGROUND
(3) JP 2021-146893 A discloses a configuration in which it is determined whether or not a passenger who gets on an automatic driving vehicle is an authorized reservation person, and when it is determined that there is a passenger who is not an authorized reservation person, the door of the automatic driving vehicle is kept open.
(4) There is a need for improvements for more accurate boarding of a vehicle.
SUMMARY
(5) According to one aspect of the present disclosure, a control method of a vehicle including a communication circuit capable of communicating with a computer via a network includes: acquiring, from the computer via the communication circuit, first reservation information including first boarding area information indicating a first boarding area for a first user who has reserved the vehicle to board, first seat information indicating a first seat reserved by the first user among a plurality of seats of the vehicle, and first color information indicating a first color selected from a plurality of colors to identify the first user from other users who ride in the vehicle; causing the vehicle to travel to the first boarding area based on the first boarding area information; and causing, in the first boarding area, at least two lighting devices to emit light of the first color based on the first color information, the at least two lighting devices being selected from a group consisting of a first door light provided on a side surface of the vehicle and indicating a first door where the first user is to board, a first seat light provided in the vehicle and indicating the first seat reserved by the first user, and a first baggage light provided in a trunk of the vehicle and indicating an installation position where a first baggage of the first user is to be placed or a lock to be attached to the first baggage.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a block diagram illustrating an example of an overall configuration of a vehicle allocation system according to a first embodiment;
(2) FIG. **2** is a sequence diagram illustrating an example of processing of the vehicle allocation system according to the first embodiment;
(3) FIG. **3** is a diagram illustrating an example of guidance by light of a door of a vehicle according to the first embodiment;
(4) FIG. **4** is a diagram illustrating an example of guidance by light of the door of the vehicle according to the first embodiment;
(5) FIG. **5** is a diagram illustrating an example of a UI when a seat is reserved by an information terminal according to the first embodiment;
(6) FIG. **6** is a diagram illustrating an example of a UI that adjusts a temperature and lighting of a seat by the information terminal according to the first embodiment;
(7) FIG. **7**A is a flowchart illustrating an example of processing of adjusting the temperature and lighting of the seat by the information terminal according to the first embodiment;

(8) FIG. **7**B is a diagram illustrating an example of guiding a user to the vehicle according to the first embodiment;

(9) FIG. **8** is a sequence diagram illustrating an example of processing of the vehicle allocation system according to the first embodiment;

(10) FIG. **9** is a sequence diagram illustrating an example of processing of the vehicle allocation system according to the first embodiment;

(11) FIG. **10** is a diagram illustrating an example of a UI that changes a direction of a seat by the information terminal according to the first embodiment;

(12) FIG. **11** is a flowchart illustrating an example of processing of changing a direction of a seat by an information terminal according to a second embodiment;

(13) FIG. **12** is a diagram illustrating an example of a UI that changes a direction of a seat by the information terminal according to the second embodiment;

(14) FIG. **13** is a diagram illustrating an example of a UI that changes a direction of a seat by the information terminal according to the second embodiment;

(15) FIG. **14**A is a flowchart illustrating an example of processing of changing a direction of a seat by the information terminal according to the second embodiment;

(16) FIG. **14**B is a flowchart illustrating an example of processing of changing a direction of a seat by the information terminal according to the second embodiment;

(17) FIG. **15** is a diagram illustrating an example of processing of adjusting a temperature and lighting of a seat by the information terminal according to the second embodiment;

(18) FIG. **16** is a diagram illustrating an example of processing of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(19) FIG. **17** is a diagram illustrating an example of processing of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(20) FIG. **18**A is a flowchart illustrating an example of processing of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(21) FIG. **18**B is a flowchart illustrating an example of a process of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(22) FIG. **19** is a diagram illustrating an example of processing of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(23) FIG. **20** is a diagram illustrating an example of processing of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(24) FIG. **21**A is a flowchart illustrating an example of processing of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(25) FIG. **21**B is a flowchart illustrating an example of a process of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(26) FIG. **22** is a diagram illustrating an example of processing of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(27) FIG. **23** is a diagram illustrating an example of processing of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(28) FIG. **24** is a diagram illustrating an example of processing of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(29) FIG. **25**A is a flowchart illustrating an example of processing of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(30) FIG. **25**B is a flowchart illustrating an example of a process of adjusting the temperature and lighting of the seat by the information terminal according to the second embodiment;

(31) FIG. **26** is a flowchart illustrating an example of processing of changing a direction of a seat by the information terminal according to the second embodiment;

(32) FIG. **27** is a block diagram illustrating an example of an overall configuration of a vehicle allocation system according to a third embodiment;

(33) FIG. **28** is a sequence diagram illustrating an example of processing of the vehicle allocation system according to the third embodiment;

(34) FIG. **29** is a flowchart illustrating an example of lighting processing of light when guiding a user to a reserved seat according to the third embodiment;

(35) FIG. **30** is a diagram illustrating an example of guidance by light of a door of a vehicle according to the third embodiment;

(36) FIG. **31** is a flowchart illustrating an example of processing of specifying a boarding door according to the third embodiment;

(37) FIG. **32** is a diagram illustrating an example of guidance by a projector of the vehicle according to the third embodiment;

(38) FIG. **33** is a diagram illustrating an example of guidance by light of the seat of the vehicle according to the third embodiment;

(39) FIG. **34**A is a diagram illustrating an example of guidance of a baggage placement position by light of a trunk of the vehicle according to the third embodiment;

(40) FIG. **34**B is a diagram illustrating an example of guidance of the baggage placement position by light of the trunk of the vehicle according to the third embodiment;

(41) FIG. **35** is a diagram illustrating an example of guidance by light of a baggage lock in the trunk of the vehicle according to the third embodiment;

(42) FIG. **36** is a flowchart illustrating an example of lighting processing of light when guiding a user to a reserved seat according to the third embodiment;

(43) FIG. **37**A is a flowchart illustrating an example of processing of guiding a user to a vacant seat closer to a getting-off door according to the third embodiment; and

(44) FIG. **37**B is a flowchart illustrating an example of processing of specifying the getting-off door according to the third embodiment.

DETAILED DESCRIPTION

Background to Present Disclosure

(45) In recent years, development for fully automatic driving has progressed, and it is predicted that a world in which many automatic driving vehicles travel on public roads and many people share the automatic driving vehicles will be realized in the near future. In the sharing of the automatic driving vehicles, it is important how efficiently vehicle allocation is performed. Efficient allocation of the automatic driving vehicles can reduce traffic congestion caused by the automatic driving vehicles, leading to efficient utilization of energy in the entire town. Therefore, the efficient allocation of the automatic driving vehicles is also important for contributing to environmental load reduction. Generally, a method of determining a vehicle to be allocated on the basis of a position of the automated driving vehicle and a position of the user is conceivable as the automated driving vehicle allocation. However, when the automated driving vehicle overflows into the town, it is necessary to perform the vehicle allocation more precisely including the time for the user to get on and off the automated driving vehicle. Therefore, an object of the present disclosure is to shorten the vehicle allocation time for each vehicle to improve the vehicle allocation efficiency, improve the energy efficiency of the entire town, and reduce the environmental burden by realizing vehicle allocation that reduces the user's getting on and off time to the automated driving vehicle.

(46) Note that the present disclosure can also be implemented as a program that causes a computer to execute each characteristic configuration included in a control method used here, or a system that operates by the program. Furthermore, it goes without saying that such a computer program can be distributed via a computer-readable non-transitory recording medium such as an SD card or a communication network such as the Internet.

(47) Note that each of the embodiments described below illustrates a specific example of the present disclosure. Numerical values, shapes, constituent elements, steps, order of steps, and the like shown in the following embodiments are merely examples, and do not limit the present disclosure. Furthermore, among the constituent elements in the following embodiments, constituent

elements that are not described in independent claims indicating the highest concept are described as arbitrary constituent elements. Moreover, in all the embodiments, the respective contents can be combined.

First Embodiment

(48) FIG. **1** is a block diagram illustrating an example of an overall configuration of a vehicle allocation system **1** according to an embodiment of the present disclosure. The vehicle allocation system **1** includes an information terminal **10**A, a vehicle **20**A, and a vehicle management cloud **30**. The information terminal **10**A of a user UA and the vehicle **20**A can access various types of information by connecting to the Internet N1 which is a wide-area communication network using a wireless communication standard such as cellular communication called 4G or 5G. Furthermore, the information terminal **10**A of the user UA and the vehicle **20**A can wirelessly communicate with a short-distance device using a short-range wireless communication network N2 such as Bluetooth (registered trademark) or UWB that is an ultra-wideband wireless communication standard. For example, in a case where the user UA owns or uses the vehicle **20**A, a direction, arrangement, temperature, lighting, and the like of a seat of the vehicle **20**A can be controlled through the short-range wireless communication network N2 or the Internet N1. Furthermore, for example, in a case where the user UA does not own or use a vehicle, the user UA makes a vehicle reservation to the vehicle management cloud **30** through the Internet N1, and in a case where an optimal vehicle is the vehicle **20**A, the vehicle **20**A can be allocated to the user UA. The user UA and the vehicle **20**A are described as an example, and many other users and vehicles may be similarly connected to the vehicle management cloud **30** through the Internet N1.

(49) When the vehicle reservation is made from the information terminal **10**A of the user UA, the reservation information is transmitted to the vehicle management cloud **30** via the Internet N1. The vehicle management cloud **30** manages reservation statuses of a plurality of vehicles, selects an optimal vehicle on the basis of reservation information of the user UA (coordinate position, use time, and destination of the user UA), and transmits a control signal to the vehicle through the Internet N1 so as to move to the position of the user UA.

(50) Here, a configuration of the information terminal **10**A will be described. The information terminal **10**A includes a communication unit **11**A, a calculation unit **12**A, a sensor **13**A, a memory **14**A, an operation unit **15**A, and a video/audio output unit **16**A.

(51) The communication unit **11**A transmits and receives information to and from the vehicle **20**A and the vehicle management cloud **30** via the short-range wireless communication network N2 or the Internet N1. The calculation unit **12**A performs calculation related to processing of the information terminal **10**A. The sensor **13**A detects the state of the information terminal **10**A. Examples of the sensor **13**A include an acceleration sensor, a GPS sensor, and the like. The memory **14**A stores various types of information. Examples of the memory **14**A include various storage media and storage devices such as an HDD, an SSD, and a flash memory. The operation unit **15**A receives various operations from the user UA. Examples of the operation unit **15**A include an input device that receives a user's input, such as a touch panel or a keyboard. The video/audio output unit **16**A outputs video and audio. Examples of the video/audio output unit **16**A include a liquid crystal display, an organic EL display, and a speaker.

(52) Next, a configuration of the vehicle **20**A will be described. The vehicle **20**A includes a communication unit **21**A, a calculation unit **22**A, a sensor **23**A, an illumination **24**A, a memory **25**A, a key control unit **26**A, an information input/output unit **27**A, a movable unit **28**A, and a vehicle interior space control unit **29**A.

(53) The communication unit **21**A transmits and receives information to and from the information terminal **10**A and the vehicle management cloud **30** via the short-range wireless communication network N2 or the Internet N1. The calculation unit **22**A performs calculation related to control of the vehicle **20**A. The sensor **23**A detects the state of the vehicle **20**A. Examples of the sensor **23**A include an acceleration sensor, a GPS sensor, and the like. The illumination **24**A is a device that

illuminates an interior of the vehicle **20**A. The memory **25**A stores various types of information. Examples of the memory **25**A include various storage media and storage devices such as an HDD, an SSD, and a flash memory. The key control unit **26**A controls opening and closing of a key of a door of the vehicle **20**A. The information input/output unit **27**A inputs information from an external device to the vehicle **20**A. Furthermore, the information input/output unit **27**A outputs information from the vehicle **20**A to an external device. The movable unit **28**A is a unit of the vehicle **20**A that is movable by the operation of the user UA. Examples of the movable unit **28**A include a brake pedal, a shift lever, a steering wheel, and the like. The vehicle interior space control unit **29**A controls an environment of a space inside the vehicle **20**A. For example, the vehicle interior space control unit **29**A controls a vehicle interior temperature, brightness of the illumination, and the like.

(54) Next, a configuration of the vehicle management cloud **30** will be described. The vehicle management cloud **30** includes a communication unit **31**, a calculation unit **32**, and a memory **33**.

(55) The communication unit **31** transmits and receives information to and from the information terminal **10**A and the vehicle **20**A via the Internet N1. The calculation unit **32** performs calculation related to processing of the vehicle management cloud **30**. The memory **33** stores various types of information. Examples of the memory **33** include various storage media and storage devices such as an HDD, an SSD, and a flash memory.

(56) FIG. **2** is a sequence diagram illustrating an example of processing of the vehicle allocation system **1**. The vehicle **20**A is, for example, an automatic driving vehicle, and performs going-around movement in order to allow any passenger to get on the vehicle. The vehicle **20**A senses a situation of a passenger in the vehicle **20**A by an in-vehicle monitoring system (camera, infrared sensor, and weight sensor) mounted in the vehicle. Since a passenger in the vehicle **20**A can freely move in the vehicle **20**A and sit on a favorite seat, it is necessary to check the latest situation in the vehicle and determine whether another passenger can be accommodated and in which seat another passenger can be seated. Therefore, the latest in-vehicle information sensed by the in-vehicle monitoring system is transmitted to the vehicle management cloud **30** (Step S**1**). Since the latest in-vehicle information is transmitted from a plurality of vehicles, the vehicle management cloud **30** always updates and manages the latest in-vehicle information of the plurality of vehicles (Step S**2**). When the user UA wishes vehicle allocation and the reservation request information (coordinate position, use time, destination, and destination arrival time of the user UA) is transmitted from the information terminal **10**A (Step S**3**), the vehicle management cloud **30** selects an optimal vehicle on the basis of the latest status of use of each seat inside each vehicle, the coordinate position information of each vehicle, a traveling direction, the coordinate position information of the user UA, the use time, the destination, and the destination arrival time (Step S**4**). For example, in a case where the user UA stands by on the right side in the traveling direction of the vehicle on a right-hand traffic road as in the United States, when a vehicle with a vacant seat on the right side with respect to the traveling direction of the vehicle is selected and when the vehicle arrives at a place where the user UA stands by, the user UA can sit on the right seat in the immediate vicinity of the opened right door, so that the user UA can get on smoothly. Therefore, in a case where a plurality of vehicles are located around the user UA, a vehicle to which a vehicle with a vacant right seat is allocated with priority is determined. In a case where the number of sharing vehicles increases, the number of allocatable vehicle candidates increases. Therefore, by using the latest usage status of the seat inside the vehicle, the coordinate position of the vehicle, the traveling direction, and the coordinate position of the user, the vehicle allocation time including the user's boarding time can be shortened, and the vehicle allocation can be performed more smoothly. The vehicle management cloud **30** transmits the vehicle information (vehicle position, seat reservation status, and arrival time) of the selected vehicle **20**A to the information terminal **10**A of the user UA (Step S**5**). The user UA selects a desired seat from the available seats displayed on the information terminal, and transmits reservation information (desired seat) to the vehicle management cloud **30** (Step S**6**). The vehicle management cloud **30** reserves the seat selected by the user UA on the basis of the

reservation information (Step S**7**), and transmits the reservation request information (coordinate position, use time, destination, and destination arrival time of the user UA) and the reservation information (wish seat) to the vehicle **20**A (Step S**8**). The vehicle **20**A turns on a light installed on the reserved seat in red based on the reservation information (Step S**9**). For example, it is conceivable to turn on a light installed at an edge of the seat in red. In order to smoothly get on and off the vehicle including the boarding time of the user UA, the vehicle and the seat are reserved. Therefore, when another passenger uses the reserved seat, the vehicle allocation time cannot be shortened. Therefore, by turning on the seat in red, it is possible to prevent other passengers on board from being seated or putting an object, and to more reliably shorten the vehicle allocation time. Furthermore, the vehicle management cloud **30** transmits the vehicle **20**A and the seat information for which the reservation of the vehicle **20**A is completed to the information terminal **10**A of the user UA (Step S**10**). The information terminal **10**A displays a situation inside the vehicle **20**A (seating information indicating which seat another passenger is seated, and information about a reserved seat reserved by the user UA) (Step S**11**). The vehicle **20**A periodically transmits information on the coordinate position of the own vehicle to the vehicle management cloud **30** (Step S**12**), and determines whether or not the coordinate position of the own vehicle is within a predetermined range from the coordinate position of the user UA. In a case where it is determined that the coordinate position of the own vehicle is within the predetermined range from the coordinate position of the user UA (Step S**13**), the lighting of the light installed in the reserved seat is changed from red to blue. Furthermore, a light installed on a door close to the reserved seat is turned on in blue (Step S**14**). For example, in a case where the right seat in the traveling direction is reserved and the user UA is waiting on the right side in the traveling direction, the door closest to the reserved seat on the right side in the traveling direction is turned on in blue. In a case where the seat on the left side in the traveling direction is reserved and the user UA is waiting on the right side in the traveling direction, the door (alternatively, a door that allows the user to get on the reserved seat most smoothly, and so on.) closest to the reserved seat on the right side in the traveling direction is turned on in blue. In this manner, by turning on the door close to the reserved seat in blue, the vehicle allocation time including the boarding time of user UA can be shortened. For example, it is conceivable to turn on a light installed on a door knob in blue. The vehicle management cloud **30** determines whether or not the coordinate position of the vehicle **20**A has entered a predetermined range from the coordinate position of the user UA, and when determining that the coordinate position has entered the predetermined range (Step S**15**), the vehicle management cloud transmits vehicle arrival information to the information terminal **10**A of the user UA (Step S**16**). Upon receiving the vehicle arrival information, the information terminal **10**A notifies the user UA in advance of the status of the contents of the vehicle **20**A and the position of the reserved seat by making an announcement such as "the vehicle will arrive soon", and blinking the seat arrangement, the seat usage status, and the reserved seat of the vehicle **20**A in blue (Step S**17**). Here, an example of turning on and blinking in red or blue has been described, but the present disclosure is not limited thereto as long as it is a method that can be recognized by a passenger. Other colors may be used as long as the colors are recognizable by the passenger.

(57) Furthermore, in FIG. **2**, the user UA determines the reserved seat. Alternatively, when the current location, the destination, and the number of people of the user UA are transmitted to the vehicle management cloud **30**, the management cloud may automatically determine the reserved vehicle and the reserved seat. By determining the reserved seat on the management cloud side, the reservation time can be shortened, and the efficiency of the entire vehicle allocation can be improved.

(58) FIG. **3** is an example in which a door of the vehicle **20**A is illuminated blue and the vicinity of a bottom of the door of the vehicle **20**A is illuminated blue in order to shorten the time for determining the door to be used for the user UA who is a reservation person. In a case where it is determined that the coordinate position of the vehicle **20**A has entered the predetermined range

from the coordinate position of the user UA, which door the vehicle 20A illuminates is determined on the basis of a standby coordinate position of the user UA, a reserved seat R, and the traveling direction of the vehicle, and the door of the vehicle 20A is illuminated in blue and the vicinity of the bottom of the door of the vehicle 20A is illuminated in blue. For example, in the case of right-hand traffic as in the United States, when the coordinate position of the user UA is located on the right with respect to the traveling direction of the vehicle 20A, the right door is selected. Only the door of the vehicle 20A may be illuminated in blue from when the coordinate position of the vehicle 20A enters the predetermined range from the coordinate position of the user UA until the vehicle arrives at the coordinate position of the user UA, and when the vehicle arrives at the coordinate position of the user UA, in addition to the door of the vehicle 20A, the vicinity of the bottom of the door of the vehicle 20A may be illuminated in blue. With such a configuration, it is possible to prevent erroneous recognition that some kind of notification is given to passersby other than the reservation person, and at the same time, it is possible to shorten the boarding time by providing appropriate guidance to the reservation person when the reservation person arrives. When the door of the vehicle is turned on, as illustrated in FIG. 3, the light installed near the door knob may be turned on, or the light installed along the edge of the door may be turned on. Furthermore, the color to be illuminated is not limited to blue, and may be a specific identical color.

(59) FIG. 4 is another example of guiding the user UA who is a reservation person to a reserved seat R in a case where the vehicle is a double-door automatic driving vehicle in which the doors are opened to the left and right. In the case of double doors, since the doors are simultaneously opened to the left and right, the same display as that displayed on the information terminal 10A is performed near the bottom of the door. For example, in a case where a room layout of seats in the vehicle, a usage status of the seats, and the reserved seat R are displayed on the information terminal 10A, the display is displayed near the bottom of the door when the automatic driving vehicle arrives. Furthermore, as in FIG. 3, only the door of the vehicle 20A may be illuminated in blue from when the coordinate position of the vehicle 20A enters the predetermined range from the coordinate position of the user UA to when the vehicle arrives at the coordinate position of the user UA. When the vehicle arrives at the coordinate position of the user UA, the vicinity of the bottom of the door of the vehicle 20A may be illuminated in blue in addition to the door of the vehicle 20A, and a guide diagram of the inside of the vehicle displayed on the information terminal 10A may be displayed. Since the same guide map as the guide diagram of the interior of the vehicle 20A displayed on the information terminal 10A is displayed near the bottom of the door of the vehicle 20A that arrived, the user UA can smoothly find the reserved seat and shorten the boarding time. Here, when the vicinity of the bottom of the door of the vehicle is illuminated or the guide diagram of the inside of the vehicle is displayed, a projector may be installed near the bottom of the door of the vehicle, or a projector may be installed above the door.

(60) Note that it is conceivable that the user UA may load baggage into the trunk of the automated driving vehicle. In this case, the user UA may notify the vehicle management cloud 30 in advance that there is baggage to be checked in the trunk with (the application of) the information terminal 10A. In this case, when the automated driving vehicle arrives, the user UA first unlocks the trunk (or opens the automatically unlocked trunk) and stores the baggage in the trunk. At this time, a plurality of baggage storage keys (smart locks), hereinafter referred to as baggage locks, are installed in the trunk so as not to be mistaken for baggage of another user, and a reserved seat of the user UA and/or a baggage lock to be used by the user UA shines in the same color as a door (such as a door knob) that shines when the user UA gets in the vehicle. The user UA with his/her baggage in the trunk closes the trunk, enters through the guided door, and sits in the reserved seat. Also in a case where the user UA gets off the vehicle at the destination, when the user UA gets off the vehicle, the user UA unlocks the trunk (or opens the automatically unlocked trunk) and takes out the baggage from the trunk. In this case as well, the baggage lock may shine as in the case of loading baggage, and only the baggage lock assigned to the user UA may be automatically

unlocked. In this way, it is possible to prevent another person's baggage from being carried by mistake or intentionally without forgetting to take the baggage. It is desirable that the reserved seat, the door at the time of boarding, and the baggage lock in the trunk of the user UA described above shine in the same color for the user UA. Moreover, it is desirable that this color is a color different from those of other users who get on the vehicle at the same time because it is easy to identify. Furthermore, this color may be notified from the vehicle management cloud **30** to the information terminal **10**A so that it can be confirmed in advance on the information terminal at the time of reservation.

(61) FIG. **7**B is a flowchart illustrating the example of FIGS. **3** and **4**. The vehicle **20**A acquires the position information of the standby place of the user UA from the vehicle management cloud **30** and starts moving (Step S**31**). The vehicle **20**A determines whether the position of the own vehicle is within a predetermined range from the position of the standby place of the user UA (Step S**32**). When it is determined that the position of the own vehicle is within the predetermined range (Step S**32**: Yes), in order to notify the user UA that the vehicle is a target vehicle scheduled to be boarded, a notification is given to the user UA in a visually recognizable manner (Step S**33**). For example, the vicinity of the front light may be blinked in blue, or the door of the vehicle may be blinked in blue. Next, the vehicle **20**A determines whether or not the vehicle has arrived at the standby place of the user UA (Step S**34**), and in a case where it is determined that the vehicle has arrived (Step S**34**: Yes), the vehicle illuminates the vicinity of the bottom of the door with light (Step S**35**). Alternatively, as illustrated in FIG. **4**, the projector displays the same content as the interior floor plan displayed on the information terminal. At this time, the blinking near the front light may be stopped, and the blinking of the door may be changed to lighting. As described above, by changing the place where the light is turned on and blinks according to the distance from the user, it is possible to more smoothly guide the user to the seat, and it is possible to shorten the boarding time of the user. Note that, although the description has been given assuming that the processing proceeds to the next processing in a case where it is determined as No in the determination of steps S**32** and S**34**, the present disclosure is not limited thereto, and a processing form in which the processing returns immediately before each determination may be adopted in a case where it is determined as No.

(62) FIG. **5** illustrates a UI when the user UA reserves a seat by the information terminal **10**A. The information terminal **10**A displays a usage status SJ of the seat in the vehicle. When the user UA reserves a seat, a controller CL**1** (slide bar SB**1**, slide bar SB**2**) for temperature adjustment and dimming of the reserved seat is displayed on the left and right of the reserved seat. The user UA can remotely perform temperature adjustment and dimming by moving a finger up and down on a bar of the controller CL**1** for temperature adjustment and dimming. Since the temperature and dimming of the reserved seat can be adjusted while the vehicle **20**A is reserved, the temperature and dimming are adjusted to the user UA's preference when the user UA gets into the vehicle, and the comfort of the user UA can be improved. Here, when the information terminal **10**A and the vehicle **20**A can wirelessly communicate with each other, a control signal may be directly transmitted from the information terminal **10**A to the vehicle **20**A. When the information terminal **10**A and the vehicle **20**A cannot perform wireless communication, a control signal may be transmitted from the information terminal **10**A to the vehicle management server, and a control signal may be transmitted from the vehicle management server to the information terminal **10**A to perform temperature and dimming.

(63) FIG. **6** illustrates another example of the UI at the time of performing temperature and dimming. When the circle is enlarged in the operation of pinching the circular display CL**2** of the seat with the fingertips, light is adjusted brightly, and when the circle is reduced, light is adjusted darkly. Tapping the upper semicircle adjusts the temperature higher, and tapping the lower semicircle adjusts the temperature lower. Since temperature adjustment and dimming can be performed with one icon in this manner, it is possible to realize a UI that prevents malfunction in a

(64) FIG. **7**A is a diagram illustrating an example of a flow of the processing of FIGS. **5** and **6**. The information terminal **10**A receives reservation information of each seat of the vehicle **20**A from the vehicle management cloud **30** (Step S**21**). The seat arrangement of the vehicle **20**A and the reservation status of each seat are displayed on the information terminal **10**A (Step S**22**). The information terminal **10**A determines whether or not a seat icon indicating a vacant seat has been touched (Step S**23**), and in a case where the seat icon has been touched (Step S**23**: Yes), the information terminal transmits a seat reservation signal to the vehicle management cloud **30**. After receiving the reservation completion signal from the vehicle management cloud **30**, a temperature adjustment and dimming icon is displayed (Step S**24**). As illustrated in FIG. **5**, a control bar may be displayed on the left and right of the reserved seat, or as illustrated in FIG. **6**, a circular control icon may be displayed.

(65) FIGS. **8** and **9** are diagrams illustrating another form of sequence when the vehicle **20**A is reserved. The processes up to the process of illuminating the reserved seat in red (steps S**41** to S**49**) are the same as those in FIG. **2** (steps S**1** to S**9**), and thus the description thereof is omitted. The vehicle management cloud **30** transmits a reservation completion signal and the lighting and temperature information about the reserved seat (Step S**50**). When the user UA inputs a desired temperature and lighting to the information terminal **10**A (Step S**51**), the temperature and lighting information desired by the user UA is transmitted to the vehicle management cloud **30** (Step S**52**). The vehicle management cloud **30** transmits the received temperature and lighting information to the vehicle **20**A (Step S**53**). When the information terminal **10**A and the vehicle **20**A are in a state capable of wireless communication, the temperature and lighting information may be transmitted from the information terminal **10**A to the vehicle **20**A by wireless communication. The vehicle **20**A adjusts the lighting and temperature of the reserved seat based on the received temperature and lighting information (Step S**54**). The vehicle management cloud **30** transmits vehicle allocation instruction information to the vehicle **20**A (Step S**55**). Furthermore, the vehicle management cloud **30** transmits a notification indicating the scheduled vehicle allocation position to the information terminal **10**A (Step S**56**). Upon receiving the vehicle allocation instruction information from the vehicle management cloud **30**, the vehicle **20**A moves to the vicinity of the coordinate position of the user UA (Step S**57**). When the vehicle **20**A moves from the position of the user UA to a position within a predetermined range, the vehicle management cloud **30** transmits a notification indicating that the vehicle **20**A will arrive soon to the information terminal **10**A (Step S**58**). The vehicle **20**A counts the number of passengers using the in-vehicle monitoring system (Step S**59**), and transmits information on the number of passengers to the vehicle management cloud **30** (Step S**60**). The vehicle management cloud **30** determines whether or not the number of persons for reservation matches the number of passengers (Step S**61**), and in a case where the number of persons for reservation is different from the number of passengers, the information terminal **10**A is notified of the number of passengers exceeding the number of persons for reservation and the payment notification of the additional fee (Step S**62**). When the user UA pays the additional fee using the information terminal **10**A (Step S**63**), the vehicle management cloud **30** receives the additional fee (Step S**64**). Next, the vehicle management cloud **30** makes a reservation cancellation and a fare discount notification to another user UB who has reserved the seat of the vehicle **20**A (Step S**65**). Since it is difficult to secure the reserved seat of the user UB due to the fact that the user UA gets on the vehicle with the number of persons exceeding the number of persons for reservation, the reservation cancellation and the fare discount notification are performed to the user UB. When the user UB inputs reservation information to an information terminal **10**B again (Step S**66**), processing similar to that in steps S**41**, S**43**, S**44**, and S**56** to S**58** is performed, and the vehicle management cloud **30** selects an optimal vehicle and allocates a vehicle to the user UB (steps S**67** to S**72**).

Second Embodiment

(66) FIG. **10** is a diagram illustrating an example of a UI when a seat arrangement ZH of the vehicle **20**A is changed in a case where the user UA owns the vehicle **20**A. When a living mode button LM is touched, the front seat is rotated by 180 degrees, and the seat arrangement ZH in which the front seat and the rear seat face each other is controlled. When an individual mode button KM is touched, both the front seat and the rear seat are controlled to have the seat arrangement ZH facing the traveling direction. As illustrated in FIG. **15**, in the living mode, a controller UZ is displayed in the vicinity of the center of the floor plan of the vehicle so that temperature adjustment and dimming can be performed in the entire vehicle. In the case of the living mode, since a scene in which the occupant performs a conference or a game while facing each other is assumed, priority is given to temperature adjustment and dimming in the entire vehicle. On the other hand, in the case of the individual mode, a controller UK (controllers UK**1** to UK**4**) is displayed on the icon of each seat so that temperature adjustment and dimming can be individually performed at each seat. Since a scene in which each seat individually enjoys the space is assumed, priority is given to a private space by individual temperature adjustment and dimming. Note that, since the controller UZ and the controller UK can also be referred to as icons for displaying temperature, the controller UZ and the controller UK may be referred to as temperature display icons in the following description.

(67) FIG. **11** is a diagram illustrating a flow when the living mode/individual mode is changed. In a case where the information terminal **10**A receives the signal indicating the direction of the chair from the vehicle (Step S**81**, Step S**82**, Step S**82**: Yes), the information terminal **10**A displays the living mode/individual mode on the user's information terminal based on the received signal (Step S**83**). On the other hand, in a case where the signal indicating the direction of the chair cannot be received from the vehicle due to some influence such as a communication error (Step S**82**: No), the information terminal **10**A displays the mode at the end of the previous application stored in the information terminal **10**A on the information terminal (Step S**84**). Note that, since the direction of the chair is assumed to be a direction state at the time of the previous application end, the mode at the time of the previous application end may be displayed on the information terminal without receiving a signal of the direction of the chair from the vehicle. When the user UA touches the living mode (Step S**85**, Step S**85**: Yes), a control signal for changing the seat arrangement to the living mode is transmitted to the vehicle. Furthermore, the display of the information terminal **10**A is changed to the living mode (Step S**86**). When the user UA touches the individual mode (Step S**85**: No, Step S**87**, Step S**87**: Yes), a control signal for changing the seat arrangement to the individual mode is transmitted to the vehicle. Furthermore, the display of the information terminal **10**A is changed to the individual mode (Step S**88**).

(68) FIG. **12** is a view illustrating a UI when the direction of the seat is changed one by one. In the living mode, when the user UA operates an icon IB of a seat B so as to rotate the seat B, only the seat B rotates by 180 degrees, and the direction of the seat is changed. At this time, since the remaining seats face each other, the living mode is maintained as the mode. When there are a large number of seats in the vehicle, it may be determined that the living mode is maintained when the number of seats facing each other is larger than the number of seats not facing each other. When the user UA operates an icon IA of a seat A so as to rotate the seat A, only the seat A rotates by 180 degrees, and the direction of the seat is changed. In this case, since all the front seats face the traveling direction, the mode is changed to the individual mode.

(69) FIG. **13** is a diagram illustrating a UI when the individual mode is changed to the living mode. In the individual mode, when the user UA rotates one (for example, the front seat icon IM**2**) of front seat icons IM (front seat icons IM**1** and IM**2**), three of the four seats face each other, and thus the mode shifts to the living mode. When the remaining front seat icons IM (for example, the front seat icon IM**1**) are rotated, all the seats face each other, and the living mode is maintained. As described above, in a case where the number of seats facing each other among the plurality of seats in the vehicle is larger than the number of seats not facing each other, the living mode is set, so that

it is possible to perform temperature adjustment and dimming with priority given to a conference or a happy family scene.

(70) FIG. **14**A is a flowchart illustrating a flow of the UI of FIG. **12**. In a case where the living mode is displayed on the information terminal (Step S**91**), it is determined whether or not the chair icon IB has been touched (Step S**92**). In a case where there is a touch (Step S**92**: Yes), a signal for rotating the chair corresponding to the chair icon IB by 180 degrees is transmitted to the vehicle. Furthermore, the chair icon IB is rotated by 180 degrees and displayed on the information terminal. At this time, since the number of chairs facing each other (three seats) is larger than the number of chairs not facing each other (one seat), the living mode is maintained (Step S**93**). Next, it is determined whether or not the chair icon IA has been touched (Step S**94**), and in a case where the chair icon IA has been touched (Step S**94**: Yes), a signal for rotating the chair corresponding to the chair icon IA by 180 degrees is transmitted to the vehicle. Furthermore, the chair icon IA is rotated by 180 degrees and displayed on the information terminal. At this time, since the number of chairs not facing each other (four seats) is larger than the number of chairs facing each other (0 seats), the mode is changed to the individual mode (Step S**95**). Here, as an example, the flow is in the order of the chair icons IA and IB, but the present invention is not limited thereto, and the chair is determined in the order of the chair icons touched by the user, and the chair is rotated.

(71) FIG. **14**B is a flowchart illustrating a flow of the UI of FIG. **13**. When the individual mode is displayed on the information terminal (Step S**101**), it is determined whether or not the chair icon IB has been touched (Step S**102**). When there is a touch (Step S**102**: Yes), a signal for rotating the chair corresponding to the chair icon IB by 180 degrees is transmitted to the vehicle. Furthermore, the chair icon IB is rotated by 180 degrees and displayed on the information terminal. At this time, since the number of chairs facing each other (three seats) is larger than the number of chairs not facing each other (one seat), the mode is changed to the living mode (Step S**103**). Next, it is determined whether or not the chair icon IA has been touched (Step S**104**), and in a case where the chair icon IA has been touched (Step S**104**: Yes), a signal for rotating the chair corresponding to the chair icon IA by 180 degrees is transmitted to the vehicle. Furthermore, the chair icon IA is rotated by 180 degrees and displayed on the information terminal. At this time, since the number of chairs facing each other (four seats) is larger than the number of chairs not facing each other (0 seats), the living mode is maintained (Step S**105**).

(72) FIG. **16** illustrates a flow of changing from overall temperature adjustment and dimming to individual temperature adjustment and dimming of each seat in the living mode. In the living mode, since a scene such as a conference is assumed, basically, a controller UZ is displayed in the vicinity of the center of the floor plan of the vehicle by default for temperature adjustment and dimming in the entire vehicle. In the living mode, when the user determines that individual temperature adjustment and dimming of each seat are necessary, the user touches a seat icon IZ (chair icons IZ**1** to IZ**4**). When determining that the seat icon IZ is touched in the living mode, the information terminal device displays a controller UK for temperature adjustment and dimming on each seat.

(73) FIG. **17** illustrates a flow when the temperature adjustment and dimming of each seat is changed to the overall temperature adjustment and dimming in the living mode. In the living mode, when the user touches the vicinity of the center of the floor plan of the vehicle, the controller UK on each seat disappears, and the controller UZ for performing overall temperature adjustment and dimming is displayed in the vicinity of the center of the floor plan of the vehicle. As described above, when the information terminal determines that the vicinity of the center of the room layout in the vehicle is touched, the information terminal changes the display of the UI of the controller from the individual temperature adjustment and dimming controller UK of each seat to the overall temperature adjustment and dimming controller UZ.

(74) FIG. **18**A illustrates a processing flow when the overall temperature adjustment and dimming is changed to individual temperature adjustment and dimming in the living mode. In the living mode, the information terminal displays the controller UZ in the vicinity of the center of the room

layout in the vehicle for overall temperature adjustment and dimming which are default settings (Step S**111**). It is determined whether any of the chair icons IZ has been touched (Step S**112**), and if there has been a touch (Step S**112**: Yes), the controller UK is displayed on each seat for individual temperature adjustment and dimming while the living mode display is maintained (Step S**113**).

(75) FIG. **18**B illustrates a processing flow when changing from individual temperature adjustment and dimming to overall temperature adjustment and dimming in the living mode. In the living mode, the information terminal displays the controller UK on each seat for individual temperature adjustment and dimming (Step S**121**). It is determined whether or not there is a touch on the vicinity of the center of the room layout in the vehicle (Step S**122**), and in a case where there is a touch (Step S**122**: Yes), the controller UZ is displayed in the vicinity of the center of the room layout in the vehicle for overall temperature adjustment and dimming while the living mode display is maintained (Step S**123**).

(76) FIG. **19** illustrates a flow when changing from individual temperature adjustment and dimming to overall temperature adjustment and dimming in the individual mode. In the individual mode, since a scene in which each seat enjoys an individual private space is assumed, basically, the controller UK is displayed on each seat by default for individual temperature adjustment and dimming. In the individual mode, when the user determines that the overall temperature adjustment and dimming is necessary, the user touches the vicinity of the center of the room layout in the vehicle. When the information terminal device determines that the vicinity of the center of the floor plan of the vehicle is touched in the individual mode, the information terminal device turns off the controller UK displayed on each seat and displays the controller UZ near the center of the vehicle for overall temperature adjustment and dimming.

(77) FIG. **20** illustrates a flow when the overall temperature adjustment and dimming is changed to individual temperature adjustment and dimming in the individual mode. In the individual mode, when one of the chair icons IZ is touched, the controller UZ displayed in the vicinity of the center of the floor plan of the vehicle disappears, and the controller UK is displayed on each seat. As described above, when the information terminal determines that any seat icon is touched, the information terminal changes the display of the UI of the controller from the overall temperature adjustment and dimming to individual temperature adjustment and dimming.

(78) FIG. **21**A illustrates a processing flow when changing from individual temperature adjustment and dimming to overall temperature adjustment and dimming in the individual mode. In the individual mode, the information terminal displays a temperature display icon (controller UK) on each seat for individual temperature adjustment and dimming which are default settings (Step S**131**). Furthermore, the information terminal determines whether or not there is a touch on the vicinity of the center of the interior floor plan (Step S**132**), and if there is a touch (Step S**132**: Yes), the information terminal turns off the controller UK on each seat for overall temperature adjustment and dimming while maintaining the individual mode display, and displays a temperature display icon (controller UZ) near the center of the interior floor plan (Step S**133**).

(79) FIG. **21**B illustrates a processing flow when the overall temperature adjustment and dimming is changed to individual temperature adjustment and dimming in the individual mode. In the individual mode, the information terminal displays a temperature display icon (controller UZ) near the center of the room layout in the vehicle for overall temperature adjustment and dimming (Step S**141**). It is determined whether any of the seat icons has been touched (Step S**142**), and when the seat icon has been touched (Step S**142**: Yes), a temperature display icon (controller UK) is displayed above each of the seat icons for individual temperature adjustment and dimming while maintaining the individual mode display (Step S**143**).

(80) FIGS. **22** and **25**A illustrate an example of temperature adjustment and dimming. In the living mode, the information terminal displays a temperature display icon (controller UZ) in the vicinity of the center of the room layout in the vehicle for overall temperature adjustment and dimming which are default settings (Step S**151**). Next, the information terminal determines whether the

controller UZ has been touched (Step S**152**). When the information terminal determines that the controller UZ has been touched (Step S**152**: Yes), a slide bar SB**1** for temperature adjustment and a slide bar SB**2** for dimming (controller CL**1** for temperature/illuminance adjustment) are displayed on the left and right sides of the controller UZ (Step S**153**). When it is determined that there is a touch on the slide bar SB**1** for temperature adjustment and there is an upward slide, a control signal for raising the temperature is transmitted to the vehicle, and the color temperature of the entire floor plan of the vehicle is lowered and displayed. For example, the color is changed to a red color and displayed. When it is determined that the vehicle slides downward, a control signal for lowering the temperature is transmitted to the vehicle, and the color temperature of the entire floor plan of the vehicle is increased and displayed. For example, the color is changed to a blue color and displayed. When it is determined that the slide bar SB**2** for dimming has been touched and has been slid upward, a control signal for brightening the lighting inside the vehicle is transmitted to the vehicle, and the entire color of the floor plan of the vehicle interior is changed to a yellow color and displayed. When it is determined that the vehicle has slid downward, a control signal for darkening the lighting inside the vehicle is transmitted to the vehicle, and the color of the entire floor plan inside the vehicle is changed to a gray color and displayed. As described above, at the time of overall temperature adjustment and dimming, the controller UZ in the vicinity of the center is used, and the color of the interior floor plan changes, so that it is possible to reliably adjust the temperature and illuminance intended for the entire interior without errors. The positions of the slide bars (slide bars SB**1** and SB**2**) for adjusting the temperature and illuminance are merely an example, and the slide bars may be arranged above and below the controller UZ, or the left and right positions may be interchanged and displayed.

(81) FIG. **23** is a diagram illustrating another form of the UI of the controller. The controller CL**2** is displayed in a circular shape. When it is determined that an operation input of expanding the circle in the vertical or horizontal direction is received so as to increase the size of the circle, a control signal is transmitted to the vehicle so that the light is adjusted brightly, and the entire inside of the vehicle is changed to a yellow color and displayed. On the other hand, when it is determined that an operation input for reducing the size of the circle in the vertical or horizontal direction is received, a control signal is transmitted to the vehicle so as to adjust the light to be dark, and the entire inside of the vehicle is changed to a gray color and displayed. When it is determined that the upper half of the controller CL**2** is touched, a control signal for raising the temperature in the vehicle is transmitted to the vehicle. On the other hand, when it is determined that the lower half is touched, a control signal for lowering the temperature in the vehicle is transmitted to the vehicle. Furthermore, when the temperature is raised, the color temperature in the vehicle is lowered, and when the temperature is lowered, the color temperature in the vehicle is raised and displayed.

(82) FIGS. **24** and **25**B are diagrams illustrating an example when temperature adjustment and dimming are performed for each seat individually. In the individual mode, the information terminal displays a temperature display icon (controller UK) on each seat for individual temperature adjustment and dimming (Step S**161**). Next, the information terminal determines whether or not the controller UK has been touched (Step S**162**). When the information terminal determines that one of the controllers UK on each seat is touched (Step S**162**: Yes), slide bars SB**1** and SB**2** are displayed on the left and right of the touched controller UK (Step S**163**). Since the operation is similar to that in FIG. **22**, the description thereof is omitted. Note that a circular controller CL**2** as illustrated in FIG. **23** may be used.

(83) FIG. **26** is a diagram illustrating a flow of processing of prohibiting rotation of a seat in a case where an object is placed on the seat or in a case where a person is sitting, in consideration of safety. An in-vehicle monitoring system displays a seat direction change icon on the information terminal (Step S**171**). The in-vehicle monitoring system determines whether an object is placed on each seat or a person is seated (Steps S**172**), and transmits information on whether the object is placed on each seat or the person is seated to an information terminal. In a case where an

instruction to rotate the seat is received with respect to the seat on which it is determined that an object is placed or a person is seated on the basis of the received information, the information terminal notifies that the seat cannot be rotated without rotating the seat (Step S**173**). For example, the seat may be displayed in red, blinking in red, or the like. Here, an example of rotating the seat has been described, but the present invention is not limited thereto, and an operation such as moving the seat may also be prohibited. In this manner, in a case where an object is placed on a seat or in a case where a person is sitting, it is possible to improve safety in the vehicle by prohibiting processing such as rotating or moving the seat.

Third Embodiment

(84) FIG. **27** is a block diagram illustrating an example of an overall configuration of a vehicle allocation system **1**A according to an exemplary embodiment of the present disclosure. The vehicle allocation system **1**A includes an information terminal **10**C, a vehicle **20**C, and a vehicle management cloud **30**A. The information terminal **10**C is an information terminal used by the user UC. Since the configurations of the information terminal **10**C, the vehicle **20**C, and the vehicle management cloud **30**A are similar to those of the information terminal **10**A, the vehicle **20**A, and the vehicle management cloud **30** in FIG. **1**, the description thereof will be omitted.

(85) FIG. **28** is a sequence diagram illustrating an example of processing of the vehicle allocation system. Since the processing from steps S**181** to S**185** is similar to the processing from steps S**1** to S**5** in FIG. **2** of the first embodiment, the description thereof is omitted.

(86) After the processing of Step S**185**, the user UC selects a reserved seat from the available seats displayed on the information terminal **10**C. Furthermore, the user UC selects the color of the light used for guiding to the reserved seat. Further, the user UC selects whether or not to use the trunk. The information terminal **10**C transmits the reservation information (reserved seat information, color information, and trunk use information) to the vehicle management cloud **30**A (Step S**186**). When a plurality of vehicle candidates are displayed, the user UC specifies the vehicle candidate to be reserved and then selects the reserved seat.

(87) The vehicle management cloud **30**A reserves the seat selected by the user UC on the basis of the reservation information (Step S**187**). Furthermore, the vehicle management cloud **30**A specifies a predetermined range from the coordinate position of the user UC as a boarding area (Step S**188**).

(88) Then, the vehicle management cloud **30**A transmits reservation confirmation information (coordinate position of user UC, use time, destination, destination arrival information, reserved seat information, color information, trunk use information, and boarding area information) to the vehicle **20**C as reservation confirmation information (Step S**189**). Note that the vehicle management cloud **30**A may not specify the boarding area, and the vehicle **20**C may specify the boarding area from the coordinate position of the user UC. In this case, the vehicle management cloud **30**A does not transmit the boarding area information to the vehicle **20**C.

(89) Furthermore, the vehicle management cloud **30**A transmits the reservation completion information to the information terminal **10**C (Step S**190**). The reservation completion information includes information on a reserved seat reserved by the user UC, color information, and seating information indicating a seat on which another passenger is seated.

(90) Based on the reservation completion information, as illustrated in FIGS. **31** and **32** described above, the information terminal **10**C displays the situation inside the vehicle **20**C (seating information indicating a seat on which another passenger is seated, and information of a reserved seat reserved by the user UC) and the object indicating the color information selected by the user on the display of the information terminal **10**C (Step S**191**).

(91) Note that, in a case where the vehicle management cloud **30**A determines that the vehicle **20**C has arrived within the predetermined range of the user UC, the information terminal **10**C may display the fact and the color information selected by the user on the display or the like of the information terminal **10**C using an object or the like. Since the user UC can confirm the color selected by the user UC in advance with the information terminal **10**C, it is possible to prevent

erroneous recognition.

(92) Furthermore, in a case where the vehicle **20**C detects the user UC with a sensor such as an image sensor, the information terminal **10**C may cause a display or the like of the information terminal **10**C to display the color information selected by the user using an object or the like together with the fact. As a result, the user can confirm immediately before boarding, and it is possible to further prevent erroneous recognition.

(93) The vehicle **20**C causes the own vehicle to travel toward the coordinate position of the user UC on the basis of the reservation confirmation information (Step S**192**). Furthermore, the vehicle **20**C periodically transmits information on the coordinate position of the own vehicle to the vehicle management cloud **30**A (Step S**193**).

(94) Next, the vehicle **20**C determines that the coordinate position of the own vehicle has entered the boarding area based on the reservation confirmation information (Step S**194**). Furthermore, the vehicle management cloud **30**A determines that the vehicle position has entered the predetermined range based on the position of the reservation person (Step S**195**).

(95) Next, the vehicle **20**C illuminates the guide door based on the color of the light designated in Step S**186** (Step S**196**). Furthermore, the vehicle **20**C illuminates the reserved seat based on the color of the light designated in Step S**186** (Step S**197**). Furthermore, the vehicle **20**C illuminates the baggage placement position and/or the baggage lock in the trunk based on the color of the light designated in Step S**186** (Step S**198**). Note that the processing of steps S**196** to S**197** may be executed simultaneously, or may be sequentially executed in the order illustrated in FIGS. **29** and **36** described later.

(96) FIG. **29** is a flowchart illustrating an example of light lighting processing for guiding a user to a reserved seat. The vehicle **20**C periodically transmits information on the coordinate position of the own vehicle to the vehicle management cloud **30**A, and causes the vehicle to travel toward the coordinate position of the user UC on the basis of the reservation confirmation information (Step S**201**).

(97) Next, the vehicle **20**C determines whether the coordinate position of the own vehicle has entered the riding area (Step S**202**). In a case where it is determined that the coordinate position of the own vehicle is within the boarding area (Step S**202**: Yes), the light installed on the door close to the reserved seat is turned on in the color designated by the user UC (Step S**203**). By turning on the light of the door when the vehicle enters the boarding area, the user can recognize the boarding door in advance, and smooth boarding can be realized.

(98) Here, FIG. **30** is a diagram illustrating an example of guidance by a light of a door of the vehicle **20**C. In FIG. **30**, an object OB, a reserved seat R**1**, a vacant seat VS, and a seat NS being used are displayed on the display of the information terminal **10**C.

(99) The object OB is, for example, an icon indicating a color designated by the user UC. Furthermore, the reserved seat R**1** is, for example, an icon indicating a seat reserved by the user UC. Furthermore, the vacant seat VS is, for example, an icon indicating a vacant seat among the seats of the vehicle **20**C. Furthermore, the seat NS in use is an icon indicating the seat in use among the seats of the vehicle **20**C.

(100) Furthermore, in FIG. **30**, the vehicle **20**C lights the light LT installed on the door close to the reserved seat R**1** reserved by the user UC in the same color as the object OB indicating the color designated by the user UC.

(101) Here, FIG. **31** is a flowchart illustrating a method of identifying a boarding door. The vehicle **20**C identifies the boarding door from the coordinate position of the user and the reserved seat (Step S**211**). Next, the vehicle **20**C determines whether another passenger is seated between the boarding door and the reserved seat (Step S**212**). In a case where it is determined that another passenger is not seated (Step S**212**: No), the vehicle **20**C causes the door identified first to illuminate as a boarding door (Step S**213**).

(102) On the other hand, in a case where it is determined that another passenger is seated between

the boarding door and the reserved seat (Step S**212**: Yes), the vehicle **20**C identifies a door opposite to the boarding door identified first as the boarding door and illuminates the same (Step S**214**). As described above, by changing the boarding door according to the passenger between the boarding door and the reserved seat, smoother boarding can be realized.

(103) Here, FIG. **32** is another example of guiding the user UC who is a reservation person to the reserved seat in the case of the double-sided automatic driving vehicle in which the doors are opened to the left and right. In the case of double doors, since the doors are simultaneously opened to the left and right, the vehicle **20**C performs the same display as that displayed on the display of the information terminal **10**C near the bottom of the door.

(104) For example, when the floor plan F of the seats in the vehicle, the usage status of the seats (vacant seats VS, seats NS in use), and the reserved seat R**1** are displayed on the display of the information terminal **10**C, the display P**1** similar to the display is displayed near the bottom of the door when the automatic driving vehicle arrives.

(105) In this case, since the same guide diagram as the guide diagram of the inside of the vehicle **20**C displayed on the display of the information terminal **10**C is displayed near the bottom of the door of the arriving vehicle **20**C, the user UC can smoothly know the reserved seat and can shorten the boarding time.

(106) Furthermore, in addition to the light installed on the door, an indicator light installed on the outer surface of the vehicle may be turned on in a color designated by the user UC. For example, the visibility can be further enhanced by using an indicator light attached to the roof of the vehicle. Note that the process of turning on the indicator light in the color designated by the user UC may be performed before the vehicle management cloud **30**A detects the user.

(107) Furthermore, information indicating that the vehicle is a vehicle reserved by the user UC may be displayed on the indicator light of the vehicle **20**C. For example, by displaying the reservation number of the user UC on the indicator light of the vehicle **20**C, it is possible to reduce the possibility of erroneous recognition by the user UC. Furthermore, by displaying the reservation number in the color designated by the user UC, the recognition rate can be improved. Note that the processing of displaying the reservation number and the like on the indicator light may be performed before the vehicle management cloud **30**A detects the user.

(108) Here, FIG. **33** is a diagram illustrating an example of guidance by a light of a seat of the vehicle **20**C. As illustrated in FIG. **33**, the vehicle **20**C lights a light LS installed in the reserved seat in the color designated by the user UC. As illustrated in FIG. **33**, the light LS is installed so as to illuminate the edge of the seat and the feet of the seat, and smooth guidance by light is possible.

(109) Furthermore, the lighting of the light installed in the seat may be started after detection of unlocking of the door that is turned on. By starting lighting after detecting the unlocking of the door, the user who gets in the vehicle can confirm the lighting of the light, and the visibility can be further enhanced.

(110) Furthermore, the lighting of the light installed in the seat may be started simultaneously with the lighting of the light of the door. By starting at the same time as turning on the light of the door, it is possible to cause another passenger to recognize the reserved seat, and for example, in a case where baggage is placed on the reserved seat, it is possible to prepare for the user to get on, such as moving in advance, and thus, it is possible to smoothly get on.

(111) Furthermore, in FIG. **28**, whether or not the vehicle **20**C has entered the boarding area is used as a reference. However, when the distance from the vehicle **20**C to the boarding area is less than or equal to a predetermined distance, the lights of the doors and the lights of the seats may be turned on.

(112) Returning to Step S**204** in FIG. **29**, the description will be continued. The vehicle management cloud **30**A determines whether or not the user UC uses the trunk on the basis of the trunk use information (Step S**204**). In a case where the user UC determines to use the trunk (Step S**204**: Yes), the vehicle management cloud **30**A turns on the light in the trunk in the color

designated by the user UC so as to specify the location where the baggage of the user UC is placed, as illustrated in FIGS. **34**A and **34**B (Step S**205**). Furthermore, as illustrated in FIG. **35**, the vehicle management cloud **30**A turns on the baggage lock light used by the user UC in the color designated by the user UC (Step S**205**).

(113) FIG. **34**A illustrates an example in which a plurality of lights LD is installed so as to partition the location of the baggage in the trunk, and a space between two lights LD to be turned on is specified as the location of the baggage. Of course, the number of lights LD to be turned on may be one, and it is sufficient that the location of the load in the trunk can be specified by turning on the lights LD. FIG. **34**B illustrates an example in which the light LP is installed on the back side of the rear seat, and the location is specified by illuminating the location PS where the baggage is placed.

(114) In FIG. **34**B, a plurality of lights LP (LP**1** to LP**4**) are installed on the back side of the rear seat, and one of the lights LP**1** is used to illuminate the baggage placement location PS**1** with the color designated by the user, so that the baggage placement location PS**1** used by the user can be specified from the plurality of baggage placement locations (PS**1** to PS**4**).

(115) FIG. **35** illustrates an example in which a baggage lock for fixing baggage is installed in the trunk, and a light LW is installed on the baggage lock. FIG. **35** illustrates an example in which the baggage lock includes the light LW at the root portion of the baggage lock and the light RW at the locking wire portion. However, the load lock may include only one of the light LW and the light RW. Furthermore, both the light LW at the root portion of the baggage lock and the light RW at the locking wire portion may be turned on, or only one of them may be turned on.

(116) After determining that the trunk is closed, the vehicle **20**C turns off the light in the trunk or turns off the light of the baggage lock. Note that, in a case where the baggage lock is used, the vehicle **20**C may turn off the light when the baggage lock is locked.

(117) As described above, the three methods of turning on the light of the door, turning on the light of the seat, and turning on the baggage lock of the trunk are used as the guidance method of the user UC, but any two of these guidance methods may be used.

(118) Note that, in the boarding area, when the user UC is detected using a sensor (such as an image sensor) installed in the vehicle **20**C or coordinate position information transmitted from the information terminal **10**C, a light installed on a door may be turned on. Since the user UC can confirm lighting of the door immediately before boarding, it is possible to improve visibility.

(119) Furthermore, in a case where the user UC is detected, the light in the trunk may be turned on or the light of the baggage lock may be turned on. By turning on the light immediately before use by the user, power saving can be further achieved.

(120) Here, FIG. **36** is a flowchart illustrating an example of a method of turning on a light of a door, a light of a seat, and a light of a baggage lock in a case where the user UC is detected using a sensor installed in the vehicle **20**C or coordinate position information transmitted from the information terminal **10**C.

(121) FIG. **36** is different from FIG. **29** in a lighting order of lights, and FIG. **36** is different in that lighting of lights of baggage locks is prioritized over lighting of lights of doors and lights of seats. Step S**221** is similar to Step S**201** in FIG. **29**, and thus description thereof is omitted.

(122) Next, the vehicle **20**C determines whether a user has been detected (Step S**222**). In a case where the vehicle **20**C does not detect the user UC (Step S**222**: No), this process ends. Note that, in this case, the processing of Step S**222** may be repeated until the vehicle **20**C detects the user UC.

(123) On the other hand, in a case where the vehicle **20**C detects the user UC (Step S**222**: Yes), it is determined whether or not to use the trunk on the basis of the trunk use information (Step S**223**). When it is determined that the user UC uses the trunk (Step S**223**: Yes), as illustrated in FIGS. **34**A to **35**, the vehicle **20**C turns on the light in the trunk and/or the light of the baggage lock (Step S**224**).

(124) In a case where it is determined that the trunk is closed or the baggage lock is attached, the vehicle **20**C turns off the light in the trunk or the light of the baggage lock, and then turns on the

light of the door and the light of the seat as illustrated in FIGS. **30**, **32**, and **33** (Step S**225**). On the other hand, in a case where it is determined in Step S**223** that the user UC does not use the trunk on the basis of the trunk usage information (Step S**223**: No), the process proceeds to Step S**225** without turning on the light in the trunk or the light of the baggage lock.

(125) Note that the vehicle management cloud **30**A may specify a predetermined range as a getting-off area from the destination information, and include the getting-off area in the reservation confirmation information. FIG. **37**A is a flowchart illustrating an example of a process of guiding the user to a vacant seat closer to the getting-off door. In this case, as illustrated in FIG. **37**A, after the vehicle **20**C enters the predetermined range from the getting-off area, the vehicle management cloud **30**A identifies the getting-off door on the basis of the destination and the seat information of the user (Step S**231**). The door closest to the user's seat on the side where the destination is located with respect to the traveling direction is specified as the getting-off door. For example, in a case where the user's seat is on the right rear side in the traveling direction and the destination is on the left side in the traveling direction, the door on the left rear side in the traveling direction is specified as the getting-off door.

(126) Next, the vehicle management cloud **30**A determines whether a seat closer to the door for getting off than the seat of the user UC is vacant (Step S**232**). In a case where it is determined that a seat closer to the door for getting off than the seat of the user UC is vacant (Step S**232**: Yes), the vehicle management cloud **30**A causes the light of the vacant seat of the vehicle **20**C to illuminate in the color designated by the user UC in order to guide the user UC to a vacant seat (Step S**233**). On the other hand, when it is determined that a seat closer to the door for getting off than the seat of the user UC is not vacant (Step S**232**: No), the process proceeds to Step S**234**.

(127) Then, the vehicle management cloud **30**A displays the getting-off door on the display of the information terminal **10**C (Step S**234**). With such a configuration, the user UC can move to a seat close to the door when getting off the vehicle before getting off the vehicle, so that it is possible to efficiently get off the vehicle. Alternatively, the getting-off area may not be specified, and after the vehicle enters a predetermined range from the destination, it may be determined whether or not a seat closer to the door at the time of getting off is a vacant seat.

(128) Here, FIG. **37**B is a flowchart illustrating an example of another method of guiding the user to a vacant seat close to the getting-off door in order to make getting-off smoother. First, the vehicle management cloud **30**A identifies the getting-off door from the destination and the seat information of the user (Step S**241**). Next, the vehicle management cloud **30**A determines whether another passenger is seated between the getting-off door and the user's seat (Step S**242**).

(129) When it is determined that another passenger is not seated (Step S**242**: No), the vehicle management cloud **30**A lights light of a vacant seat in a color designated by the user in order to guide the user UC to the vacant seat close to the getting-off door (Step S**243**), and displays the getting-off door on the display of the information terminal **10**C (Step S**245**).

(130) On the other hand, in a case where it is determined that another passenger is seated between the getting-off door and the seat of the user UC (Step S**242**: Yes), the vehicle management cloud **30**A specifies the door on the opposite side of the getting-off door as the getting-off door (Step S**244**), and displays the getting-off door on the display of the information terminal **10**C (Step S**245**).

(131) In this manner, by guiding the user to the seat close to the getting-off door, it is possible to smoothly get off the vehicle. Furthermore, when there is another passenger between the door and the seat of the user, the door on the opposite side is specified as the getting-off door, so that it is possible to improve the efficiency when getting off the vehicle. Note that the vehicle management cloud **30**A may perform the above processing while the vehicle **20**C is temporarily stopped due to waiting at a traffic light or the like within a predetermined range of the getting-off area for the safety of the user.

(132) Note that, when a different user UD makes a ridesharing reservation for the vehicle **20**C

reserved by the user UC, the vehicle management cloud **30**A performs display on the display of an information terminal **20**D of the user UD so as to select from colors other than the color selected by the user UC. The vehicle management cloud **30**A assigns the color selected by the user UD as the color of the user UD, and assigns the seat selected by the user UD among the available seats as the reserved seat of the user UD.

(133) Then, the vehicle management cloud **30**A transmits reservation completion information to the information terminal **20**D. In this case, the operation is the same as that at the time of reservation of the user UC except that a color other than the color selected by the user UC is selected. By using different colors for the user UC and the user UD, it is possible to prevent erroneous recognition in a case where the user UC and the user UD are close to each other.

Other Embodiments

(134) The present disclosure is not limited to the embodiments described above. The present disclosure can also include modifications or omissions added to the above embodiments and forms constructed by combining components in different embodiments within the scope conceivable by those skilled in the art without departing from the gist of the present disclosure. Other embodiments will be additionally described below.

(135) A control method according to one aspect of the present disclosure may be a control method of a vehicle including a communication circuit capable of communicating with a computer via a network, the control method including: (A1) acquiring, from the computer via the communication circuit, first reservation information including first boarding area information indicating a first boarding area for a first user who has reserved the vehicle to board and first seat information indicating a first seat reserved by the first user among a plurality of seats of the vehicle; (A2) causing the vehicle to travel to the first boarding area based on the first boarding area information; and (A3) causing a projector provided on a side surface of the vehicle to irradiate a road surface near a bottom of a door where the first user is to board with light when the vehicle detects the first user in the first boarding area, and displaying an image indicating a position of the first seat on the road surface.

(136) For example, the image may include a diagram illustrating an arrangement of the plurality of seats in the vehicle, and an object illustrating an area showing the first seat.

(137) A control method according to one aspect of the present disclosure may be a control method of a terminal capable of communicating via a network with a computer that manages vehicle allocation of an autonomously traveling vehicle, the control method including: (B1) receiving selection of a first seat requested by a first user of the terminal from among a plurality of seats of the vehicle, the plurality of seats including a plurality of front seats that can be set forward or backward with respect to a traveling direction of the vehicle, and a plurality of rear seats located behind the plurality of front seats in the traveling direction; (B2) displaying, on a display of the terminal, a first object that collectively sets a vehicle interior temperature of the vehicle when the plurality of front seats and the plurality of rear seats face each other, and in response to an input operation to the first object by the first user, transmitting an instruction to control the vehicle interior temperature to the vehicle via the network; and (B3) displaying, on the display, a second object that individually sets a temperature of the first seat when the plurality of front seats and the plurality of rear seats face forward in the traveling direction, and in response to an input operation to the second object by the first user, transmitting an instruction to control the temperature of the first seat to the vehicle via the network.

(138) A control method according to one aspect of the present disclosure may be a control method of a vehicle including a communication circuit capable of communicating with a computer via a network, the control method including: (C1) acquiring, from the computer via the communication circuit, first reservation information including first boarding area information indicating a first boarding area for a first user who has reserved the vehicle to board and first seat information indicating a first seat reserved by the first user among a plurality of seats of the vehicle; (C2)

causing the vehicle to travel to the first boarding area based on the first boarding area information; and (C3) in the first boarding area, causing at least two lighting devices to emit light in a common color, the at least two lighting devices being selected from a group consisting of a first door light provided on a side surface of the vehicle and indicating a first door where the first user is to board, a first seat light provided in the vehicle and indicating the first seat reserved by the first user, and a first baggage light provided in a trunk of the vehicle and indicating an installation position where a first baggage of the first user is to be placed or a lock to be attached to the first baggage.

(139) Note that the reference signs (A1), (A2), (A3), and the like described above are merely attached to identify each step in the control method, and do not limit the order of each step or exclude entry of other steps.

(140) According to the present disclosure, further improvement can be made.

(141) While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel methods and systems described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the methods and systems described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

Claims

1. A control method of a vehicle including a communication circuit capable of communicating with a computer via a network, the method comprising: acquiring, from the computer via the communication circuit, first reservation information including first boarding area information indicating a first boarding area for a first user who has reserved the vehicle to board, first seat information indicating a first seat reserved by the first user among a plurality of seats of the vehicle, and first color information indicating a first color selected from a plurality of colors to identify the first user from other users who ride in the vehicle; causing the vehicle to travel to the first boarding area based on the first boarding area information; and causing, in the first boarding area, at least two lighting devices to emit light of the first color based on the first color information, the at least two lighting devices being selected from a group consisting of a first door light provided on a side surface of the vehicle and indicating a first door where the first user is to board, a first seat light provided in the vehicle and indicating the first seat reserved by the first user, and a first baggage light provided in a trunk of the vehicle and indicating an installation position where a first baggage of the first user is to be placed or a lock to be attached to the first baggage, wherein the vehicle includes, in the trunk, a plurality of locking wires that are respectively to be attached to and locked to pieces of baggage of a plurality of users, and the first baggage light is provided on a first locking wire that is to be attached to and locked to the first baggage of the first user.

2. A control method of a vehicle including a communication circuit capable of communicating with a computer via a network, the method comprising: acquiring, from the computer via the communication circuit, first reservation information including first boarding area information indicating a first boarding area for a first user who has reserved the vehicle to board, first seat information indicating a first seat reserved by the first user among a plurality of seats of the vehicle, and first color information indicating a first color selected from a plurality of colors to identify the first user from other users who ride in the vehicle; causing the vehicle to travel to the first boarding area based on the first boarding area information; and causing, in the first boarding area, at least two lighting devices to emit light of the first color based on the first color information, the at least two lighting devices being selected from a group consisting of a first door light provided on a side surface of the vehicle and indicating a first door where the first user is to board, a first seat light provided in the vehicle and indicating the first seat reserved by the first user, and a

first baggage light provided in a trunk of the vehicle and indicating an installation position where a first baggage of the first user is to be placed or a lock to be attached to the first baggage, wherein the first reservation information further includes baggage information indicating whether or not the first user requests to use the trunk of the vehicle, and the control method further comprises: when the first user requests to use the trunk based on the baggage information, causing the first baggage light to emit the light of the first color after detecting the first user, turning off the first baggage light after the first user places the first baggage at the installation position or attaches the lock to the first baggage, and causing the first door light to emit the light of the first color after turning off the first baggage light; and when the first user does not request to use the trunk based on the baggage information, causing the first door light to emit the light of the first color without causing the first baggage light to emit the light after detecting the first user.