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(54) **VEHICLE ALLOCATION DEVICE, VEHICLE, AND TERMINAL**

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B60W 50/04	(2006.01)

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(57) **ABSTRACT**

A vehicle allocation device for allocating a vehicle in response to a vehicle allocation request from a terminal of a user includes a vehicle selection unit configured to select, from a plurality of vehicles learning a relationship between input parameters and an output parameter related to traveling, a vehicle having relatively large learning progress in the relationship between the input parameters and the output parameter, and output a vehicle allocation instruction to the selected vehicle in a case where the vehicle allocation request is received.

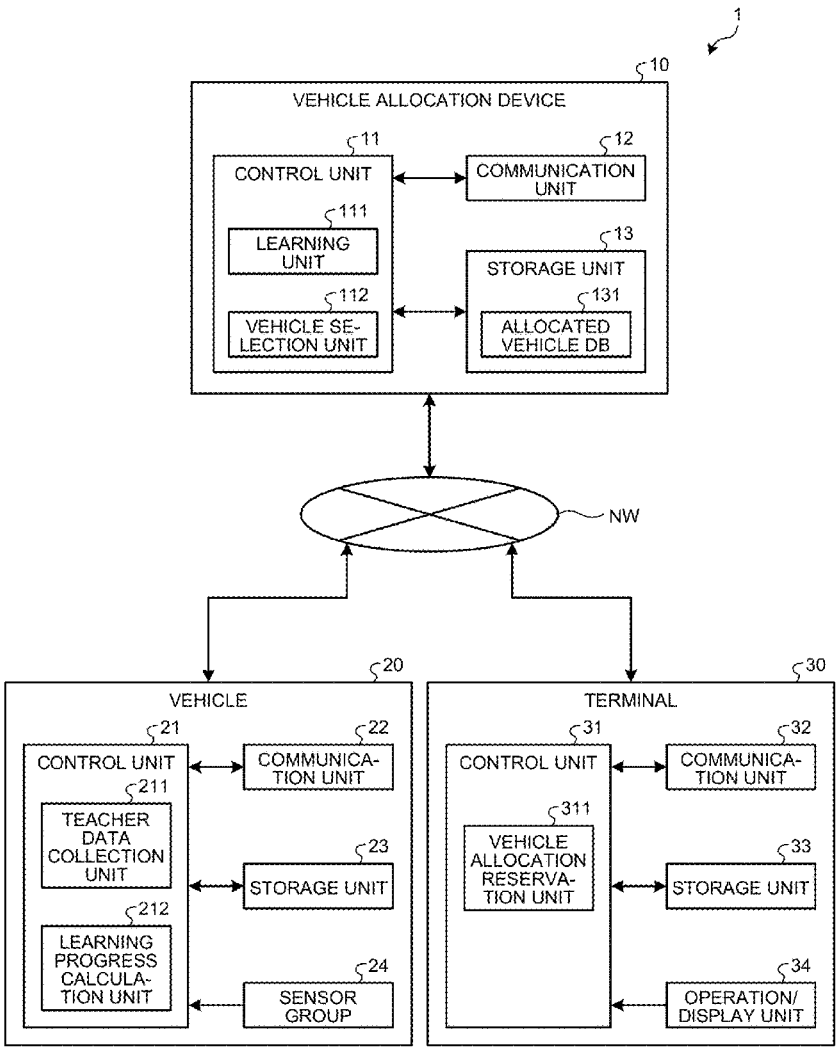


FIG.1

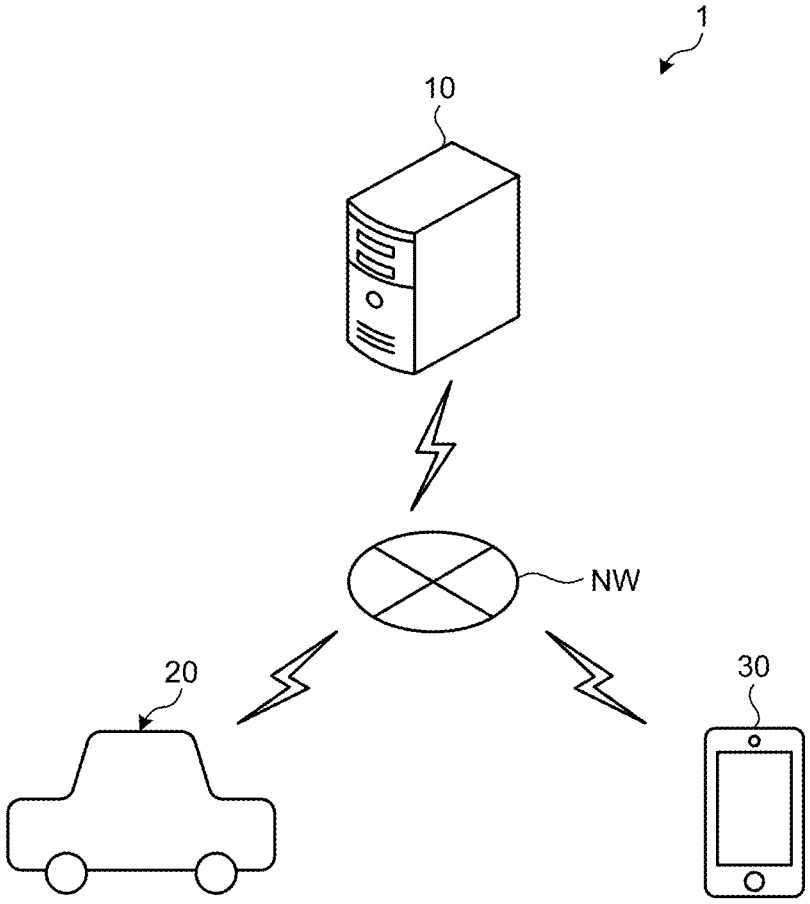


FIG.2

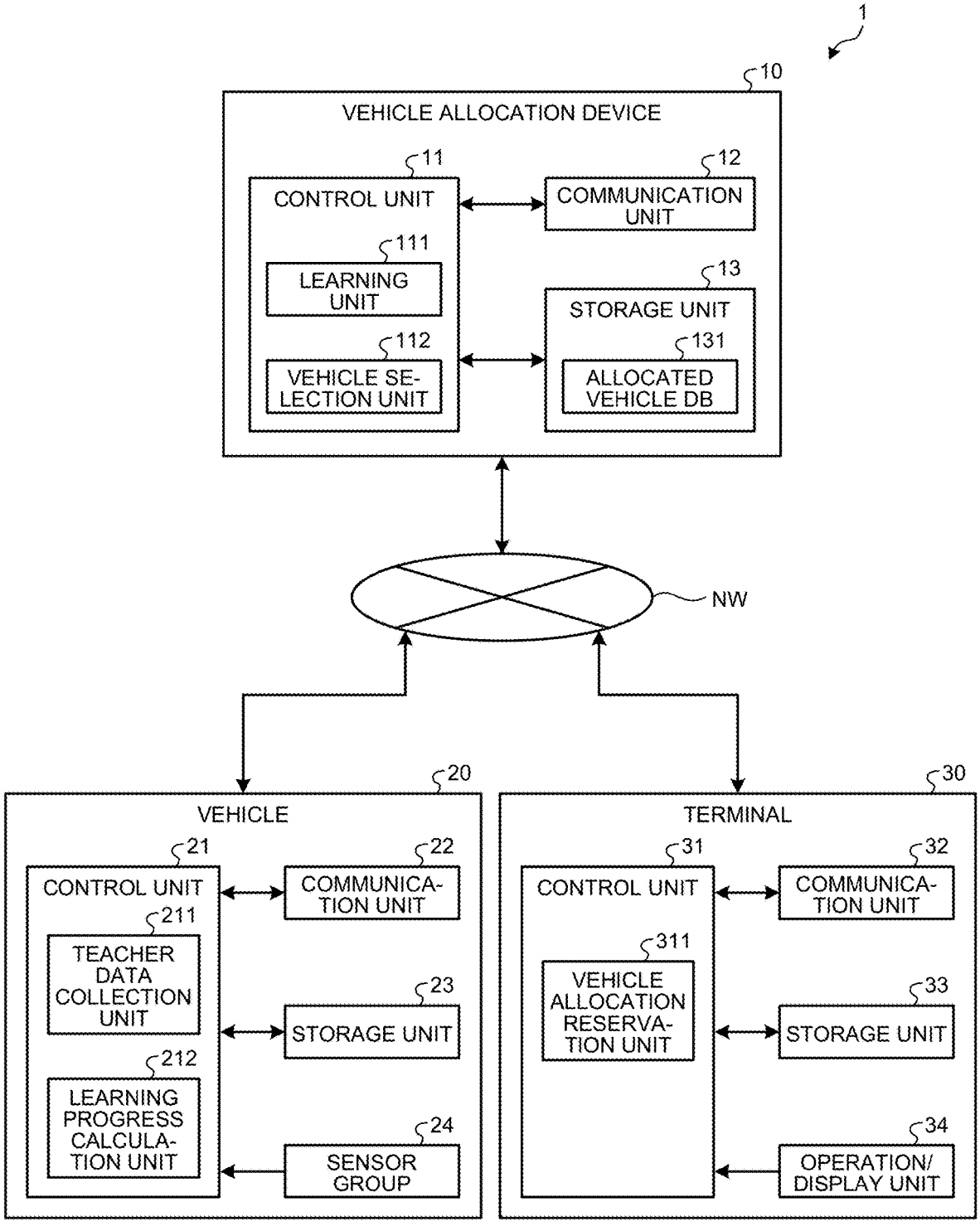

1
10
VEHICLE ALLOCATION DEVICE
11
CONTROL UNIT
12
COMMUNICATION UNIT
111
LEARNING UNIT
13
STORAGE UNIT
112
VEHICLE SELECTION UNIT
131
ALLOCATED VEHICLE DB
NW
20
VEHICLE
21
CONTROL UNIT
22
COMMUNICATION UNIT
211
TEACHER DATA COLLECTION UNIT
23
STORAGE UNIT
212
LEARNING PROGRESS CALCULATION UNIT
24
SENSOR GROUP
30
TERMINAL
31
CONTROL UNIT
32
COMMUNICATION UNIT
311
VEHICLE ALLOCATION RESERVATION UNIT
33
STORAGE UNIT
34
OPERATION/DISPLAY UNIT

FIG.3

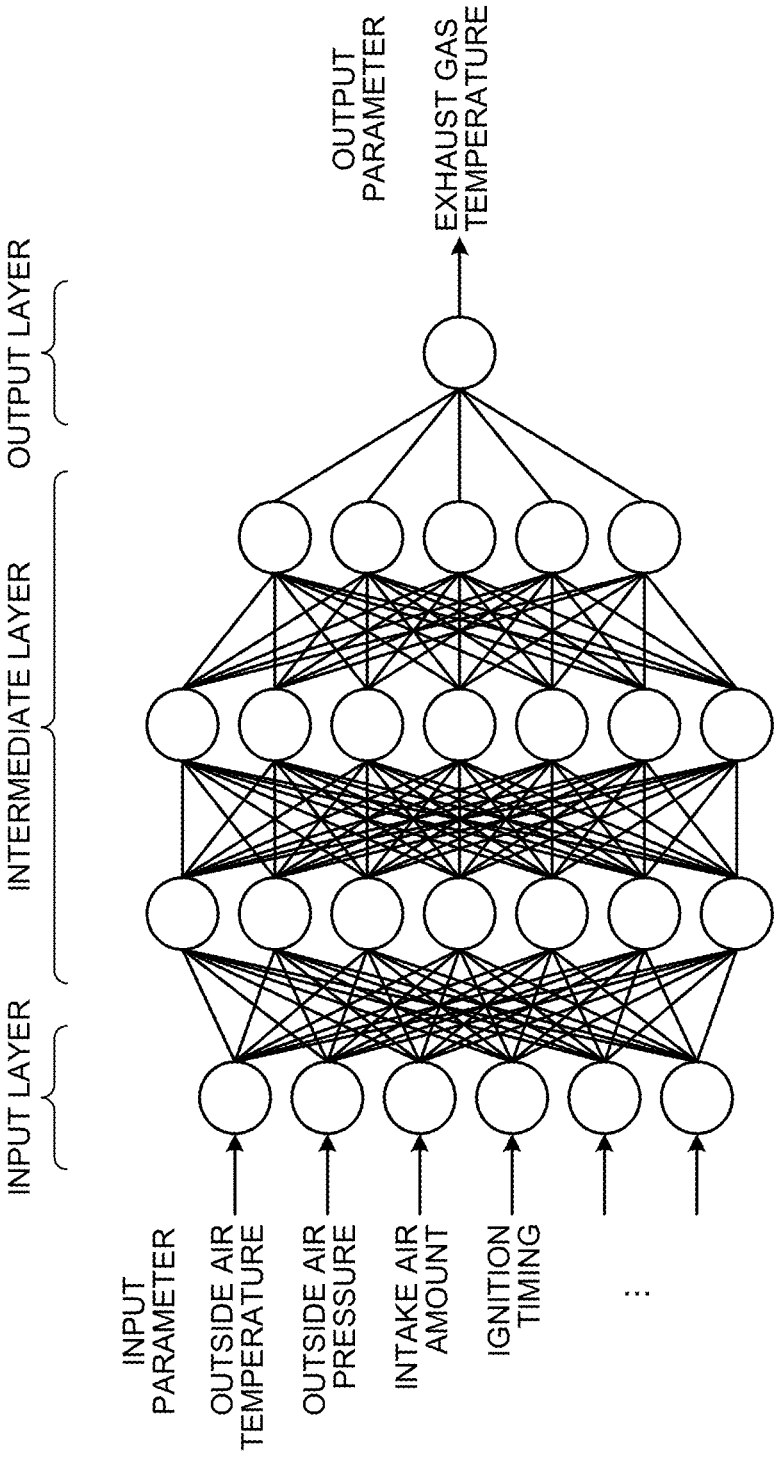

INPUT LAYER
INTERMEDIATE LAYER
OUTPUT LAYER
INPUT PARAMETER
OUTSIDE AIR TEMPERATURE
OUTSIDE AIR PRESSURE
INTAKE AIR AMOUNT
IGNITION TIMING
...
OUTPUT PARAMETER
EXHAUST GAS TEMPERATURE

FIG.4

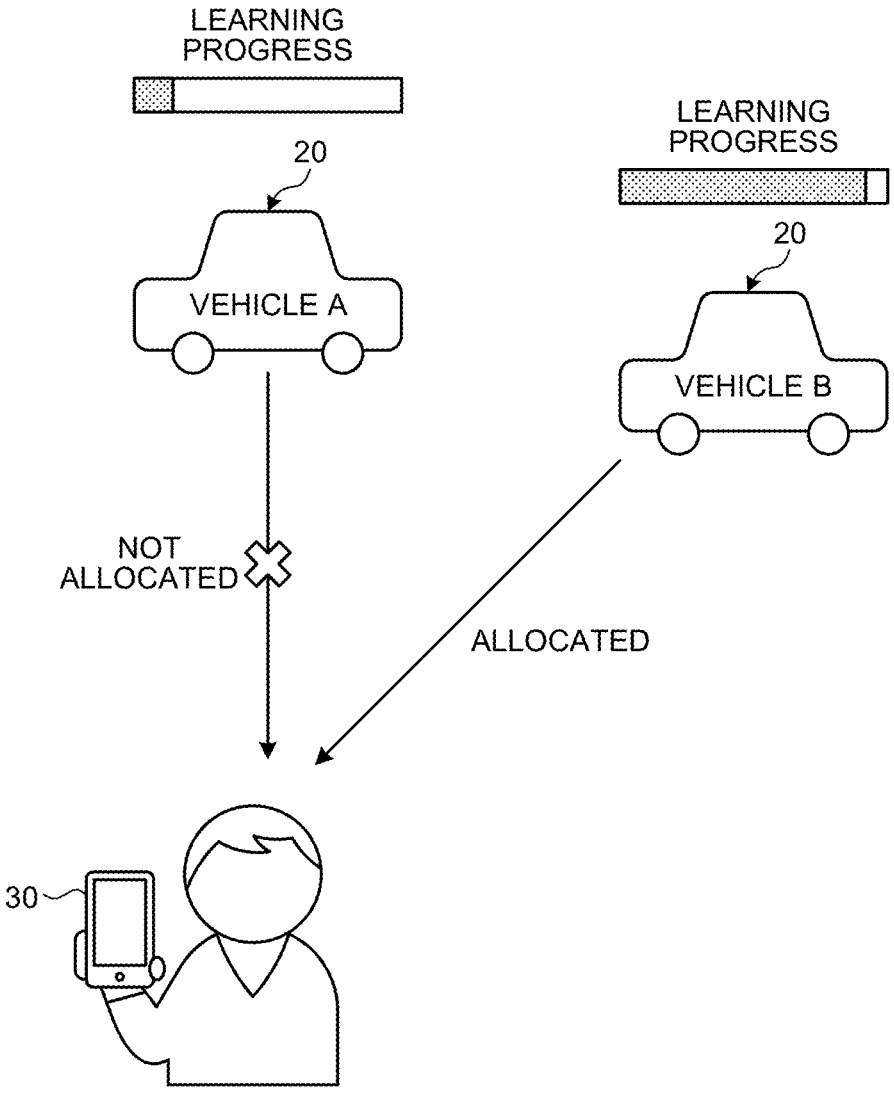

LEARNING PROGRESS
20
VEHICLE A
LEARNING PROGRESS
20
VEHICLE B
NOT ALLOCATED
ALLOCATED
30

FIG.5

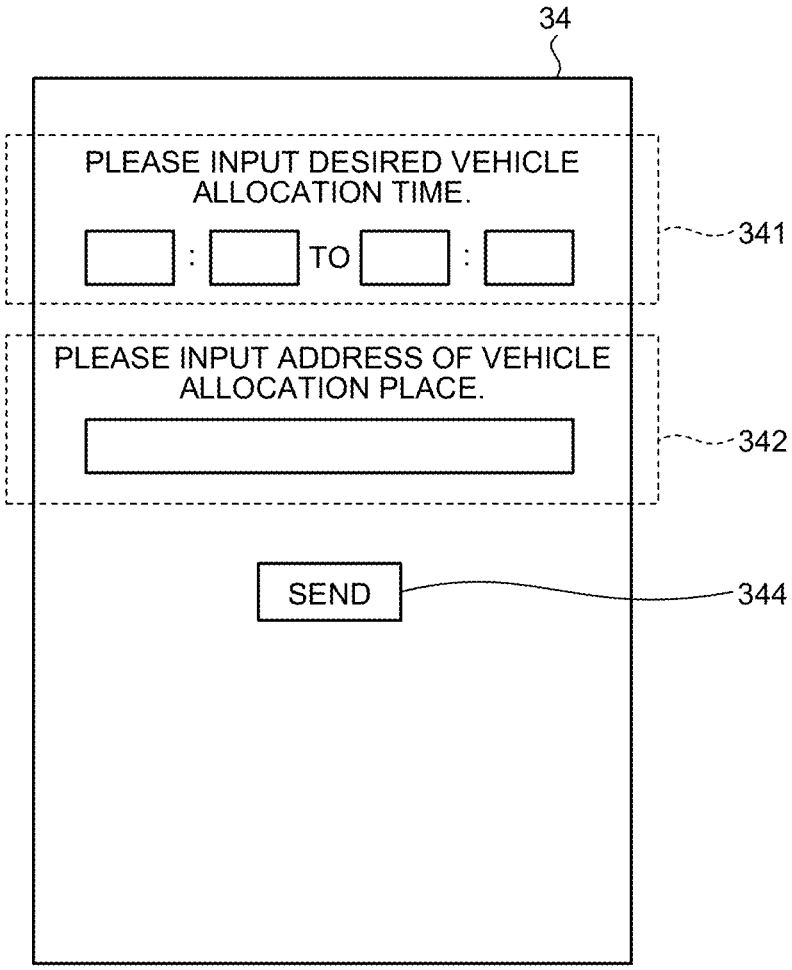

34
PLEASE INPUT DESIRED VEHICLE ALLOCATION TIME.
:
TO
:
341
PLEASE INPUT ADDRESS OF VEHICLE ALLOCATION PLACE.
342
SEND
344

FIG.6

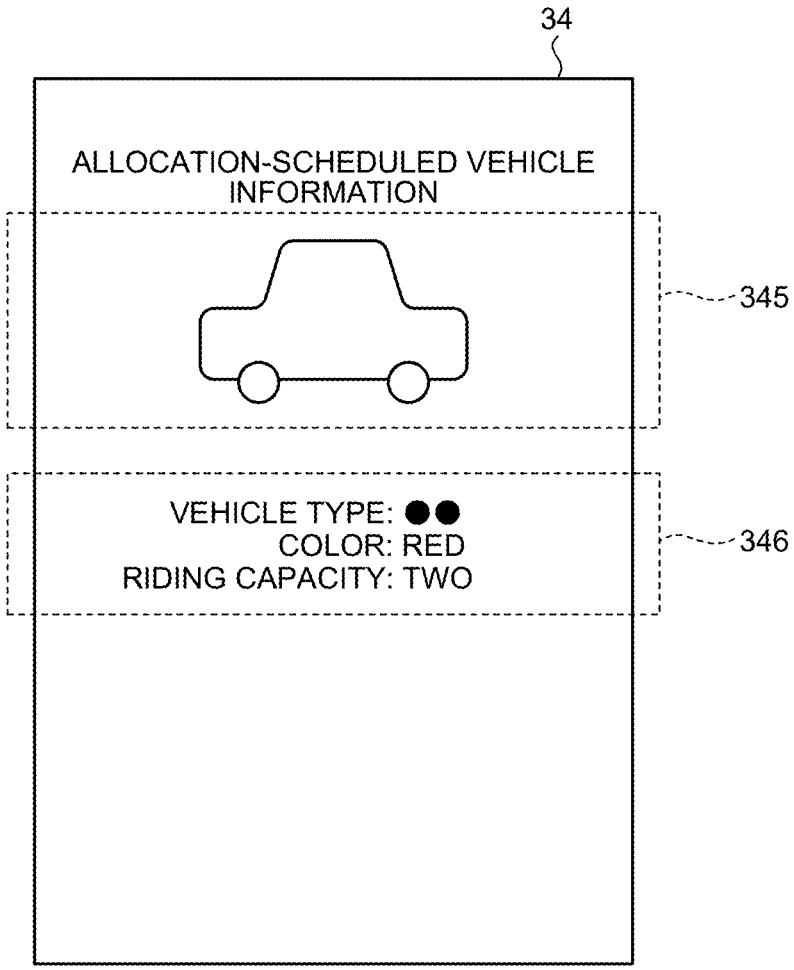

34
ALLOCATION-SCHEDULED VEHICLE INFORMATION
345
VEHICLE TYPE: ●●
COLOR: RED
RIDING CAPACITY: TWO
346

FIG.7

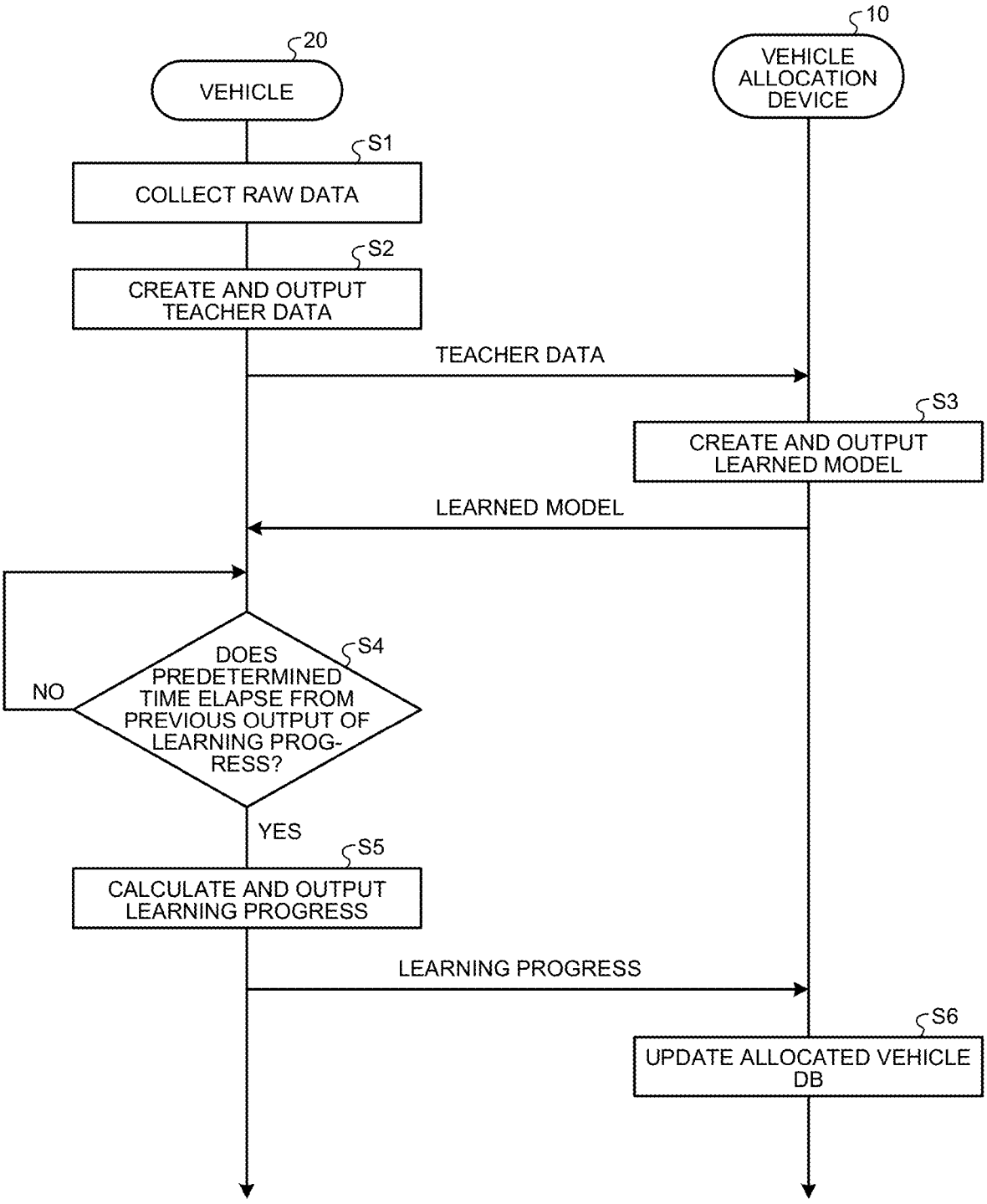
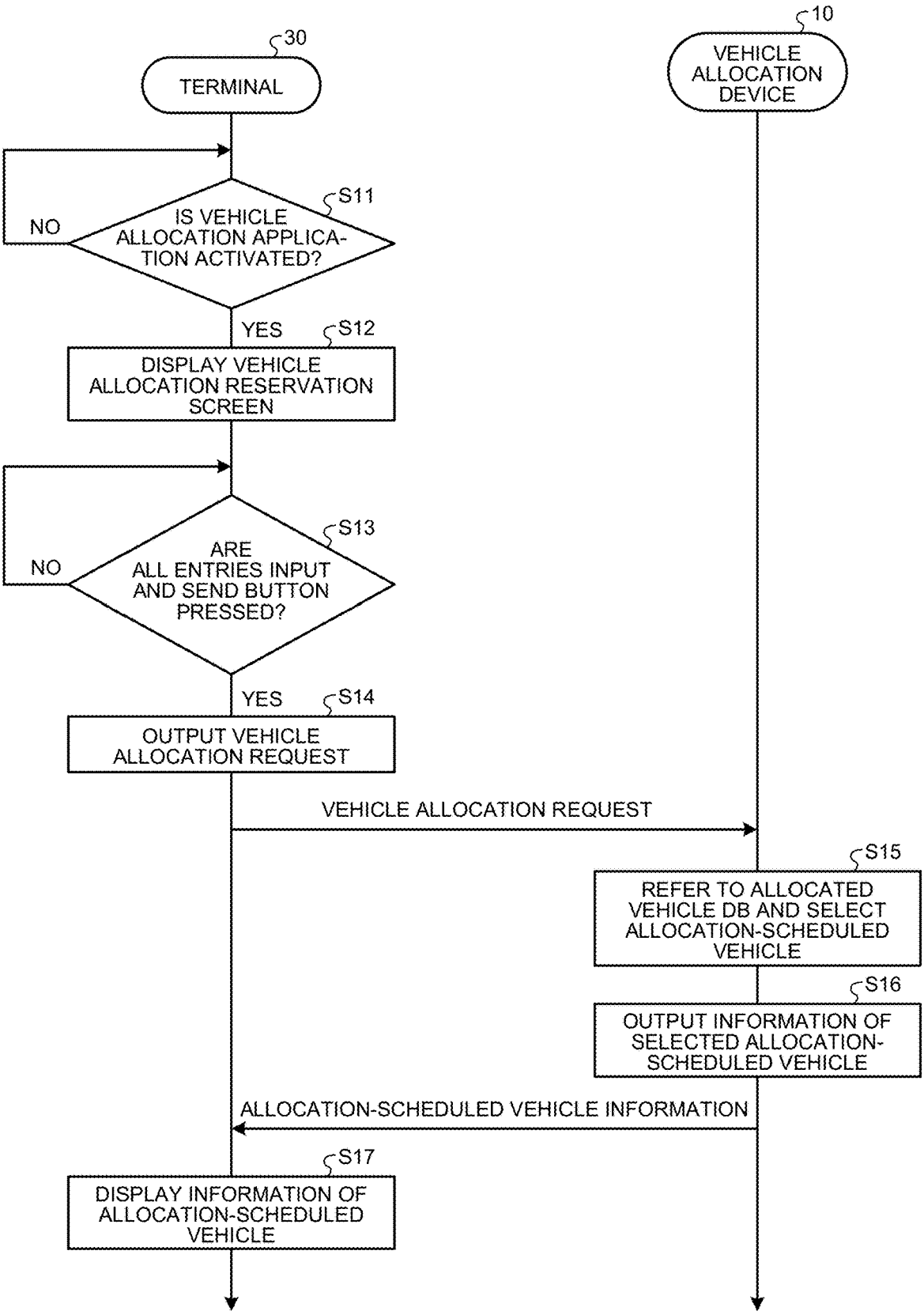

20
VEHICLE
10
VEHICLE ALLOCATION DEVICE
S1
COLLECT RAW DATA
S2
CREATE AND OUTPUT TEACHER DATA
TEACHER DATA
S3
CREATE AND OUTPUT LEARNED MODEL
LEARNED MODEL
S4
DOES PREDETERMINED TIME ELAPSE FROM PREVIOUS OUTPUT OF LEARNING PROG-RESS?
NO
YES
S5
CALCULATE AND OUTPUT LEARNING PROGRESS
LEARNING PROGRESS
S6
UPDATE ALLOCATED VEHICLE DB

FIG.8


30
TERMINAL
10
VEHICLE ALLOCATION DEVICE
S11
IS VEHICLE ALLOCATION APPLICATION ACTIVATED?
NO
YES
S12
DISPLAY VEHICLE ALLOCATION RESERVATION SCREEN
S13
ARE ALL ENTRIES INPUT AND SEND BUTTON PRESSED?
NO
YES
S14
OUTPUT VEHICLE ALLOCATION REQUEST
VEHICLE ALLOCATION REQUEST
S15
REFER TO ALLOCATED VEHICLE DB AND SELECT ALLOCATION-SCHEDULED VEHICLE
S16
OUTPUT INFORMATION OF SELECTED ALLOCATION-SCHEDULED VEHICLE
ALLOCATION-SCHEDULED VEHICLE INFORMATION
S17
DISPLAY INFORMATION OF ALLOCATION-SCHEDULED VEHICLE

VEHICLE ALLOCATION DEVICE, VEHICLE, AND TERMINAL

[0001] The present application claims priority to and incorporates by reference the entire contents of Japanese Patent Application No. 2020-084804 filed in Japan on May 13, 2020.

BACKGROUND

[0002] The present disclosure relates to a vehicle allocation device, a vehicle, and a terminal.

[0003] A technique of preferentially allocating a vehicle that has small progress in hydraulic control learning in a system of allocating a vehicle having a hydraulic control learning function of a power transmission device is disclosed in JP 2019-032625 A.

SUMMARY

[0004] In a vehicle allocation method disclosed in JP 2019-032625 A, a vehicle having low learning progress is preferentially allocated and there is little utilization advantage for a user. Thus, there has been a demand for a vehicle allocation method that is highly advantageous for a user in utilization.

[0005] According to one aspect of the present disclosure, there is provided a vehicle allocation device for allocating a vehicle in response to a vehicle allocation request from a terminal of a user, the vehicle allocation device including a vehicle selection unit configured to select, from a plurality of vehicles learning a relationship between input parameters and an output parameter related to traveling, a vehicle having relatively large learning progress in the relationship between the input parameters and the output parameter, and output a vehicle allocation instruction to the selected vehicle in a case where the vehicle allocation request is received.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a view schematically illustrating a vehicle allocation system that includes a vehicle allocation device, a vehicle, and a terminal and that is according to an embodiment;

[0007] FIG. **2** is a block diagram schematically illustrating each configuration of the vehicle allocation system according to the embodiment;

[0008] FIG. **3** is a view for describing an example of a neural network;

[0009] FIG. **4** is a view for describing an outline of a vehicle allocation method executed by the vehicle allocation system according to the embodiment;

[0010] FIG. **5** is a view illustrating an example of a vehicle allocation reservation screen displayed on the terminal in the vehicle allocation method executed by the vehicle allocation system according to the embodiment;

[0011] FIG. **6** is a view illustrating an example of allocation-scheduled vehicle information displayed on the terminal in the vehicle allocation method executed by the vehicle allocation system according to the embodiment;

[0012] FIG. **7** is a flowchart illustrating a flow of when teacher data is collected and learned in the vehicle allocation method executed by the vehicle allocation system according to the embodiment; and

[0013] FIG. **8** is a flowchart illustrating a flow of when a vehicle allocation reservation is made in the vehicle allocation method executed by the vehicle allocation system according to the embodiment.

DETAILED DESCRIPTION

[0014] A vehicle allocation device, vehicle, and terminal according to embodiments will be described with reference to the drawings. Note that components in the following embodiments include what may be easily replaced by those skilled in the art or what is substantially the same.

[0015] A vehicle allocation system according to an embodiment will be described with reference to FIG. **1** to FIG. **6**. As illustrated in FIG. **1**, a vehicle allocation system **1** according to the embodiment includes a vehicle allocation device **10**, a vehicle **20**, and a terminal **30**. All of the vehicle allocation device **10**, the vehicle **20**, and the terminal **30** have a communication function and are configured to be able to communicate with each other through a network NW. This network NW includes, for example, the Internet, a mobile phone network, and the like.

[0016] The vehicle allocation device **10** is a device to allocate the vehicle **20** to a user of the terminal **30** in response to a vehicle allocation request from the terminal **30**. The vehicle allocation device **10** is realized by a general-purpose computer such as a workstation or a personal computer.

[0017] As illustrated in FIG. **2**, the vehicle allocation device **10** includes a control unit **11**, a communication unit **12**, and a storage unit **13**. More specifically, the control unit **11** includes a processor including a central processing unit (CPU), a digital signal processor (DSP), a field-programmable gate array (FPGA), and the like, and a memory (main storage unit) including a random access memory (RAM), a read only memory (ROM), and the like.

[0018] The control unit **11** realizes a function that meets a predetermined purpose by loading and executing a program, which is stored in the storage unit **13**, in a work area of the main storage unit and controlling each configuration unit and the like through execution of the program. More specifically, the control unit **11** functions as a learning unit **111** and a vehicle selection unit **112** through the execution of the program described above.

[0019] The learning unit **111** learns teacher data. The learning unit **111** acquires parameters (learning value), which are collected by each vehicle **20**, through the network NW from a plurality of vehicles **20** to be allocated. These parameters include, for example, air temperature, humidity, air pressure, a grade, altitude, an intake air amount of an engine, ignition timing of the engine, an exhaust gas temperature of the engine, and the like.

[0020] Subsequently, the learning unit **111** creates a learned model by performing machine learning with the above parameters as teacher data. Then, the learning unit **111** outputs the created learned model to each vehicle **20** through the network NW. In such a manner, since the teacher data is learned on a side of the vehicle allocation device **10**, a calculation load on a side of the vehicle **20** is reduced.

[0021] A machine learning method in the learning unit **111** is not specifically limited, and supervised learning such as a neural network, support vector machine, decision tree, simple Bayes, and k-nearest neighbors algorithm may be used. Moreover, semi-supervised learning may be used instead of supervised learning.

[0022] In the following, a neural network will be described as an example of a specific machine learning

method. As illustrated in FIG. **3**, the neural network has an input layer, an intermediate layer, and an output layer. The input layer includes a plurality of nodes, and different input parameters are respectively input to the nodes. An output from the input layer is input to the intermediate layer. Moreover, the intermediate layer has a multi-layer structure that includes layers having a plurality of nodes to receive the input from the input layer. The output layer receives an output from the intermediate layer and outputs an output parameter. Machine learning using a neural network in which the intermediate layer has a multi-layer structure is called deep learning. An example in which input parameters are an "outside air temperature, outside air pressure, intake air amount, and ignition timing" and an output parameter is an "exhaust gas temperature" is illustrated in the drawing. The learning unit **111** creates a learned model by learning a relationship between these input parameters and the output parameter.

[0023] The vehicle selection unit **112** selects a vehicle **20** to be allocated to the user of the terminal **30** from the plurality of vehicles **20**. In a case of acquiring a vehicle allocation request from the terminal **30** through the network NW, the vehicle selection unit **112** selects, from a plurality of vehicles **20** learning a relationship between input parameters and an output parameter related to traveling (input/output relationship of parameters), a vehicle **20** having relatively large learning progress in the relationship between the input parameters and the output parameter.

[0024] The vehicle selection unit **112** selects, from a vehicle A and a vehicle B that perform learning during vehicle allocation, the vehicle B having the largest learning progress, for example, as illustrated in FIG. **4**. Then, the vehicle selection unit **112** outputs information related to the selected vehicle B (hereinafter, referred to as "allocation-scheduled vehicle information") to the terminal **30** of the user, and outputs a vehicle allocation instruction to the selected vehicle B.

[0025] Here, the learning progress is acquired from each vehicle **20**. That is, a vehicle **20** calculates learning progress based on the number of pieces and an acquisition time of teacher data collected by the own vehicle. Then, when selecting a vehicle **20**, the vehicle selection unit **112** acquires the learning progress from each vehicle **20** and selects the vehicle **20** based on the acquired learning progress. In such a manner, by acquiring the learning progress from each vehicle **20**, it is possible to grasp on the side of the vehicle allocation device **10** how much learning is progressed in each vehicle **20**.

[0026] The communication unit **12** includes, for example, a local area network (LAN) interface board, a wireless communication circuit for wireless communication, and the like. The communication unit **12** is connected to the network NW that is a public communication network, such as the Internet. Then, the communication unit **12** communicates with a vehicle **20** and a terminal **30** by being connected to the network NW.

[0027] The storage unit **13** includes recording media such as an erasable programmable ROM (EPROM), a hard disk drive (HDD), and a removable medium. Examples of the removable media include a universal serial bus (USB) memory, and disc recording media such as a compact disc (CD), a digital versatile disc (DVD), and a Blu-ray (registered trademark) disc (BD). The storage unit **13** may store an operating system (OS), various programs, various tables, various databases, and the like.

[0028] The storage unit **13** includes an allocated vehicle database (DB) **131**. The allocated vehicle DB **131** is constructed when a program of a database management system (DBMS) which program is executed by the control unit **11** manages data stored in the storage unit **13**. The allocated vehicle DB **131** includes, for example, a relational database in which the learning progress of each vehicle **20** is stored in a searchable manner.

[0029] Moreover, in addition to the allocated vehicle DB **131**, teacher data acquired from the vehicles **20** through the network NW, a learned model created by the learning unit **111**, and the like are stored in the storage unit **13** when necessary.

[0030] The vehicle **20** is a mobile body capable of communicating with the outside, and is a vehicle to be allocated to a user of the terminal **30** in response to a vehicle allocation request from the terminal **30**. This vehicle **20** may be either a manually driven vehicle or an automatically driven vehicle.

[0031] More specifically, the vehicle **20** learns a relationship between input parameters and an output parameter related to traveling, and outputs a learning result to the vehicle allocation device **10**. Note that in the embodiment, "learning" performed by the vehicle **20** means collecting various parameters during traveling (during vehicle allocation) and creating teacher data. The "learning result" output to the vehicle allocation device **10** specifically means the teacher data.

[0032] The vehicle **20** acquires a vehicle allocation instruction from the vehicle allocation device **10** in a case where learning progress in the relationship between the input parameters and the output parameter is relatively large compared to other vehicles **20** to be allocated. Note that the vehicle **20** may acquire a vehicle allocation instruction from the vehicle allocation device **10** in a case where the learning progress in the relationship between the input parameters and the output parameter is the largest compared to the other vehicles **20** to be allocated.

[0033] As illustrated in FIG. **2**, the vehicle **20** includes a control unit **21**, a communication unit **22**, a storage unit **23**, and a sensor group **24**. The control unit **21** is an electronic control unit (ECU) that comprehensively controls operations of various components mounted on the vehicle **20**. The control unit **21** functions as a teacher data collection unit **211** and a learning progress calculation unit **212** through execution of a program stored in the storage unit **23**.

[0034] The teacher data collection unit **211** collects teacher data. Note that the "teacher data" indicates, in the embodiment, a set of input parameters and output parameters necessary for machine learning. In such a manner, the teacher data collection unit **211** collects teacher data for learning and sequentially performs an output thereof to the vehicle allocation device **10**, whereby it is possible to learn various parameters.

[0035] More specifically, the teacher data collection unit **211** collects raw data of parameters by a sensor group **24** during traveling, and creates teacher data by performing predetermined preprocessing or the like. Then, the teacher data collection unit **211** outputs the created teacher data to the vehicle allocation device **10** through the network NW.

[0036] The learning progress calculation unit **212** calculates learning progress based on the number of pieces and an

acquisition time of teacher data collected by the vehicle **20**. At that time, the learning progress calculation unit **212** calculates the learning progress in such a manner that a value becomes smaller as the acquisition time of the teacher data becomes older. Then, the learning progress calculation unit **212** outputs the calculated learning progress to the vehicle allocation device **10** at predetermined time intervals, for example. More specifically, the learning progress calculation unit **212** calculates the learning progress by the following equation (1).

$$\text{LEARNING PROGRESS} = A \times \text{NUMBER OF PIECES OF TEACHER DATA} + F \times \text{AVERAGE ACQUISITION TIME} \quad (1)$$

WHERE A: PREDETERMINED VALUE AND F: CONVERSION COEFFICIENT

[0037] Moreover, as illustrated in Table 1 below, the learning progress calculation unit **212** sets a conversion coefficient F of the above equation (1) in such a manner that learning progress becomes smaller (slower) as an average acquisition time of teacher data becomes older (later). As a result, the learning progress may be calculated based on freshness of the collected teacher data.

TABLE 1

Vehicle	Number of pieces of teacher data (Piece)	Average acquisition time	Learning progress
Vehicle A	1000	2019 Nov. 12	20
Vehicle B	700	2019 Dec. 12	90
Vehicle C	1600	2019 Oct. 3	0
. . .	. . .	. . .	. . .

[0038] The communication unit **22** includes, for example, a data communication module (DCM) and the like, and performs communication with the vehicle allocation device **10** and the terminal **30** by wireless communication through the network NW. When necessary, the storage unit **23** stores, for example, raw data of parameters collected by the teacher data collection unit **211**, teacher data created by the teacher data collection unit **211**, learning progress calculated by the learning progress calculation unit **212**, and the like.

[0039] The sensor group **24** is to detect and record parameters during traveling of the vehicle **20** and includes, for example, a vehicle speed sensor, an acceleration sensor, a GPS sensor, a traveling space sensor (3D-LiDAR), a millimeter wave sensor, a camera (imaging device), a temperature sensor, a humidity sensor, an air pressure sensor, and the like. The sensor group **24** outputs raw data of the detected parameters to the teacher data collection unit **211**.

[0040] The terminal **30** is a terminal device to make a vehicle allocation request to the vehicle allocation device **10** based on operation by a user. For example, the terminal **30** is realized by a smartphone, a mobile phone, a tablet terminal, a wearable computer, or the like owned by the user of the vehicle **20**. As illustrated in FIG. **2**, the terminal **30** includes a control unit **31**, a communication unit **32**, a storage unit **33**, and an operation/display unit **34**. The control unit **31** functions as a vehicle allocation reservation unit **311** through execution of a program stored in the storage unit **33**.

[0041] The vehicle allocation reservation unit **311** causes the operation/display unit **34** to display a vehicle allocation reservation screen, and receives a vehicle allocation reservation from the user through the vehicle allocation reservation screen. Subsequently, the vehicle allocation reservation unit **311** outputs a vehicle allocation request (vehicle allocation reservation information) to the vehicle allocation device **10** based on the vehicle allocation reservation. This vehicle allocation request includes, for example, a desired vehicle allocation time, an address of a vehicle allocation place, a destination, and information for identifying a user (such as name and ID).

[0042] Subsequently, the vehicle allocation reservation unit **311** acquires information, which is related to a vehicle **20** that is selected from a plurality of vehicles **20** learning a relationship between input parameters and an output parameter related to traveling and that has relatively large learning progress in the relationship between the input parameters and the output parameter, as allocation-scheduled vehicle information from the vehicle allocation device **10**. Then, the vehicle allocation reservation unit **311** causes the operation/display unit **34** to display this allocation-scheduled vehicle information. Note that the vehicle allocation reservation unit **311** may acquire information, which is related to a vehicle **20** having the largest learning progress in the relationship between the input parameters and the output parameter, as allocation-scheduled vehicle information from the vehicle allocation device **10**.

[0043] In making of a vehicle allocation reservation, the vehicle allocation reservation unit **311** causes the operation/display unit **34** to display a vehicle allocation reservation screen such as what is illustrated in FIG. **5**, for example. This vehicle allocation reservation screen is displayed, for example, when the user taps an icon of a vehicle allocation application displayed on the operation/display unit **34** and activates the vehicle allocation application. On the vehicle allocation reservation screen illustrated in the drawing, an entry field for a desired vehicle allocation time is displayed in a region **341**, an entry field for an address of a vehicle allocation place is displayed in a region **342**, and a send button **344** is displayed at the bottom. Note that in addition to the entries illustrated in the drawing, the vehicle allocation reservation unit **311** may display an entry field for a destination or information to identify a user (such as name or ID), for example.

[0044] When all the entries on the vehicle allocation reservation screen are input and the send button **344** is pressed by the user, the vehicle allocation reservation unit **311** outputs a vehicle allocation request including the information input to these entries to the vehicle allocation device **10**.

[0045] The vehicle selection unit **112** of the vehicle allocation device **10** that acquires the vehicle allocation request selects an allocation-scheduled vehicle with reference to the allocated vehicle DB **131**, and causes the operation/display unit **34** to display allocation-scheduled vehicle information such as what is illustrated in FIG. **6**, for example. In the allocation-scheduled vehicle information illustrated in the drawing, an image of the allocation-scheduled vehicle is displayed in a region **345**, and a vehicle type, color, and riding capacity are displayed in a region **346**.

[0046] The communication unit **32** communicates with the vehicle allocation device **10** and the vehicle **20** by wireless communication through the network NW. The storage unit

33 stores, for example, an application program (vehicle allocation application) to realize the vehicle allocation reservation unit 311.

[0047] The operation/display unit 34 includes, for example, a touch panel display or the like, and has an input function of receiving operation by a finger of an occupant of the vehicle 20, a pen, or the like, and a display function of displaying various kinds of information under the control of the control unit 31. The operation/display unit 34 displays the vehicle allocation reservation screen (see FIG. 5) and the allocation-scheduled vehicle information (see FIG. 6) under the control of the vehicle allocation reservation unit 311.

[0048] An example of a processing procedure of the vehicle allocation method executed by the vehicle allocation system 1 according to the embodiment will be described with reference to FIG. 7 and FIG. 8. In the following, with respect to the vehicle allocation system 1, a flow of a step of collecting and learning teacher data by using a vehicle 20 (hereinafter, referred to as "learning step") will be described with reference to FIG. 7, and a flow of a step of making a vehicle allocation reservation (hereinafter, referred to as "vehicle allocation reservation step") will be described with reference to FIG. 8. Moreover, in the following vehicle allocation reservation step, an example of a case where a vehicle 20 having the largest learning progress is preferentially allocated will be described.

[0049] First, a teacher data collection unit 211 of a vehicle 20 collects raw data of parameters related to traveling through a sensor group 24 (Step S1). Subsequently, the teacher data collection unit 211 creates teacher data from the raw data and outputs the created teacher data to a vehicle allocation device 10 (Step S2). Subsequently, a learning unit 111 of the vehicle allocation device 10 creates a learned model by performing machine learning on the teacher data, and outputs the created learned model to the vehicle 20 (Step S3).

[0050] Subsequently, a learning progress calculation unit 212 of the vehicle 20 determines whether a predetermined time elapses from a previous output of learning progress to the vehicle allocation device 10 (Step S4). In a case where it is determined that the predetermined time elapses from the previous output of learning progress to the vehicle allocation device 10 (Yes in Step S4), the learning progress calculation unit 212 calculates learning progress based on the above equation (1) and outputs the calculated learning progress to the vehicle allocation device 10 (Step S5). In response to this, a control unit 11 of the vehicle allocation device 10 updates an allocated vehicle DB 131 by storing the learning progress into the allocated vehicle DB 131 (Step S6). Note that in a case where it is determined that the predetermined time does not elapse from the previous output of learning progress to the vehicle allocation device 10 (No in Step S4), the learning progress calculation unit 212 returns to Step S4. From the above, the processing of the learning step of the vehicle allocation method is ended.

[0051] First, a vehicle allocation reservation unit 311 of a terminal 30 determines whether a user activates a vehicle allocation application, for example, by tapping an icon of the vehicle allocation application which icon is displayed on an operation/display unit 34 (Step S11). In a case where it is determined that the vehicle allocation application is activated (Yes in Step S11), the vehicle allocation reservation unit 311 causes the operation/display unit 34 to display the vehicle allocation reservation screen (see FIG. 5) (Step S12). Note that in a case where it is determined that the vehicle allocation application is not activated (No in Step S11), the vehicle allocation reservation unit 311 returns to Step S11.

[0052] Subsequently, the vehicle allocation reservation unit 311 determines whether all entries on the vehicle allocation reservation screen are input and a send button 344 is pressed (Step S13). In a case where it is determined that all the entries on the vehicle allocation reservation screen are input and the send button 344 is pressed (Yes in Step S13), the vehicle allocation reservation unit 311 outputs a vehicle allocation request to the vehicle allocation device 10 (Step S14). Note that in a case where it is determined that any of the entries on the vehicle allocation reservation screen is not input or the send button 344 is not pressed (No in Step S13), the vehicle allocation reservation unit 311 returns to Step S13.

[0053] Subsequently, a vehicle selection unit 112 of the vehicle allocation device 10 refers to the allocated vehicle DB 131 and selects an allocation-scheduled vehicle (Step S15). In Step S15, the vehicle selection unit 112 selects, from a plurality of vehicles 20 learning a relationship between input parameters and an output parameter related to traveling, a vehicle 20 having the largest learning progress in the relationship between the input parameters and the output parameter.

[0054] Subsequently, the vehicle selection unit 112 outputs information of the selected allocation-scheduled vehicle to the terminal 30 (Step S16). In response to this, the vehicle allocation reservation unit 311 causes the operation/display unit 34 to display the allocation-scheduled vehicle information (see FIG. 6) (Step S17). Note that in Step S16, the vehicle selection unit 112 outputs the allocation-scheduled vehicle information to the terminal 30, and also outputs a vehicle allocation instruction to the selected vehicle 20. From the above, the processing of the vehicle allocation reservation step of the vehicle allocation method is ended.

[0055] According to a vehicle allocation device 10, a vehicle 20, and a terminal 30 of the embodiment described above, a vehicle 20 in which learning of teacher data is advanced, that is, a vehicle 20 equipped with a highly accurate learned model is preferentially allocated, whereby a utilization advantage for a user is improved.

[0056] In a case where a vehicle that performs AI learning is allocated, a learning condition varies between vehicles to be allocated. Thus, a condition in which learning is extremely delayed may be generated depending on a vehicle. When such a vehicle is allocated, unfairness is generated among users who are borrowers. On the one hand, according to the vehicle allocation device 10, the vehicle 20, and the terminal 30 of the embodiment, it is determined whether learning is advanced based on the number of pieces of teacher data and an acquisition time of the teacher data (freshness of teacher data), and a vehicle 20 in which the learning is advanced is preferentially allocated. Thus, a utilization advantage for a user is improved.

[0057] Further effects and modification examples may be easily derived by those skilled in the art. Accordingly, broader aspects of the present disclosure are not limited by the specific details and representative embodiments that are illustrated and described in the above manner. Thus, various modifications may be made without departing from the sprit or scope of a general concept of the disclosure defined by the accompanying claims and an equivalent thereof.

[0058] For example, in the vehicle allocation reservation step (see FIG. **8**) of the vehicle allocation system **1** described above, a case where a vehicle **20** having the largest learning progress is selected and allocated has been described. However, selection from vehicles **20** having learning progress equal to or larger than predetermined progress may be performed according to a different condition. Alternatively, it may be determined whether vehicle allocation may be performed in order from a vehicle **20** having the largest learning progress and a vehicle **20** that is first determined that allocation may be performed may be selected.

[0059] Moreover, in the vehicle allocation system **1** described above, collection of raw data and creation of teacher data are performed on a side of a vehicle **20**, and learning of the teacher data and creation of learned data are performed on a side of a vehicle allocation device **10**. However, a subject of creating teacher data and a subject of learning are not limited to these.

[0060] In a vehicle allocation system **1**, for example, collection of raw data may be performed on a side of a vehicle **20**, and creation of teacher data, learning of the teacher data, and creation of learned data may be performed on a side of a vehicle allocation device **10**. Moreover, all of collection of raw data, creation of teacher data, learning of the teacher data, and creation of learned data may be performed on a side of a vehicle **20**.

[0061] Moreover, various parameters are collected by a teacher data collection unit **211** of a vehicle **20** in the vehicle allocation system **1**. However, various parameters may be acquired and used by road-to-vehicle communication or vehicle-to-vehicle communication, for example.

[0062] Moreover, as expressed in the above equation (1), learning progress is calculated based on the number of pieces of teacher data and an average acquisition time thereof in the vehicle allocation system **1**. However, instead of an average acquisition time of teacher data, a median of acquisition times of teacher data, the oldest acquisition time of the teacher data, or the latest acquisition time of the teacher data may be used.

[0063] Moreover, the vehicle allocation system **1** described above have been described on the assumption of a scene in which a vehicle is allocated to a user on a general public road. However, for example, it is also possible to apply a vehicle allocation system **1** to a vehicle allocation service using a self-driving vehicle in a connected city or the like in which all goods and services are connected with information.

[0064] According to the present disclosure, a vehicle in which learning of teacher data is advanced, that is, a vehicle equipped with a highly accurate learned model is preferentially allocated. Thus, a utilization advantage for a user is improved.

[0065] Moreover, a vehicle in which parameter learning is relatively advanced among vehicles to be allocated is likely to be preferentially allocated.

[0066] Moreover, a vehicle in which parameter learning is the most advanced among vehicles to be allocated is preferentially allocated.

[0067] Moreover, learning progress may be calculated based on an acquisition time of teacher data, that is, freshness of the teacher data.

[0068] Moreover, it is possible for a side of a vehicle allocation device to grasp how much learning is progressed in each vehicle.

[0069] Moreover, teacher data is learned on a side of a vehicle allocation device and a calculation load on a side of a vehicle is reduced.

[0070] Moreover, it is possible to learn various parameters.

[0071] Moreover, a vehicle in which parameter learning is relatively advanced among vehicles to be allocated is likely to be preferentially allocated.

[0072] Moreover, a vehicle in which parameter learning is the most advanced among vehicles to be allocated is preferentially allocated.

[0073] Moreover, each vehicle may collect teacher data and calculate learning progress simultaneously and may perform transmission thereof to a side of a vehicle allocation device.

[0074] Moreover, it is possible to learn various parameters.

[0075] Moreover, a vehicle in which parameter learning is relatively advanced among vehicles to be allocated is likely to be preferentially allocated.

[0076] Moreover, a vehicle in which parameter learning is the most advanced among vehicles to be allocated is preferentially allocated.

[0077] Moreover, it is possible to learn various parameters.

[0078] Although the disclosure has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

What is claimed is:

1. A vehicle allocation device for allocating a vehicle in response to a vehicle allocation request from a terminal of a user, the vehicle allocation device comprising

a vehicle selection unit configured to

select, from a plurality of vehicles learning a relationship between input parameters and an output parameter related to traveling, a vehicle having relatively large learning progress in the relationship between the input parameters and the output parameter, and

output a vehicle allocation instruction to the selected vehicle in a case where the vehicle allocation request is received.

2. The vehicle allocation device according to claim **1**, wherein the vehicle selection unit is configured to

select, from the plurality of vehicles, a vehicle having largest learning progress in the relationship between the input parameters and the output parameter, and

output a vehicle allocation instruction to the selected vehicle.

3. The vehicle allocation device according to claim **1**, wherein the learning progress is calculated based on an acquisition time of teacher data including the input parameters and the output parameter, and is calculated in such a manner that a value becomes smaller as the acquisition time of the teacher data becomes older.

4. The vehicle allocation device according to claim **1**, wherein the vehicle selection unit is configured to acquire the learning progress from the plurality of vehicles.

5. The vehicle allocation device according to claim **1**, further comprising: a learning unit configured to learn parameters collected by each of the vehicles, as teacher data from the plurality of vehicles.

6. The vehicle allocation device according to claim 1, wherein the input parameters and the output parameter include air temperature, humidity, air pressure, a grade, altitude, an intake air amount of an engine, ignition timing of the engine, and an exhaust gas temperature of the engine.

7. A vehicle adapted to be allocated by a vehicle allocation device in response to a vehicle allocation request from a terminal of a user, the vehicle comprising

circuitry configured to

learn a relationship between input parameters and an output parameter related to traveling, and

acquire a vehicle allocation instruction from the vehicle allocation device in a case where learning progress in the relationship between the input parameters and the output parameter is relatively large compared to other vehicles to be allocated.

8. The vehicle according to claim 7, wherein the circuitry is configured to acquire a vehicle allocation instruction from the vehicle allocation device in a case where the learning progress in the relationship between the input parameters and the output parameter is largest compared to the other vehicles to be allocated.

9. The vehicle according to claim 7, comprising:

a teacher data collection unit configured to collect teacher data including the input parameters and the output parameter; and

a learning progress calculation unit configured to calculate the learning progress in such a manner that a value becomes smaller as an acquisition time of the teacher data becomes older, and output the calculated learning progress to the vehicle allocation device.

10. The vehicle according to claim 7, wherein the input parameters and the output parameter include air temperature, humidity, air pressure, a grade, altitude, an intake air amount of an engine, ignition timing of the engine, and an exhaust gas temperature of the engine.

11. A terminal for making a vehicle allocation request to a vehicle allocation device, the terminal comprising:

a vehicle allocation reservation unit configured to receive a vehicle allocation reservation from a user and output the vehicle allocation request to the vehicle allocation device based on the vehicle allocation reservation, wherein

by outputting the vehicle allocation request to the vehicle allocation device, the vehicle allocation reservation unit is configured to acquire, as allocation-scheduled vehicle information, information related to a vehicle that is selected from a plurality of vehicles learning a relationship between input parameters and an output parameter related to traveling and that has relatively large learning progress in the relationship between the input parameters and the output parameter.

12. The terminal according to claim 11, wherein by outputting the vehicle allocation request to the vehicle allocation device, the vehicle allocation reservation unit is configured to acquire, as allocation-scheduled vehicle information, information related to a vehicle that is selected from the plurality of vehicles learning the relationship between the input parameters and the output parameter related to traveling and that has largest learning progress in the relationship between the input parameters and the output parameter.

13. The terminal according to claim 11, wherein the input parameters and the output parameter include air temperature, humidity, air pressure, a grade, altitude, an intake air amount of an engine, ignition timing of the engine, and an exhaust gas temperature of the engine.

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