

[DESCRIPTION]

[Title of Invention]

INFORMATION PROCESSING DEVICE, INFORMATION PROCESSING SYSTEM,
INFORMATION PROCESSING METHOD, AND RECORDING MEDIUM

[Technical Field]

[0001]

The present disclosure relates to an information processing device, an information processing system, an information processing method, and a recording medium.

[Background Art]

[0002]

People may sometimes have difficulty in smoothly moving to their destinations in a certain space such as a construction site, a commercial facility, a distribution site, or an airport. Various route generation techniques or route search techniques have been studied and provided as applications to support movement in such a space. Such route generation techniques or route search techniques may be collectively referred to as “route generation techniques” in the following description. Some of such route generation techniques are proposed to add priority conditions on time or distance such as the shortest time or distance to generate a route based on the priority conditions.

[Citation List]

[Patent Literature]

[0003]

[PTL 1]

Japanese Unexamined Patent Application Publication No. 2023-000992

[Summary of Invention]

[Technical Problem]

[0004]

In a space specialized for a specific purpose, such as a construction site, a commercial facility, a distribution site, or an airport, an appropriate route may differ depending on how the person moving in the space is related to the space. For example, in a commercial facility, even if the starting and terminal points are the same, the appropriate route may differ depending on whether the person moving in the space is a customer or a salesperson.

[0005]

In light of the above-described situation, it is an object of the present invention to generate a route tailored to a user.

[Solution to Problem]

[0006]

The present disclosure described herein provides an information processing device including a receiving unit and a route generating unit. The receiving unit receives user information related to a user who requests generation of a route. The route generating unit generates the

route tailored to the user information in a space displayed for the user as a route generation target, based on map information indicating the space and the user information.

The present disclosure described herein provides an information processing system including a receiving unit, a route generating unit, and a display control unit. The receiving unit receives user information related to a user who requests generation of a route. The route generating unit generates the route tailored to the user information in a space displayed for the user as a route generation target, based on map information indicating the space and the user information. The display control unit displays the route.

The present disclosure described herein provides an information processing method including receiving user information related to a user who requests generation of a route; and generating the route tailored to the user information in a space displayed for the user as a route generation target, based on map information indicating the space and the user information.

The present disclosure described herein provides a recording medium storing a plurality of instructions which, when executed by one or more processors of a printing apparatus, causes the one or more processors to perform an information processing method. The method includes receiving user information related to a user who requests generation of a route; and generating the route tailored to the user information in a space displayed for the user as a route generation target, based on map information indicating the space and the user information.

[Advantageous Effects of Invention]

[0007]

According to one aspect of the present disclosure, a route tailored to a user can be generated.

[Brief Description of Drawings]

[0008]

A more complete appreciation of embodiments of the present disclosure and many of the attendant advantages and features thereof can be readily obtained and understood from the following detailed description with reference to the accompanying drawings.

[FIG. 1]

FIG. 1 is a diagram illustrating a configuration of an information processing system according to a first embodiment.

[FIG. 2]

FIG. 2 is a diagram illustrating a hardware configuration of a server device according to the first embodiment.

[FIG. 3]

FIG. 3 is a diagram illustrating a functional configuration of an information processing system according to the first embodiment.

[FIG. 4]

FIG. 4 is a sequence diagram illustrating a map information update process according to the first embodiment.

[FIG. 5]

FIG. 5 is a diagram illustrating a configuration of a map information storing unit.

[FIG. 6]

FIG. 6 is a diagram illustrating a space screen.

[FIG. 7]

FIG. 7 is a sequence diagram illustrating a route generation process according to the first embodiment.

[FIG. 8]

FIG. 8 is a diagram illustrating a configuration of a user information storing unit.

[FIG. 9]

FIG. 9 is a diagram illustrating a first example of a space screen displaying a route according to the first embodiment.

[FIG. 10]

FIG. 10 is a diagram illustrating a second example of a space screen displaying a route according to the first embodiment.

[FIG. 11]

FIG. 11 is a sequence diagram illustrating a route generation process according to a second embodiment.

[FIG. 12]

FIG. 12 is a diagram illustrating a space screen displaying a route according to the second embodiment.

[FIG. 13]

FIG. 13 is a sequence diagram illustrating a route generation process according to a third embodiment.

[FIG. 14]

FIG. 14 is a diagram illustrating a first example of a space screen displaying a route according to the third embodiment.

[FIG. 15]

FIG. 15 is a diagram illustrating a second example of a space screen displaying a route according to the third embodiment.

The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted. Also, identical or similar reference numerals designate identical or similar components throughout the several views.

[Description of Embodiments]

[0009]

In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this specification is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element

includes all technical equivalents that have a similar function, operate in a similar manner, and achieve a similar result.

Embodiments of the present disclosure are described below with reference to the drawings. As used herein, the singular forms “a,” “an,” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise.

FIG. 1 is a diagram illustrating a configuration of an information processing system 1 according to a first embodiment. In FIG. 1, one or more terminal devices 20 are connected to a server device 10 through a communication network 30 such as the Internet.

[0010]

The terminal device 20 is a device used by a user who requests generation of a route suitable for the user in a certain three-dimensional space including multiple routes. The three-dimensional space may be referred to simply as a “space” in the following description. For example, a personal computer (PC), a smartphone, or a tablet terminal may be used as the terminal device 20.

[0011]

The server device 10 is one or more computers that generate (search for) a route suitable for a user in a space in response to a request from the terminal device 20 and cause the terminal device 20 to display the generated route. The space is any space specialized for a specific purpose, such as a commercial facility, a distribution site, or an airport. Alternatively, the space may be a space where the number of people who use the space is limited, such as a machine room. However, the purpose of moving in the space may differ depending on the person. In other words, the purpose of moving in the space may differ depending on the user of the terminal device 20. The server device 10 generates a route that reflects the circumstances where the purpose of moving in the space may differ depending on the person.

[0012]

FIG. 2 is a diagram illustrating a hardware configuration of the server device 10 according to the first embodiment. The server device 10 of FIG. 2 includes a drive device 100, an auxiliary memory 102, a memory 103, a processor 104, and an interface device 105 that are connected to each other through a bus B.

[0013]

A program that implements the processing in the server device 10 is provided via a recording medium 101 such as a compact disc-read-only memory (CD-ROM). When the recording medium 101 storing the program is set in the drive device 100, the program is installed in the auxiliary memory 102 via the drive device 100 from the recording medium 101. In some embodiments, the program may be downloaded from another computer through a network, instead of being installed from the recording medium 101. The auxiliary memory 102 stores the installed program and also stores files and data to be used.

[0014]

In response to an instruction to activate the program, the memory 103 reads the program from

the auxiliary memory 102 and stores the program. The processor 104 is a central processing unit (CPU) alone, a graphics processing unit (GPU) alone, or both of a CPU and a GPU, and executes functions related to the server device 10 according to the program stored in the memory 103. The interface device 105 is used for connecting the server device 10 to a network, and may be implemented by a network interface circuit.

[0015]

The terminal device 20 may also have substantially the same hardware configuration as the configuration illustrated in FIG. 2. For example, in addition to the hardware elements illustrated in FIG. 2, the terminal device 20 further includes a keyboard or a mouse, a display, or a touch panel display.

[0016]

FIG. 3 is a diagram illustrating a functional configuration of the information processing system 1 according to the first embodiment.

The terminal device 20 includes an input unit 21, a request transmitting unit 22, and a display control unit 23. Each of these functional units is implemented by processing executed by the processor of the terminal device 20 according to one or more programs installed on the terminal device 20.

[0017]

The input unit 21 receives input from a user of the terminal device 20. The input unit 21 receives, for example, an instruction from the user to display map information that indicates any of multiple spaces that can be candidates for a route generation target. The space that can be a candidate for a route generation target may be referred to as a “candidate space” in the following description. In the instruction to display the map information, the user inputs the identification information of a space related to the map information of the display target. The identification information of the space may be referred to as “space identification information” in the following description.

[0018]

The input unit 21 also receives user edits for the displayed map information. The edits include moving or deleting an existing object in the space or adding a new object to the space.

[0019]

The input unit 21 further receives an instruction from the user to generate a route in the space related to the displayed map information. In the instruction to generate a route, the user inputs a starting point (departure point) and a terminal point (destination) of the route and information related to the user. The two points, which are the starting point and the terminal point, may be referred to as “route endpoints” while the information related to the user may be referred to as “user information” in the following description.

[0020]

The request transmitting unit 22 transmits a space display request, a space editing request, or a route generation request to the server device 10. The space display request is a request to

display a space and includes information input in relation to an instruction to display the space. The space editing request is a request to edit a space and includes information input in relation to an instruction to edit the space. The route generation request is a request to generate a route and includes information input in relation to an instruction to generate the route.

[0021]

The display control unit 23 controls the display of a screen based on the display information transmitted from the server device 10.

[0022]

The server device 10 includes a receiving unit 11, an update unit 12, a route generating unit 13, a display information generating unit 14, and a display information transmitting unit 15. Each of these functional units is implemented by the processor 104 executing one or more programs installed on the server device 10. The server device 10 also uses a map information storing unit 121, a user information storing unit 122, and a model storing unit 123. Each of these storing units is implemented by, for example, the auxiliary memory 102 or a storage device that is connectable to the server device 10 through a network.

[0023]

The receiving unit 11 receives a request from the terminal device 20 and information related to the request. For example, the receiving unit 11 receives information related to the space display request, information related to the space editing request, or information related to the route generation request. The receiving unit 11 receives, as information related to the space display request, the space identification information of a space to be displayed. The receiving unit 11 receives, as information related to the space editing request, information that indicates an editing result of the map information related to a space to be edited, which may be referred to simply as an “editing result” in the following description. The receiving unit 11 receives, as information related to the route generation request, the route endpoints and the user information.

[0024]

When the receiving unit 11 receives the space editing request, the update unit 12 updates the map information stored in the map information storing unit 121 based on the editing result.

[0025]

The map information storing unit 121 stores map information for each candidate space. The map information represents a three-dimensional space, including information related to an object in a space related to the map information, such as position information and position attribute information. Multiple forms may be employed as methods to represent a three-dimensional space, including point clouds, meshes, and three-dimensional Computer-Aided Design (3D CAD).

[0026]

When the receiving unit 11 receives the route generation request, the route generating unit 13

generates a route connecting the route endpoints in the space and tailored to the user information, based on the map information that indicates the space displayed for the user as a route generation target and corresponding to the space identification information (the space related to the space identification information designated in the route generation request), the user information, and the route endpoints. When generating the route, the route generating unit 13 uses a route generation model m1 stored in the model storing unit 123.

[0027]

The route generation model m1 is a machine learning model (for example, a neural network) that has learned the relationships between user information, route endpoints, and a route based on learning data including, for each piece of map information, the user information, the route endpoints, and the route connecting the route endpoints and tailored to the user information in the map information (as a correct route for the user information and the route endpoints).

[0028]

The user information storing unit 122 stores, for each user, the attribute information of the user in association with user identification information, which is information used to identify each user and identification information unique to each user. The attribute information of the user may be referred to as “user attribute” and the user identification information may be referred to as “user ID” in the following description. The user attribute is information unique to each group when users are divided into groups based on the user attribute. The attribute of the user refers to, for example, a position or a role of the user in the space.

[0029]

The display information generating unit 14 generates, for example, display information that indicates map information to be edited or map information related to a space as a route generation target, or display information that indicates the generated route.

[0030]

The display information transmitting unit 15 transmits the display information generated by the display information generating unit 14 to the terminal device 20.

[0031]

A process executed by the information processing system 1 is described below. FIG. 4 is a sequence diagram illustrating a map information update process according to the first embodiment.

[0032]

In step S101, the input unit 21 of the terminal device 20 receives an instruction from the user to display a certain space. In the instruction to display a space, the user inputs space identification information related to the space. The user may input the space identification information by, for example, selecting any map information from a list of map information stored in the map information storing unit 121.

[0033]

In step S102, the input unit 21 transmits a space display request including the received space

identification information to the server device 10.

[0034]

When the receiving unit 11 of the server device 10 receives the space display request, in step S103, the display information generating unit 14 generates the display information of a space related to the space identification information based on the map information stored in the map information storing unit 121 in association with the space identification information included in the space display request. The space related to the space identification information may be referred to as a “target space” and the display information of the target space may be referred to as “space display information” in the following description.

[0035]

FIG. 5 is a diagram illustrating a configuration of the map information storing unit 121. As illustrated in FIG. 5, the map information storing unit 121 stores, for each space, the object identification information, shape information, position information, and position attribute information of (a three-dimensional model of) each object in the space. The object identification information is identification information of an object and unique to each object. The shape information is information that indicates the shape and size of the object. The position information is three-dimensional coordinate information that indicates the position of (the reference point of) the object in the space. The position attribute information is attribute information (related to the position) of the object. The position attribute information may be any information related to an object or the position of the object. Examples of the position attribute information include the type of the object and the property of the object such as whether the object is dangerous.

[0036]

The configuration of map information illustrated in FIG. 5 is merely an example. Information in another format that can represent a three-dimensional space where a route can be generated may be used as map information. The map information may be text data. For example, the map information may be represented in comma-separated values (CSV) or Extensible Markup Language (XML) format.

[0037]

The display information generating unit 14 generates space display information that indicates the target space based on such map information.

[0038]

In step S104, the display information transmitting unit 15 transmits the space display information generated by the display information generating unit 14 to the terminal device 20.

[0039]

When the display control unit 23 of the terminal device 20 receives the space display information, in step S105, the display control unit 23 displays, on the display of the terminal device 20, a space screen that indicates the target space based on the space display information and that can receive, for example, an instruction to edit the target space or an

instruction to generate a route in the target space.

[0040]

FIG. 6 is a diagram illustrating a space screen. In FIG. 6, a space screen 510 displays a plan view of a space s1 as a target space from above. However, the representation of the space s1 is not limited to a predefined format.

[0041]

In step S106, the display control unit 23 receives user edits for the placement of the object in the target space. For example, the user can move or delete an existing object or place a new object in the target space. Step S106 may be implemented using 3D CAD software or similar tools. In this case, the map information may be three-dimensional model information having a format specific to the 3D CAD software or similar tools.

[0042]

When the user inputs an instruction to end editing, in step S107, the request transmitting unit 22 transmits a space editing request including the space identification information of the target space and the editing result to the server device 10. The editing result may be, for example, all of the map information after editing or information that indicates a difference between the map information after editing and the map information before editing.

[0043]

When the receiving unit 11 of the server device 10 receives the space editing request, in step S108, the update unit 12 updates the map information stored in the map information storing unit 121 (FIG. 5) in association with the space identification information included in the space editing request, based on the editing result included in the space editing request. In other words, the update unit 12 reflects the editing result in the map information.

[0044]

In this way, the map information of each space can be updated as appropriate based on user edits.

[0045]

FIG. 7 is a sequence diagram illustrating a route generation process according to the first embodiment. In FIG. 7, the same steps as those in FIG. 4 are denoted by the same step numbers, and redundant descriptions thereof are omitted unless otherwise required.

[0046]

Steps S101 to S105 are as described above with reference to FIG. 4. The terminal device 20 displays, on the space screen 510 (FIG. 6), a space as a route generation target, which may be referred to as a “target space” in the following description.

[0047]

In step S201, the input unit 21 receives an instruction from the user to generate a route in the target space. In the instruction to generate a route, the user inputs user information and route endpoints, which are a starting point and a terminal point. An example in which a user ID is input as user information is described below.

[0048]

In step S202, the request transmitting unit 22 transmits a route generation request including the space identification information of the target space, the user ID, and the route endpoints to the server device 10.

[0049]

When the receiving unit 11 of the server device 10 receives the route generation request, in step S203, the route generating unit 13 acquires the map information stored in the map information storing unit 121 (FIG. 5) in association with the space identification information included in the route generation request. In other words, in step S203, the route generating unit 13 acquires the map information of the target space. The acquired map information may be referred to as “target map information” in the following description. In step S204, the route generating unit 13 acquires a user attribute corresponding to the user ID included in the route generation request from the user information storing unit 122.

[0050]

FIG. 8 is a diagram illustrating a configuration of the user information storing unit 122. As illustrated in FIG. 8, the user information storing unit 122 stores user attributes in association with user IDs. The user attribute acquired in step S204 may be referred to as a “target user attribute” in the following description.

[0051]

In step S205, the route generating unit 13 generates a route connecting the route endpoints in the target space and tailored to the target user attribute, based on the route endpoints, the target user attribute, and the target map information. At this time, the route generating unit 13 uses the route generation model m1. Specifically, the route generating unit 13 inputs the route endpoints, the target user attribute, and the target map information to the route generation model m1. The route generating unit 13 outputs a route according to the inputs based on the learned parameters. At this time, the probability that each of the multiple routes is correct may also be output. In this case, the route generating unit 13 acquires the top N routes in the probability. N may be 1 or may be 2 or more. For the sake of description, it is assumed that N is 1. The route may be represented by, for example, text information that indicates a directed graph indicating the route in the target space. Alternatively, the route may be represented by another data format. The directed graph is a graph obtained by connecting nodes, which are points (three-dimensional coordinates) through which a route passes, with directed edges.

The route may be generated by any of the following approaches.

(1) A rule-based approach for determining the next position to move from the starting point: Generate a route by finding a point (node) that does not encounter an obstacle and gradually extending the node (Greedy approach).

When an obstacle is encountered, generate a route in a trial-and-error manner by returning to the previous node and expanding the node in another direction.

(2) Deep-learning-based approach: An approach for associating a map (input) with a map (output) on which a correct route is drawn and learning the correspondence between the maps end-to-end. Generate a route at once by learning a large amount of route patterns.

Alternatively, in addition to the above, node coordinates of the route may be learned (as an output value). For example, when a route is represented by one straight line, the number of nodes is two. When a route is represented by two straight lines, the number of nodes is three (because the via point is shared).

[0052]

Referring back to FIG. 8, in step S206, the display information generating unit 14 generates display information based on the target map information and the route generated by the route generating unit 13. The display information generated by the display information generating unit 14 is information for displaying the target route and may be referred to as “route display information” in the following description while the route generated by the route generating unit 13 may be referred to as a “target route” in the following description. The route display information is, for example, information for displaying a target route in a target space. In step S207, the display information transmitting unit 15 transmits the route display information to the device 20.

[0053]

When the display control unit 23 of the terminal device 20 receives the route display information, in step S208, the display control unit 23 updates the space screen 510 (FIG. 6) based on the route display information to display the target route.

[0054]

FIG. 9 is a diagram illustrating a first example of a space screen displaying a route according to the first embodiment. In FIG. 9, identical or similar reference signs are given to elements similar to those illustrated in FIG. 6, and redundant descriptions thereof are omitted unless otherwise required.

[0055]

The space screen 510 of FIG. 9 includes a message m11 and a message m12. The message m11 is a message displayed based on the instruction input in step S201 to generate a route. The message m11 may be input by the user or may be generated by applying the user ID, the starting point, and the terminal point input by the user to a message template. The message m12 is a fixed phrase for notifying the user that the route has been generated.

[0056]

In the space s1, a route generated between a starting point p1 and a terminal point p2 is indicated by a line segment. The space s1 is a machine room. Since the user attribute of the user is an “equipment inspector,” FIG. 9 illustrates a route based on the learning results of the route generation model m1 for the equipment inspector. Specifically, the route generation model m1 is trained based on learning data in which a route connecting each piece of equipment is a correct answer for an equipment inspector to inspect the pieces of equipment

in a space as a machine room. For this reason, the route connecting equipment A, B, C, and D is generated for the space s1.

[0057]

FIG. 10 is a diagram illustrating a second example of a space screen displaying a route according to the first embodiment.

In FIG. 10, identical or similar reference signs are given to elements similar to those illustrated in FIG. 9, and redundant descriptions thereof are omitted unless otherwise required.

[0058]

FIG. 10 illustrates a route generated when the same starting and terminal points are designated for the same space s1 as in FIG. 9 by a user having a user attribute different from that in FIG. 9. Since the users are different, the user ID included in a message m21 is different from the user ID included in the message m11 in FIG. 9. The user attribute of the user in FIG. 10 is a “general affairs staff member.” Unlike the equipment inspector, the route generation model m1 is trained based on learning data in which a route avoiding machines is a correct answer for a general affairs staff member to avoid the machines (to avoid risks) while passing through a machine room. For this reason, the route for avoiding machines (equipment A, B, C, and D) is generated for the space s1.

[0059]

As described above, according to the first embodiment, a route is generated based on user information. Accordingly, a route tailored to a user can be generated. More specifically, a three-dimensional route tailored to a user can be generated. For example, different routes can be generated for the same target space, which is a three-dimensional space, based on the user information.

[0060]

Although an example in which the user information input to the route generation model m1 is the user attribute has been described, the user ID may be input to the route generation model m1, without executing step S204 in FIG. 7. In this case, the user information included in the learning data of the route generation model m1 may be user IDs. The user IDs as user information allow the route generation model m1 to learn different parameters for each user.

[0061]

Although an example in which the user inputs the user ID has been described, the user may input the user attribute. In this case, the user attribute input by the user may be input to the route generation model m1, without executing step S204 in FIG. 7.

[0062]

A second embodiment is described below. In the second embodiment, the differences from the first embodiment are described. Accordingly, aspects not specifically mentioned may be the same as those in the first embodiment.

[0063]

In the second embodiment, the output of the route generation model m1 differs from that of

the first embodiment. Specifically, the route generation model m1 generates a route and text information that describes the route. The text information that describes the route includes context such as “This is the shortest route.” or “This route avoids danger.” Such a route generation model m1 can be obtained by causing a machine learning model to learn the relationships between user information, route endpoints, a route, and text information based on learning data including, for each piece of map information, the user information, the route endpoints, the route connecting the route endpoints in a space related to the map information and tailored to the user information, and the text information that describes the route.

[0064]

FIG. 11 is a sequence diagram illustrating a route generation process according to the second embodiment. In FIG. 11, the same steps as those in FIG. 7 are denoted by the same step numbers, and redundant descriptions thereof are omitted unless otherwise required. In FIG. 11, steps S205, S207, and S208 in FIG. 7 are replaced with steps S205a, S207a, and S208a, respectively.

[0065]

In step S205a, the route generating unit 13 generates a route connecting the route endpoints in the target space and tailored to the target user attribute and text information that describes the route, based on the route endpoints, the target user attribute, and the target map information. The text information that describes the route may be referred to as “output text” in the following description. Specifically, the route generating unit 13 inputs the route endpoints, the target user attribute, and the target map information to the route generation model m1. The route generating unit 13 outputs a route according to the inputs with output text based on the learned parameters. When multiple routes are output, the output text is output for each route.

[0066]

In step S207a, the display information transmitting unit 15 transmits the route display information generated in step S206 and the output text generated in step S205a to the terminal device 20.

[0067]

When the display control unit 23 of the terminal device 20 receives the route display information and the output text, in step S208a, the display control unit 23 updates the space screen 510 (FIG. 6) based on the route display information and the output text to display the target route and the output text.

[0068]

FIG. 12 is a diagram illustrating a space screen displaying a route according to the second embodiment. In FIG. 12, identical or similar reference signs are given to elements similar to those illustrated in FIG. 10, and redundant descriptions thereof are omitted unless otherwise required.

[0069]

In FIG. 12, the message m12, which is a fixed phrase in FIG. 10, is replaced with a message m22. The message m22 is a message based on the output text. The user can know the description about the route, such as the reason or ground for the generation of the route, by referring to such a message.

[0070]

A third embodiment is described below. In the third embodiment, the differences from the first embodiment are described. Accordingly, aspects not specifically mentioned may be the same as those in the first embodiment.

[0071]

In the third embodiment, the input to the route generation model m1 differs from that of the first embodiment. Specifically, the route generation model m1 receives text information that indicates a condition for a route such as restrictions or needs, in addition to map information, user information, and route endpoints. The text information that indicates a condition for a route may be referred to as “route generation conditions” in the following description. The route generation model m1 generates a route connecting the route endpoints in a space related to the map information, tailored to the user information, and satisfying the route generation condition. Examples of the route generation condition include text information such as “the shortest route,” information related to an object in the target space indicated by the map information, and text information that indicates the size of an object to be moved, which is an object carried by the user. The text information that indicates the size may be referred to as “size information” in the following description. The information related to an object in the target space indicated by the map information is, for example, text information that lists the identification information of one or more objects set as via-points on the route, which may be referred to as “via-point information” in the following description.

[0072]

When the route generation condition is “the shortest route,” the route generation model m1 outputs the shortest route tailored to the user based on the user information. When the route generation condition is “via-point information,” the route generation model m1 generates a route tailored to the user based on the user information via the points indicated by the via-point information. When the route generation condition is “size information,” the route generation model m1 generates a route that is tailored to the user based on the user information and that allows an object having a size indicated by the size information to pass through the route. Such a route generation model m1 can be obtained by causing a machine learning model to learn the relationships between user information, route endpoints, a route generation condition, and a route, based on learning data including, for each map information, the user information, the route endpoints, the route generation condition, and the route connecting the route endpoints in a space related to the map information, tailored to the user information, and satisfying the route generation condition. In other words, the learning data includes user information, a route generation condition, (2D or 3D) map information, and

route endpoints as inputs, and map information in which a route is drawn (added) to the map information as an output (answer). The learning data may include text including a feature of the generated route such as the shortest route as an output (correct answer).

[0073]

FIG. 13 is a sequence diagram illustrating a route generation process according to the third embodiment. In FIG. 13, the same steps as those in FIG. 7 are denoted by the same step numbers, and redundant descriptions thereof are omitted unless otherwise required. In FIG. 13, steps S201, S202, and S205 are replaced with steps S201b, S202b, and S205b, respectively.

[0074]

In step S201b, the input unit 21 receives input of user information, route endpoints, and a route generation condition with an instruction to generate a route.

[0075]

In step S202b, the request transmitting unit 22 transmits a route generation request including the space identification information of the target space, the user ID, the route endpoints, and the route generation condition to the server device 10. In response, the receiving unit 11 of the server device 10 receives the route generation request including the space identification information of the target space, the user ID, the route endpoints, and the route generation condition.

[0076]

In step S205b, the route generating unit 13 generates a route connecting the route endpoints in the target space, tailored to the target user attribute, and satisfying the route generation condition, based on the route endpoints, the target user attribute, the route generation condition, and the target map information. Specifically, the route generating unit 13 inputs the route endpoints, the target user attribute, the route generation condition, and the target map information to the route generation model m1. The route generating unit 13 outputs a route according to the inputs based on the learned parameters.

[0077]

The route thus generated is displayed in step S208.

[0078]

FIG. 14 is a diagram illustrating a first example of a space screen displaying a route according to the third embodiment.

In FIG. 14, identical or similar reference signs are given to elements similar to those illustrated in FIG. 9, and redundant descriptions thereof are omitted unless otherwise required.

[0079]

The space screen 510 of FIG. 14 further includes a message m13. The message m13 is a message displayed based on the route generation condition input in step S201. The message m13 may be input by the user or may be generated by applying the route generation condition input by the user to a message template. The route generation condition may be included in

the message m11.

[0080]

In FIG. 14, the inputs other than the route generation condition are the same as those in FIG. 9, and the route generation condition is the shortest route. Specifically, FIG. 14 illustrates the shortest route among the routes via each piece of equipment.

[0081]

FIG. 15 is a diagram illustrating a second example of a space screen displaying a route according to the third embodiment. In FIG. 15, identical or similar reference signs are given to elements similar to those illustrated in FIG. 14, and redundant descriptions thereof are omitted unless otherwise required.

[0082]

The space screen 510 of FIG. 15 includes a message m23 instead of the message m13. The message m23 is a message displayed based on the route generation condition input in step S201, similarly to the message m13. The message m23 may be input by the user or may be generated by applying the route generation condition input by the user to a message template.

[0083]

In FIG. 15, the inputs other than the route generation condition are the same as those in FIG. 9, and the route generation condition is to pass through the equipment A, B, and C.

Specifically, FIG. 15 illustrates a route via the equipment A, B, and C alone. In other words, FIG. 15 illustrates a route not via the equipment D.

[0084]

When size information (for example, length, width, or height) is input as a route generation condition, a route through which an object having a size indicated by the size information can pass is generated.

[0085]

A combination of multiple conditions may be input as route generation conditions. For example, route generation conditions including at least two of the shortest route, the via-point information, and the size information may be input. Conditions other than the aforementioned conditions may be input.

[0086]

The third embodiment and the second embodiment may be combined.

[0087]

As described above, according to the third embodiment, a route can be generated based on a route generation condition such as user needs in addition to user information. Accordingly, different routes can be generated depending on user attributes and route generation conditions in the same target space, which is a three-dimensional space.

[0088]

(1) For example, when the target space is a certain machine room, it is possible to increase the likelihood of preferentially generating the following routes based on the user attribute and the

route generation condition, depending on the learning of the route generation model m1.

[0089]

(1-1) When the user attribute is an equipment inspector and the route generation condition is a list of equipment to be inspected, it is possible to increase the likelihood of preferentially generating the shortest route via each piece of equipment in the order listed.

[0090]

(1-2) When the user attribute is an evacuee in the event of a disaster and the route generation condition is the shortest route, it is possible to increase the likelihood of preferentially generating the shortest route for avoiding equipment with risks such as ignition.

[0091]

(1-3) When the user attribute is a person in charge of bringing in equipment and the route generation condition is the size information of an object to be brought in, it is possible to increase the likelihood of preferentially generating a route for bringing in the object without interference.

[0092]

(1-4) When the user attribute is a person in charge of installing equipment and the route generation condition is the equipment to be installed, it is possible to increase the likelihood of preferentially generating a route that prioritizes efficient equipment installation. The route that prioritizes efficient equipment installation is, for example, a route that allows equipment installation in the back first in a scene where the equipment installed in the front prevents another piece of equipment from being installed in the back.

[0093]

(2) When the target space is a certain commercial facility such as a supermarket or a department store, it is possible to increase the likelihood of preferentially generating the following routes based on the user attribute and the route generation condition, depending on the learning of the route generation model m1.

[0094]

(2-1) When the user attribute is a customer and the route generation condition is a list of products desired to be purchased, it is possible to increase the likelihood of preferentially generating the shortest route for purchasing the listed products.

[0095]

(2-2) When the user attribute is a customer and the route generation condition is a route for a family with a stroller or cart or an elderly person who has difficulty in walking, it is possible to increase the likelihood of preferentially generating a route for actively using an elevator.

[0096]

(2-3) When the user attribute is a staff member and the route generation condition is a list of supplementary products or a list of products for which the sales floor needs to be reviewed, it is possible to increase the likelihood of preferentially generating the shortest route for visiting the listed products.

[0097]

(2-4) When the user attribute is a site security guard and the route generation condition is a list of inspection points, it is possible to increase the likelihood of preferentially generating a route for visiting the inspection points in the shortest time or distance.

[0098]

When the user attribute and the route generation condition are the same, different routes can be generated in different target spaces.

[0099]

(3) For example, when the user attribute is a person in charge of bringing in equipment and the route generation conditions are the information of equipment to be brought in and the shortest route, it is possible to increase the likelihood of preferentially generating the following routes based on the target space, depending on the learning of the route generation model m1.

[0100]

(3-1) When the target space is a space where equipment is present, it is possible to increase the likelihood of preferentially generating a route for bringing in an object without interference.

[0101]

(3-2) When the target space is a space where equipment is absent such as a space immediately after completion, it is possible to increase the likelihood of preferentially generating a route that prioritizes efficient equipment installation. The route that prioritizes efficient equipment installation is, for example, a route that allows the installation of multiple pieces of equipment in order from the equipment distant from the starting point (because, if equipment is stalled in the middle, a person in charge of installing equipment has to walk around the equipment when installing another piece of equipment in a distant location).

[0102]

(4) When the user attribute is a safety inspector and the route generation condition is a list of equipment to be inspected, it is possible to increase the likelihood of preferentially generating the following routes based on the target space, depending on the learning of the route generation model m1.

[0103]

(4-1) When the target space is a space where listed equipment is unevenly located, it is possible to increase the likelihood of preferentially generating a route with the shortest distance of movement distance regardless of the order of the list.

[0104]

(4-2) When the target space is a space where listed equipment is evenly located, it is possible to increase the likelihood of preferentially generating a route via equipment in the order of the list.

[0105]

(5) When the user attribute is an evacuee in the event of a disaster and the route generation condition is the shortest route that avoids risks, it is possible to increase the likelihood of preferentially generating the following routes based on the target space, depending on the learning of the route generation model m1.

[0106]

(5-1) When the target space is a space where no equipment with risks is present (for example, a space where no object is placed), it is possible to increase the likelihood of preferentially generating a route with the shortest distance or time of movement from the starting point to the terminal point.

[0107]

(5-2) When the target space is a space where equipment with risks is present, it is possible to increase the likelihood of preferentially generating the shortest route among the routes that avoid the equipment with risks.

[0108]

(6) When the user attribute is a customer and the route generation conditions are a list of products to be purchased and “less burden on body,” it is possible to increase the likelihood of preferentially generating the following routes based on the target space, depending on the learning of the route generation model m1.

[0109]

(6-1) When the target space is a space where the listed products are placed on one floor, it is possible to increase the likelihood of preferentially generating a route with the shortest amount of movement.

[0110]

(6-2) When the target space is a space where the listed products are placed on multiple floors, it is possible to increase the likelihood of preferentially generating a route for preferentially using an escalator, an elevator, or a moving sidewalk.

[0111]

(7) When the user attribute is a staff member and the route generation condition is “want to secure safety quickly in the event of a disaster,” it is possible to increase the likelihood of preferentially generating the following routes based on the target space, depending on the learning of the route generation model m1.

[0112]

(7-1) When the target space is a space where a person such as a customer is present, it is possible to increase the likelihood of preferentially generating a route for guiding the customer quickly and safely.

[0113]

(7-2) When the target space is a space where no person such as a customer is present, it is possible to increase the likelihood of preferentially generating a route with the shortest distance or time to an emergency exit away from the disaster source.

[0114]

(8) When the user attribute is a manager and the route generation condition is “want to maximize sales,” it is possible to increase the likelihood of preferentially generating the following routes based on the target space, depending on the learning of the route generation model m1.

[0115]

(8-1) When the target space is a department store or a shopping mall including multiple shops, it is possible to increase the likelihood of preferentially generating a route for encouraging movement between shops to lead to customer purchases based on past cases. For example, customers who have purchased baby wear tend to take a rest at a cafe, and thus a route tailored to such customers is generated.

[0116]

(8-2) When the target space is a sales floor where the replenishment of the products is necessary, it is possible to increase the likelihood of preferentially generating a route for preferentially replenishing the products having a larger stockout.

[0117]

The text information as route generation conditions is not limited to the above.

For example, the following text information may be used as route generation conditions.

[0118]

(1) “Generate a route with a level difference of 10 cm or less.” (2) “Generate a route where light does not reach” on the premise that information indicating the superposition results of light intensity simulations in a space is included in the map information related to the space. (3) “Generate a route where cold air does not reach” on the premise that information indicating the superposition results of air condition simulations in a space is included in the map information related to the space. (4) “Generate a three-dimensional route along which a drone of 1 m × 1 m × 1 m travels” as an example of allowing the air as a range of movement. In the above embodiments, the user is allowed to specify the route endpoints, which are the starting point and the terminal point. However, there may be a space where candidates for the starting point and the terminal point are obvious. For such a space, the route generation model m1 may be caused to learn a starting point and a terminal point based on input such as user information, and thus, the input of the route endpoints by the user at the time of route generation may be made unnecessary. In this case, the route endpoints in the above description may be treated as not existing.

[0119]

Although one route generation model m1 is used in the above-described embodiments, the route generation model m1 may be trained for each piece of user information, each piece of map information, each route generation condition (in the case of the third embodiment), and each combination of two or more pieces of the aforementioned input information. In this case, the route generating unit 13 may generate a route with the route generation model m1

based on the inputs.

[0120]

In one or more embodiments described above, the user may input information that indicates whether to adopt a generated (proposed) route after the route is displayed. When the user does not adopt the route, the route may be modified as desired by the user. In this case, additional training may be performed on the route generation model m1 based on the inputs and the results of modification when the adoption or rejection is input. In other words, additional training of the route generation model m1 may be performed based on the learning data in which a route as a result of modification is set as a correct route for the inputs.

[0121]

The functionality of the elements disclosed herein may be implemented using circuitry or processing circuitry which includes general purpose processors, special purpose processors, integrated circuits, application-specific integrated circuits (ASICs), field-programmable gate arrays (FPGAs), and/or combinations thereof which are configured or programmed, using one or more programs stored in one or more memories, to perform the disclosed functionality. Processors are considered processing circuitry or circuitry as they include transistors and other circuitry therein. In the disclosure, the circuitry, units, or means are hardware that carry out or are programmed to perform the recited functionality. The hardware may be any hardware disclosed herein which is programmed or configured to carry out the recited functionality. There is a memory that stores a computer program which includes computer instructions. These computer instructions provide the logic and routines that enable the hardware (e.g., processing circuitry or circuitry) to perform the method disclosed herein. This computer program can be implemented in known formats as a computer-readable storage medium, a computer program product, a memory device, a record medium such as a CD-ROM or digital versatile disk (DVD) , and/or the memory of an FPGA or ASIC.

[0122]

The apparatuses or devices described in the above embodiments are merely one example of multiple computing environments that implement one or more embodiments of the disclosure.

[0123]

In some embodiments, the server device 10 includes multiple computing devices such as server clusters. The multiple computing devices are configured to communicate with each other through any type of communication link including a network and a shared memory and perform the processes disclosed herein. In substantially the same manner, the terminal device 20 may include such multiple computing devices configured to communicate with one another.

[0124]

The terminal device 20 may have all of the functions of the server device 10.

[0125]

The server device 10 and the terminal device 20 are examples of an information processing

device.

[0126]

The above-described embodiments are illustrative and do not limit the present invention. Thus, numerous additional modifications and variations are possible in light of the above teachings. For example, elements and/or features of different illustrative embodiments may be combined with each other and/or substituted for each other within the scope of the present invention. Any one of the above-described operations may be performed in various other ways, for example, in an order different from the one described above.

[0127]

Aspects of the present disclosure are, for example, as follows.

[0128]

According to a first aspect, an information processing device includes a receiving unit and a route generating unit. The receiving unit receives user information related to a user who requests generation of a route. The route generating unit generates the route tailored to the user information in a space displayed for the user as a route generation target, based on map information that indicates the space and the user information.

[0129]

According to a second aspect, in the information processing device of the first aspect, the route generating unit generates the route based on the user information received by the receiving unit, with a machine learning model that has learned the relationship between the user information and the route based on learning data including the user information and the route tailored to the user information in the map information.

[0130]

According to a third aspect, in the information processing device of the first or second aspect, the space is a three-dimensional space.

[0131]

According to a fourth aspect, in the information processing device according to any one of the first to third aspects, the user information is one of user identification information unique to each user and information unique to each group when users are divided into groups based on attributes of the users.

[0132]

According to a fifth aspect, in the information processing device of any one of the first to fourth aspects, the map information includes information related to an object in the space.

[0133]

According to a sixth aspect, in the information processing device of any one of the first to fifth aspects, the route generating unit generates the route based on the user information related to the user and text information that describes the route, with a machine learning model that has learned the relationships between the user information, the route, and the text information based on learning data including the user information, the route tailored to the

user information in the map information, and the text information that describes the route.

[0134]

According to a seventh aspect, in the information processing device of any one of the first to sixth aspects, the receiving unit further receives text information that indicates a condition for the route. The route generating unit generates the route based on the user information and the text information received by the receiving unit, with a machine learning model that has learned the relationships between the user information, the text information, and the route based on learning data including the user information, the text information that indicates the condition for the route, and the route tailored to the user information and the text information in the map information.

[0135]

According to an eighth aspect, in the information processing device of the seventh aspect, the text information includes information related to an object in the space indicated by the map information.

[0136]

According to a ninth aspect, the information processing device of any one of the fifth to eighth aspects further includes an update unit that updates information related to the object in the space, included in the map information stored in a storing unit, in response to user input.

[0137]

According to a tenth aspect, in the information processing device of any one of the first to ninth aspects, the receiving unit further receives size information of an object that moves along the route. The route generating unit generates the route based on the user information and the size information received by the receiving unit, with a machine learning model that has learned the relationships between the user information, the size information of the object, and the route based on learning data including the user information, the size information of the object that moves along the route, and the route tailored to the user information and passable for the object in the map information.

[0138]

According to an eleventh aspect, an information processing device includes a receiving unit, a route generating unit, and a display control unit. The receiving unit receives user information related to a user who requests generation of a route. The route generating unit generates the route tailored to the user information in a space displayed for the user as a route generation target, based on map information that indicates the space and the user information. The display control unit displays the route.

[0139]

According to a twelfth aspect, an information processing method executed by a computer includes receiving user information related to a user who requests generation of a route; and generating the route tailored to the user information in a space displayed for the user as a route generation target, based on map information that indicates the space and the user

information.

[0140]

According to a thirteenth aspect, a program causes a computer to execute receiving user information related to a user who requests generation of a route; and generating the route tailored to the user information in a space displayed for the user as a route generation target, based on map information that indicates the space and the user information.

[0141]

The present invention can be implemented in any convenient form, for example using dedicated hardware, or a mixture of dedicated hardware and software. The present invention may be implemented as computer software implemented by one or more networked processing apparatuses. The processing apparatuses include any suitably programmed apparatuses such as a general purpose computer, a personal digital assistant, a Wireless Application Protocol (WAP) or third-generation (3G)-compliant mobile telephone, and so on. Since the present invention can be implemented as software, each and every aspect of the present invention thus encompasses computer software implementable on a programmable device. The computer software can be provided to the programmable device using any conventional carrier medium (carrier means). The carrier medium includes a transient carrier medium such as an electrical, optical, microwave, acoustic or radio frequency signal carrying the computer code. An example of such a transient medium is a Transmission Control Protocol/Internet Protocol (TCP/IP) signal carrying computer code over an IP network, such as the Internet. The carrier medium may also include a storage medium for storing processor readable code such as a floppy disk, a hard disk, a compact disc read-only memory (CD-ROM), a magnetic tape device, or a solid state memory device.

[0142]

This patent application is based on and claims priority to Japanese Patent Application No. 2024-070247, filed on April 24, 2024, in the Japan Patent Office, the entire disclosure of which is hereby incorporated by reference herein.

[Reference Signs List]

[0143]

- 1 Information processing system
- 10 Server device
- 11 Receiving unit
- 12 Update unit
- 13 Route generating unit
- 14 Display information generating unit
- 15 Display information transmitting unit
- 20 Terminal device
- 21 Input unit
- 22 Request transmitting unit

23 Display control unit
100 Drive device
101 Recording medium
102 Auxiliary memory
103 Memory
104 Processor
105 Interface device
121 Map information storing unit
122 User information storing unit
123 Model storing unit
B Bus
m1 Route generation model

[CLAIMS]

[Claim 1]

An information processing device, comprising:
a receiving unit configured to receive user information related to a user who requests generation of a route; and
a route generating unit configured to generate the route tailored to the user information in a space displayed for the user as a route generation target, based on map information indicating the space and the user information.

[Claim 2]

The information processing device according to claim 1,
wherein the route generating unit is configured to generate the route based on the user information received by the receiving unit, with a machine learning model having learned a relationship between the user information and the route based on learning data including the user information and the route tailored to the user information in the map information.

[Claim 3]

The information processing device according to claim 1 or 2,
wherein the space is a three-dimensional space.

[Claim 4]

The information processing device according to any one of claims 1 to 3, wherein the user information is one of:
user identification information unique to each user; and
information unique to each group when users are divided into groups based on attributes of the users.

[Claim 5]

The information processing device according to any one of claims 1 to 4,
wherein the map information includes information related to an object in the space.

[Claim 6]

The information processing device according to any one of claims 1 to 5,
wherein the route generating unit is configured to generate the route based on the user information related to the user and text information describing the route, with a machine learning model having learned relationships between the user information, the route, and the text information based on learning data including the user information, the route tailored to the user information in the map information, and the text information describing the route.

[Claim 7]

The information processing device according to any one of claims 1 to 6,
wherein the receiving unit is further configured to receive text information indicating a condition for the route, and
the route generating unit is configured to generate the route based on the user information and the text information received by the receiving unit, with a machine learning model having

learned relationships between the user information, the text information, and the route based on learning data including the user information, the text information indicating the condition for the route, and the route tailored to the user information and the text information in the map information.

[Claim 8]

The information processing device according to claim 7, wherein the text information includes information related to an object in the space indicated by the map information.

[Claim 9]

The information processing device according to any one of claims 5 to 8, further comprising an update unit configured to update information related to the object in the space, the information being included in the map information stored in a memory, in response to user input.

[Claim 10]

The information processing device according to any one of claims 1 to 9, wherein the receiving unit is further configured to receive size information of an object that moves along the route, and the route generating unit is configured to generate the route based on the user information and the size information received by the receiving unit, with a machine learning model having learned relationships between the user information, the size information of the object, and the route based on learning data including the user information, the size information of the object that moves along the route, and the route tailored to the user information and passable for the object in the map information.

[Claim 11]

An information processing system, comprising:
a receiving unit configured to receive user information related to a user who requests generation of a route;
a route generating unit configured to generate the route tailored to the user information in a space displayed for the user as a route generation target, based on map information indicating the space and the user information; and
a display control unit configured to display the route.

[Claim 12]

An information processing method, comprising:
receiving user information related to a user who requests generation of a route; and
generating the route tailored to the user information in a space displayed for the user as a route generation target, based on map information indicating the space and the user information.

[Claim 13]

A recording medium storing a plurality of instructions which, when executed by one or more

processors, causes the one or more processors to perform an information processing method, the method comprising:

receiving user information related to a user who requests generation of a route; and

generating the route tailored to the user information in a space displayed for the user as a route generation target, based on map information indicating the space and the user information.