

## DESCRIPTION

TITLE OF INVENTION:

AUTONOMOUS MOBILE DEVICE MANAGEMENT SYSTEM, AUTONOMOUS  
MOBILE DEVICE MANAGEMENT METHOD AND PROGRAM

## 5 TECHNICAL FIELD

[0001]

The present disclosure relates to an autonomous mobile device management  
system, an autonomous mobile device management method, and a program.

Priority is claimed on Japanese Patent Application No. 2022-051893 filed on  
10 March 28, 2022, the content of which is incorporated herein by reference.

BACKGROUND ART

[0002]

There is known an autonomous traveling body that travels autonomously while  
recognizing known obstacles based on a map stored in advance and its own estimated  
15 position (see, for example, Patent Document 1).

Citation List

Patent Document

[0003]

Patent Document 1: Japanese Unexamined Patent Application, First Publication  
20 No. 2021-047680

SUMMARY OF INVENTION

Technical Problem

[0004]

However, in the future, when a plurality of autonomous mobile devices of  
25 different types (for example, a plurality of robots with different specifications

manufactured by different manufacturers) are introduced within a predetermined area (for example, within the same building), each of the plurality of robots may act selfishly and cause a deadlock in which they interfere with each other's operations. For example, when passing through a narrow passageway or sharing an elevator, the robots may  
5 continue to block the passageway or a state of mutual compromise may continue, resulting in a situation where neither of their objects can be achieved.

[0005]

The present disclosure has been made in consideration of such circumstances, and an object thereof is to provide technology that makes it possible to suitably control a  
10 plurality of autonomous mobile devices even when they are of different types.

Solution to Problem

[0006]

An autonomous mobile device management system according to one aspect of the present disclosure includes a plurality of autonomous mobile devices that move  
15 autonomously within a building based on instruction information, and a management device that manages the plurality of autonomous mobile devices, in which the autonomous mobile device includes an operation information transmission unit that transmits operation information including a current point, a moving speed, and a moving destination to the management device, and an instruction information reception unit that  
20 receives the instruction information transmitted from the management device, the management device includes an operation information reception unit that receives the operation information transmitted from each of the autonomous mobile devices, a list creation unit that creates a movement list for each of the autonomous mobile devices including one or more via-points to be passed through when the autonomous mobile  
25 device is autonomously moved from a current point to a final target point, a list updating

unit that updates the movement list for each of the autonomous mobile devices which is created by the list creation unit, and an instruction information transmission unit that transmits instruction information to each of the autonomous mobile devices based on the movement list for each of the autonomous mobile devices created by the list creation unit  
5 or based on the movement list for each of the autonomous mobile devices which is updated by the list updating unit, and the list updating unit updates the movement list for one of the autonomous mobile devices which is created by the list creation unit based on the operation information of the plurality of autonomous mobile devices received by the operation information reception unit.

10 [0007]

One aspect of the present disclosure is an autonomous mobile device management method performed by the autonomous mobile device management system.

[0008]

One aspect of the present disclosure is a program for the autonomous mobile  
15 device management system.

Advantageous Effects of Invention

[0009]

According to the above-described aspects, it is possible to suitably control a plurality of autonomous mobile devices even when they are of different types.

20 BRIEF DESCRIPTION OF DRAWINGS

[0010]

[FIG. 1] A diagram showing a configuration example of an autonomous mobile device management system in this embodiment.

[FIG. 2A] A diagram showing management points.

25 [FIG. 2B] A diagram showing management points.

[FIG. 2C] A diagram showing management points.

[FIG. 2D] A diagram showing management points.

[FIG. 3] A diagram showing an example of a functional configuration of a management device.

5 [FIG. 4] A diagram showing an example of a functional configuration of an autonomous mobile device.

[FIG. 5] A flowchart showing an example of a processing procedure of the management device.

[FIG. 6] A diagram showing operations of the autonomous mobile device  
10 management system.

[FIG. 7] A diagram showing operations of the autonomous mobile device management system.

## DESCRIPTION OF EMBODIMENTS

[0011]

15 FIG. 1 is a diagram showing a configuration example of an autonomous mobile device management system 1 in this embodiment. The autonomous mobile device management system 1 includes a management device 10 and a plurality of autonomous mobile devices 20 (autonomous mobile devices 20-1, 20-2,..., and 20-N), where N is an integer equal to or greater than 2. The devices (the management device 10, each of the  
20 autonomous mobile devices 20) store device identification information by which the devices can be uniquely identified within the autonomous mobile device management system 1.

[0012]

The management device 10 is a device (for example, a server) that manages  
25 (controls operations of) the plurality of autonomous mobile devices 20. The

management device 10 may be installed at a location where the autonomous mobile devices 20 are introduced (for example, inside a building), or may be installed at a location different from the location where the autonomous mobile devices 20 are introduced (for example, a data center, or the like). The functions of the management device 10 may be distributed to a plurality of devices (servers).

[0013]

The autonomous mobile device 20 is a device (for example, a robot) that autonomously moves in a predetermined region (for example, inside a passageway, inside a room, inside an elevator) of the introduction location. Each of the N autonomous mobile devices 20 may have the same (common) specifications (for example, specifications related to an autonomous movement control method) or may have different specifications. In the following description, the N autonomous mobile devices 20 include at least two types of autonomous mobile devices 20 with different specifications. Each of the N autonomous mobile devices 20 may have the same or different uses.

There are no limitations on the uses, but the uses may be, for example, transportation of luggage, introduction (guiding) of people, or monitoring.

[0014]

The management device 10 and the autonomous mobile devices 20 are connected to each other so that they can communicate with each other in a wireless manner. The management device 10 and the autonomous mobile devices 20 may be connected to each other via another device (for example, a relay device, not shown). That is, it is sufficient that the management device 10 is capable of receiving information transmitted (sent) from the autonomous mobile device 20, and the autonomous mobile device 20 is capable of receiving information transmitted (sent) from the management device 10.

[0015]

Inherently, each of the autonomous mobile devices 20 can autonomously estimate its own position and plan a route to autonomously move to a final target point without being controlled from the outside (for example, the management device 10) by using its own autonomous movement function. When only one autonomous mobile device 20 is introduced, that is, there is no possibility of a situation in which they would interfere with each other's operations when a plurality of autonomous mobile devices 20 are introduced, they can autonomously move to the final target point without being controlled from the outside. When a plurality of autonomous mobile devices 20 are introduced (particularly, when a plurality of autonomous mobile devices 20 with different specifications are introduced), a situation where they interfere with each other's operations may occur, resulting in a possibility that at least some of the autonomous mobile devices 20 may not be able to move autonomously to the final target point.

[0016]

The management device 10 manages the autonomous mobile devices 20 so that all of the autonomous mobile devices 20 being managed can move to the final target point even when a plurality of autonomous mobile devices 20 with different specifications are introduced. In addition to their individual autonomous movement functions, each of the autonomous mobile devices 20 moves to the final target point under the control of the management device 10.

[0017]

The functions of the management device 10 will be described below.

(Determination of autonomous mobile device 20 to be operated, determination of final target point)

The management device 10 determines the autonomous mobile device 20 to be

operated and a final target point. For example, the management device 10 determines the autonomous mobile device 20 to be operated and the final target point based on an operation instruction (operation request). The operation instruction includes information indicating the type of autonomous mobile device 20 (use, work contents) and information indicating the final target point (desired movement point). Hereinafter, the information indicating the type of autonomous mobile device 20 and the information indicating the final target point may be referred to as operation determination information. The operation instruction may be an instruction based on an operator's operation, or may be an instruction received from another device (for example, a personal computer, a smartphone, or the like).

[0018]

For convenience, the term "operation instruction" is simply used, but the expression of "operation instruction" refers to operation instruction information that indicates an operation instruction. The same applies to "operation schedule," "calendar," "schedule," "sensing results," "movement list," and the like, which will be described later.

[0019]

Instead of or in addition to the operation instruction, the management device 10 may determine the autonomous mobile device 20 to be operated and the final target point based on the operation schedule. For example, the management device 10 may determine the autonomous mobile device 20 to be operated and the final target point based on a schedule acquired from a calendar (for example, a linked web calendar). The operation schedule includes operation determination information.

[0020]

The management device 10 may determine the autonomous mobile device 20 to

be operated and the final target point based on sensing results obtained through various sensing instead of or in addition to the operation instruction and the operation schedule. For example, one or more cameras may be installed at the introduction location, and the management device 10 may determine the autonomous mobile device 20 to be operated and the final target point based on recognition results (for example, the movement of a person recognized from the captured image) of images captured by the cameras. The management device 10 may acquire recognition results of captured images from another device (a device that acquires images captured by a camera and recognizes the images, not shown), or the management device 10 itself may acquire images captured by a camera and recognize the images. The recognition results of the captured images and operation determination information are stored in association with each other at a location that can be referred to by the management device 10 so that the management device 10 can determine the autonomous mobile device 20 to be operated and the final target point in accordance with what object is captured by which camera.

15 [0021]

(Reception of operation information)

The management device 10 receives operation information from each of the autonomous mobile devices 20. Examples of the operation information include movement status information, movement completion information, and movement failure information. The movement status information includes, for example, device identification information, the current point (self-location information), a traveling speed, and a moving destination (via-point or final target point) of the autonomous mobile device 20. The movement completion information includes, for example, device identification information and a movement completion point (via-point or final target point) of the autonomous mobile device 20. The movement failure information

includes, for example, device identification information, the current point, a traveling speed, and a moving destination of the autonomous mobile device 20.

[0022]

(Creation of movement list)

5           The management device 10 creates a movement list (movement route) for the autonomous mobile device 20 that has been determined to operate. The movement list includes information indicating one or more via-points through which the autonomous mobile device 20 (the autonomous mobile device 20 that has been determined to operate) will pass when autonomously moving the autonomous mobile device 20 from the current  
10 point to the final target point (the determined final target point). That is, a process of creating the movement list is a process of generating a movement route from the current point to the final target point. The creation of the movement list will be described in detail below.

[0023]

15           The management device 10 can refer to a management point set that includes, as elements, points (management points) that can be designated as moving destinations (via-points, final target points) of the autonomous mobile device 20. The management device 10 may store the management point set, or may refer to a management point set stored by another device (for example, another server, not shown). In this specification,  
20 the terms “list” and “set” are used differently depending on whether the order of the elements (points) (for example, the order of definition) is significant. The order is not significant for “set”, while the order is significant for “list”.

[0024]

FIGS. 2A to 2D are diagrams showing management points. In a method of  
25 setting a management point set, the number N of autonomous mobile devices 20 and the

number  $M$  ( $M \leq N$ ) of autonomous mobile devices 20 that should avoid changing their moving directions (for example, autonomous mobile devices 20 that are not suitable for changing their course directions in consideration of work contents and the like) are given so that the autonomous mobile devices 20 can move to any point within a predetermined area, and are determined using graph theory. For example, a loop structure that secures sufficient distances between points so that a detour route can be generated, or  $N+1$  or more end points are provided. FIG. 2A shows an example of a loop structure. FIG. 2B shows an example of  $N+1$  or more end points. As shown in FIG. 2C, when a loop structure is provided, end points may be provided.

10 [0025]

The management device 10 may present a management point set to an operator who gives an instruction for operation. When the management device 10 presents the management point set, the management device 10 may present the management point set as it is (present all points), or may extract and present a portion of the management point set (present some points extracted). The some points may be a predetermined point (a point previously determined as a main point), a point within a specific floor, a point according to the purpose (for example, an empty conference room when the operator inputs a conference as the purpose), and the like.

[0026]

20 The management device 10 creates a movement list including movement points (via-points, final target point) of one autonomous mobile device 20 (the autonomous mobile device 20 to be operated) as elements through optimization with constraints such as the shortest distance and the shortest time with reference movement status information of a plurality of autonomous mobile devices 20. The movement list shows points from  
25 the current point to the final target point in order, such as [a via-point 1, a via-point 2, a

via-point 3,..., and the final target point]. The elements (the via-point 1, the via-point 2, the via-point 3,..., and the final target point) of the movement list are elements selected from a movement point set.

[0027]

5 (Updating of movement list)

The management device 10 updates a movement list for one autonomous mobile device 20 based on movement completion information of the autonomous mobile device 20. For example, when the management device 10 receives movement completion information indicating the completion of movement to the via-point 1, the “via-point 1”  
10 is deleted from the movement list [via-point 1, via-point 2, via-point 3,..., final target point]. That is, after the updating, a movement list [via-point 2, via-point 3,..., final target point] is obtained.

[0028]

The management device 10 determines whether the movement list for the  
15 autonomous mobile device 20 needs to be updated with reference to movement status information of a plurality of autonomous mobile devices 20. The management device 10 may determine whether the movement list needs to be updated at a timing when operation information is received from the autonomous mobile device 20, or may determine whether the movement list needs to be updated at regular time intervals.

20 [0029]

When the management device 10 determines that the movement list needs to be updated, the management device 10 updates the movement list for the autonomous mobile device 20. For example, the management device 10 changes a point designated as the via-point 1 in the movement list [via-point 1, via-point 2, via-point 3,..., final target  
25 point] to another point. The management device 10 adds information “ ” (blank)

indicating temporary stopping to the beginning of the movement list [via-point 1, via-point 2, via-point 3,..., final target point]. That is, after the updating, a movement list [“ “, via-point 1, via-point 2, via-point 3,..., final target point] is obtained. The management device 10 deletes the information “ “ ” indicating temporary stopping at the beginning of the movement list [“ “, via-point 1, via-point 2, via-point 3,..., final target point]. That is, after the updating, a movement list [via-point 1, via-point 2, via-point 3,..., final target point] is obtained.

[0030]

(Creation and updating of movement list based on priority)

10 The management device 10 may set the priority (priority) of movement for each of the autonomous mobile devices 20. For example, the management device 10 may set the priority of movement for each of the autonomous mobile devices 20 in accordance with the use, work contents, and the like of each of the autonomous mobile devices 20. For example, in the case of an autonomous mobile device 20 for visitor guidance and an autonomous mobile device 20 for indoor delivery, a higher priority may be set for the autonomous mobile device 20 for visitor guidance. Even when the use, the work contents, and the like are the same, the priority may be set in accordance with the degree of urgency, or the like. For example, for the autonomous mobile device 20 for indoor delivery, the priority may be set in accordance with the degree of urgency, the type of delivery object, arrival/shipment, the presence or absence of a receiver and an operator, or the like. The management device 10 may create or update a movement list for each of the autonomous mobile devices 20 based on the priority. For example, the management device 10 may create or update the movement list for each of the autonomous mobile devices 20 so that the traveling of the autonomous mobile device 20 for indoor delivery does not affect the traveling of the autonomous mobile device 20 for

visitor guidance, even when the traveling of the autonomous mobile device 20 for visitor guidance may affect the traveling of the autonomous mobile device 20 for indoor delivery.

[0031]

- 5           The management device 10 can refer to a look-up table for outputting priorities based on the type and work contents of autonomous mobile device 20, and the like. The management device 10 may store a look-up table, or may refer to a look-up table stored by another device (for example, another server, not shown).

[0032]

- 10           (Transmission of instruction information)

The management device 10 transmits instruction information based on each movement list to each autonomous mobile device 20. For example, the management device 10 transmits instruction information to one autonomous mobile device 20 after a movement list for one autonomous mobile device 20 is generated (or updated).

- 15   Examples of the instruction information include movement instruction information (also referred to as a movement request) and cancellation instruction information. The movement instruction information includes, for example, device identification information of an autonomous mobile device 20 to be instructed, and a moving destination. The cancellation instruction information includes, for example, device  
20   identification information of the autonomous mobile device 20 to be instructed and a moving destination for which movement is to be cancelled.

[0033]

(Reporting of operation results)

- 25           The management device 10 reports (outputs) operation results. For example, the management device 10 reports operation success information indicating that an

operation has been completed (movement to a final target point has been completed), or operation failure information indicating that an operation has failed (movement to the final target point has failed). For example, when the management device 10 receives movement completion information from one autonomous mobile device 20, the management device 10 outputs operation success information for the autonomous mobile device 20. When the management device 10 receives movement failure information from one autonomous mobile device 20, or when the management device 10 does not receive movement completion information from one autonomous mobile device 20 within a predetermined time, the management device 10 outputs operation failure information for the autonomous mobile device 20.

[0034]

The functions of the autonomous mobile device 20 will be described.

(Transmission of operation information)

The autonomous mobile device 20 transmits operation information (movement status information, movement completion information, and movement failure information) to the management device 10. For example, the autonomous mobile device 20 transmits the movement status information to the management device 10 at regular time intervals. The autonomous mobile device 20 transmits the movement status information even when it is in an operation state (a traveling where it is traveling to a via-point or a final target point, or a stopped state where its traveling to a via-point or a final target point is temporarily stopped) or in a non-operation state (a standby state).

[0035]

As described above, the movement status information includes the current point, a traveling speed, and a moving destination, but these pieces of information are internal information internally managed by the autonomous mobile device 20 as a result of self-

position estimation or as received contents (moving destination included in the movement instruction information) received from the management device 10.

[0036]

When the movement of the autonomous mobile device 20 to an instructed point  
5 (via-point or final target point) has been completed, the autonomous mobile device 20 transmits movement completion information to the management device 10. When the movement of the autonomous mobile device 20 to the instructed point has not completed within a predetermined time, the autonomous mobile device 20 transmits movement failure information to the management device 10.

10 [0037]

(Starting of autonomous movement or temporarily stopping of autonomous movement)

When the autonomous mobile device 20 receives movement instruction information from the management device 10, the autonomous mobile device 20 starts  
15 autonomous movement to a moving destination (via-point or final target point) indicated by the movement instruction information. When the autonomous mobile device 20 receives cancellation instruction information from the management device 10, the autonomous mobile device 20 temporarily stops autonomous movement to the moving destination. When the autonomous mobile device 20 that has stopped autonomous  
20 movement receives the movement instruction information again from the management device 10, the autonomous mobile device 20 restarts autonomous movement to the moving destination.

[0038]

FIG. 3 is a diagram showing an example of a functional configuration of the  
25 management device 10. The functions of the management device 10 are realized by a

CPU included in the management device 10 executing a program. The management device 10 includes a communication unit 101, a control unit 102, and a storage unit 103. The control unit 102 executes control in the management device 10. The control unit 102 includes an information acquisition unit 121, a list creation and updating unit 122, a  
 5 list updating necessity determination unit 123, an instruction information creation unit 124, and an operation result creation unit 125. The storage unit 103 stores a variety of information. The storage unit 103 includes an operation information storage unit 131 and a list storage unit 132.

[0039]

10 The communication unit 101 communicates with the autonomous mobile device 20. For example, the communication unit 101 receives a variety of information transmitted by the autonomous mobile device 20 and supplies it to the control unit 102 (information acquisition unit 121). The communication unit 101 also acquires a variety of information created by the control unit 102 (instruction information creation unit 124,  
 15 operation result creation unit 125) and transmits it to the autonomous mobile device 20.

[0040]

The information acquisition unit 121 acquires a variety of information. For example, the information acquisition unit 121 acquires operation instructions and operation information (movement status information, movement completion information,  
 20 and movement failure information). The list creation and updating unit 122 creates or updates a movement list. The list updating necessity determination unit 123 determines whether the created movement list needs to be updated. The instruction information creation unit 124 creates instruction information (movement instructions, cancellation instructions). The operation result creation unit 125 creates operation results (operation  
 25 success information, operation failure information).

[0041]

The operation information storage unit 131 stores operation information (movement status information and the like) of each of the autonomous mobile devices 20 which is acquired by the information acquisition unit 121. The list storage unit 132  
5 stores a movement list for each of the autonomous mobile devices 20 generated (or updated) by the list creation and updating unit 122.

[0042]

FIG. 4 is a diagram showing an example of a functional configuration of the autonomous mobile device 20. The functions of the autonomous mobile device 20 are  
10 realized by the CPU included in the autonomous mobile device 20 executing a program. The autonomous mobile device 20 includes a communication unit 201, a region measurement sensor 202, a movement mechanism unit 203, a control unit 204, and a storage unit 205. The control unit 204 executes a variety of control in the autonomous mobile device 20. The control unit 204 includes an information acquisition unit 241, an  
15 operation information creation unit 242, and an autonomous mobile control unit 243. The storage unit 205 stores a variety of information. The storage unit 205 includes an instruction information storage unit 251 and a map storage unit 252.

[0043]

The communication unit 201 communicates with the management device 10.  
20 For example, the communication unit 201 receives instruction information (movement instruction, cancellation instruction) transmitted by the management device 10 and supplies it to the control unit 204 (information acquisition unit 241). The communication unit 201 acquires operation information (movement status information, movement completion information, movement failure information) created by the control  
25 unit 204 (operation information creation unit 242) and transmits it to the management

device 10. The region measurement sensor 202 is a sensor that measures a distance to an object by performing two-dimensional scanning using, for example, a laser beam.

The movement mechanism unit 203 is a drive mechanism unit for moving the autonomous mobile device 20. The movement mechanism unit 203 includes, for example, wheels, a motor that drives the wheels, a direction change mechanism for changing a movement direction, and the like.

[0044]

The information acquisition unit 241 acquires a variety of information. For example, the information acquisition unit 241 acquires instruction information. The operation information creation unit 242 creates operation information (movement status information, movement completion information, and movement failure information).

The autonomous mobile control unit 243 performs control so that the autonomous mobile device 20 moves autonomously using a map stored in the map storage unit 252.

[0045]

The instruction information storage unit 251 stores instruction information from the management device 10 acquired by the information acquisition unit 221. The map storage unit 252 stores the map to be referred to when autonomous movement is performed.

[0046]

FIG. 5 is a flowchart showing an example of a processing procedure of the management device 10. The flowchart in FIG. 5 shows an example of a processing procedure from determination of one autonomous mobile device 20 (autonomous mobile device 20-1) as the autonomous mobile device 20 to be operated to outputting of operation success information of the autonomous mobile device 20-1.

[0047]

Step S1: The management device 10 creates a movement list for the autonomous mobile device 20-1. For example, the management device 10 creates the movement list for the autonomous mobile device 20-1 with reference to movement status information of the autonomous mobile device 20-1 and operation information (movement status  
5 information) of other autonomous mobile devices 20 (autonomous mobile devices 20-2,...). Then, the management device 10 proceeds to step S2.

Step S2: The management device 10 transmits instruction information to the autonomous mobile device 20-1 based on the movement list. Specifically, the management device 10 transmits the movement instruction information to the  
10 autonomous mobile device 20-1 based on the movement list created in step S1 or an updated movement list updated in step S9. Then, the management device 10 proceeds to step S3.

Step S3: The management device 10 determines whether movement status information has been acquired (received) from any of the autonomous mobile devices 20.  
15 When the movement status information has been acquired, the management device 10 proceeds to step S4. When the movement status information has not been acquired, the management device 10 proceeds to step S7.

[0048]

Step S4: The management device 10 determines whether the movement list for  
20 the autonomous mobile device 20-1 needs to be updated based on operation information of the plurality of autonomous mobile devices 20. For example, the management device 10 determines that the movement list for the autonomous mobile device 20-1 needs to be updated when a moving destination of the autonomous mobile device 20-1 needs to be changed, when the movement of the autonomous mobile device 20-1 to the moving  
25 destination needs to be temporarily stopped, or when the temporary stopping of the

movement of the autonomous mobile device 20-1 to the moving destination needs to be cancelled. When the movement list needs to be updated, the management device 10 proceeds to step S5. When the movement list does not need to be updated, the management device 10 proceeds to step S7.

5 [0049]

Step S5: The management device 10 updates the movement list for the autonomous mobile device 20-1. For example, when the management device 10 determines in step S4 that it is necessary to change the moving destination, the management device 10 updates the point of the beginning of the list. When the management device 10 determines in step S4 that it is necessary to temporarily stop the movement to the moving destination, the management device 10 adds information indicating temporary stopping to the beginning of the list. When the management device 10 determines in step S4 that it is necessary to cancel the temporary stopping of the movement to the moving destination, the management device 10 deletes the information indicating temporary stopping added to the beginning of the list. Then, the management device 10 proceeds to step S6.

[0050]

Step S6: The management device 10 transmits instruction information to the autonomous mobile device 20-1 based on the movement list. Specifically, the management device 10 transmits movement instruction information to the autonomous mobile device 20-1 based on the movement list updated in step S5. More specifically, when the management device 10 updates the point of the beginning of the list in step S5 (when the moving destination is changed), the management device 10 transmits, to the autonomous mobile device 20-1, cancellation instruction information for instructing the autonomous mobile device 20-1 to cancel the movement to the instructed moving

destination and movement instruction information for instructing the autonomous mobile device 20-1 to move to a new moving destination. When the management device 10 adds information indicating temporary stopping to the beginning of the list in step S5 (when temporarily stopping the movement to the moving destination), the management

5 device 10 transmits cancellation instruction information for instructing the autonomous mobile device 20-1 to cancel the movement to the instructed moving destination to the autonomous mobile device 20-1. When the management device 10 deletes information indicating temporary stopping of the beginning of the list in step S5 (when the management device 10 cancels temporary stopping of movement to the moving

10 destination), the management device 10 transmits the movement instruction information for instructing the autonomous mobile device 20-1 to move to the moving destination to the autonomous mobile device 20-1 again. Then, the management device 10 proceeds to step S7.

[0051]

15 Step S7: The management device 10 determines whether movement completion information has been acquired (received) from the autonomous mobile device 20-1. When the movement completion information has been acquired, the management device 10 proceeds to step S7. When the movement completion information has not been acquired, the management device 10 returns to step S3.

20 Step S8: The management device 10 updates the movement list for the autonomous mobile device 20-1. That is, the management device 10 deletes the point where movement has been completed from the movement list for the autonomous mobile device 20-1. Then, the management device 10 proceeds to step S9.

Step S9: The management device 10 determines whether the autonomous mobile

25 device 20-1 has arrived at a final target point. For example, the management device 10

may determine that the autonomous mobile device 20-1 has arrived at the final target point when the movement list is empty. When the autonomous mobile device 20-1 has arrived at the final target point, the management device 10 proceeds to step S10. When the autonomous mobile device 20-1 has not arrived at the final target point, the management device 10 returns to step S2.

Step S10: The management device 10 outputs operation success information.

Then, this flowchart ends.

[0052]

FIGS. 6 and 7 are diagrams showing operations of the autonomous mobile device management system 1. FIG. 7 is a continuation of FIG. 6. As a scenario example for convenience, a scenario example in which the movement point set shown in FIG. 2D is set will be described. The autonomous mobile device 20 for guidance (referred to as a guide robot 20 in the description of FIGS. 6 and 7) is an object that moves from a point S to a final target point G. A movement list of the guide robot is ["B", "C", "G"]. The transmission of movement instruction information [B] for moving to a point B to the autonomous mobile device 20 is completed, and the guide robot 20 is moving from a point S to the point B. In the above situation, the control of the autonomous mobile device 20 by the management device 10 when an autonomous mobile device 20 for delivery (referred to as a delivery robot in FIGS. 6 and 7) is moved from a point I to a final target point D will be described. The guide robot 20 is an object with priority higher than that of the delivery robot.

[0053]

(ACT1 to ACT4)

The management device 10 creates a movement list ["A", "B", "C", "D"] for the delivery robot 20 with reference with movement status information of the delivery robot

20 and the guide robot 20 (ACT1). A point B and a point C are also on the movement list for the guide robot 20, but the guide robot 20 passes through the point B and moves to the point C while the delivery robot 20 passes through a point A, and thus it is determined that there is no problem. The management device 10 transmits movement instruction information [A] to the delivery robot 20 to instruct the delivery robot 20 to move to a point A (ACT2). The management device 10 receives movement status information from the delivery robot 20 and the guide robot 20 while the delivery robot 20 is moving to the point A, but determines that it is not necessary to update the movement list for the delivery robot 20 (ACT3). The management device 10 receives movement completion information ["A"] from the delivery robot that has finished moving to the point A, and updates the movement list ["A", "B", "C", "D"] to a movement list ["B", "C", "D"] (ACT4).

[0054]

(ACT5 to ACT10)

15 In ACT5 to ACT10, it is assumed that the arrival of the guide robot 20 at the point B is delayed. The management device 10 transmits movement instruction information [B] for moving to the point B to the delivery robot 20 (ACT4). The management device 10 receives movement status information from the delivery robot 20 and the guide robot 20 while the delivery robot 20 is moving to the point B, but recognizes that the arrival of the guide robot 20 at the point B is delayed from the movement status information of the guide robot 20 and that the priority of the guide robot 20 is higher than that of the delivery robot 20 from a look-up table, and determines that the movement list for the delivery robot 20 needs to be updated (the route needs to be changed) (ACT6). The management device 10 updates the movement list ["B", "C", "D"] to a movement list ["E", "C", "D"] (ACT7). The management device 10 transmits

cancellation instruction information [B] indicating an instruction for movement to the point B is cancelled and movement instruction information [E] for moving to a point E to the delivery robot 20 (ACT8). Since the delivery robot 20 uses a route plan included in an autonomous driving function of the delivery robot 20 itself, the delivery robot 20 does not move back to the point A once, but moves from the location toward the point E. The management device 10 receives movement status information from the delivery robot 20 and the guide robot 20 while the delivery robot 20 is moving to the point E, but determines that it is not necessary to update the movement list for the delivery robot 20 (ACT9). The management device 10 receives movement completion information ["E"] from the delivery robot that has finished moving to the point E and updates the movement list ["E", "C", "D"] to a movement list ["C", "D"] (ACT10).

[0055]

(ACT11 to ACT19)

In ACT11 to ACT19, it is assumed that the arrival of the guide robot 20 at the point C is also delayed. The management device 10 transmits movement instruction information [C] for moving to the point C to the delivery robot 20 (ACT11). The management device 10 receives movement status information from the delivery robot 20 and the guide robot 20 while the delivery robot 20 is moving to the point C, but recognizes that the arrival of the guide robot 20 at the point C is also delayed from the movement status information of the guide robot 20 and that the priority of the guide robot 20 is higher than that of the delivery robot 20 from the look-up table, and determines that it is necessary to update (temporarily stop) the movement list for the delivery robot 20 (ACT12). The management device 10 updates the movement list ["C", "D"] to a movement list [" ", "C", "D"] (ACT13). That is, the management device 10 adds information indicating temporary stopping to the movement list. The

management device 10 transmits cancellation instruction information [C] indicating an instruction for moving to the point C is cancelled to the delivery robot 20 (ACT14).

The delivery robot 20 is temporarily stopped because it is receiving only the cancellation instruction information [C] (because there is no instruction for a new moving

5 destination). The management device 10 recognizes that the guide robot 20 has finished passing through the point C from the movement status information of the guide robot 20, and determines that it is necessary to update the movement list for the delivery robot 20 (to cancel the temporary stopping) (ACT15). The management device 10 updates the movement list [“ ”, “C”, “D”] to a movement list [“C”, “D”] (ACT16). The  
10 management device 10 transmits movement the movement instruction information [C] for moving to the point C to the delivery robot 20 (ACT17). The management device 10 receives movement status information from the delivery robot 20 and the guide robot 20 while the delivery robot 20 is moving to the point C, but determines that it is not necessary to update the movement list for the delivery robot 20 (ACT18). The  
15 management device 10 receives movement completion information [“C”] from the delivery robot that has finished moving to the point C, and updates the movement list [“C”, “D”] to a movement list [“D”] (ACT19).

[0056]

(ACT20 to ACT23)

20 The management device 10 transmits movement instruction information [D] for moving to the point D to the delivery robot 20 (ACT20). The management device 10 receives movement status information from the delivery robot 20 and the guide robot 20 while the delivery robot 20 is moving to the point D, but determines that it is not necessary to update the movement list for the delivery robot 20 (ACT21). The  
25 management device 10 receives movement completion information [“D”] from the

delivery robot that has finished moving to the point D, and updates the movement list ["D"] to a movement list [ ] (ACT22). The management device 10 outputs operation success information because the movement list is empty.

[0057]

5           As described above, according to the autonomous mobile device management system 1 according to the embodiment, it is possible to suitably control a plurality of autonomous mobile devices 20 even when they are of different types. That is, since the autonomous mobile devices 20 are managed doubly by an autonomous mobile function of the autonomous mobile device 20 itself and a movement list (instruction information)  
10   for the management device 10, it is possible to suitably control the plurality of autonomous mobile devices 20 even when they are of different types. Since the autonomous mobile device management system 1 creates a movement list for the corresponding autonomous mobile device 20 in accordance with the timing of an operation instruction, it is possible to appropriately operate (move) the individual  
15   autonomous mobile devices 20 in parallel.

The above embodiment is an example, and the specific configuration is not limited to the above embodiment, and designs within the scope of the gist of the invention, and the like are also included.

[0058]

20           The above-described management device 10, autonomous mobile device 20, and the like may be processed by recording a program for realizing the functions of the management device 10, the autonomous mobile device 20, and the like on a computer-readable recording medium and causing a computer system to read and execute the program recorded on the recording medium. Here, the "causing the computer system to  
25   read and execute the program recorded on the recording medium" includes installing the

program in the computer system. The term “computer system” mentioned here includes hardware such as an OS and peripheral devices. In addition, the “computer system” may include a plurality of computer devices connected via a network including communication lines. The recording medium also includes an internally or externally provided recording medium that can be accessed by a distribution server in order to distribute the program.

[0059]

Although the embodiment of the present disclosure has been described above in detail with reference to the drawings, the specific configuration is not limited to this embodiment, and designs within the scope of the gist of the present disclosure, and the like are also included. The present disclosure is not limited to the above description, but is limited only by the attached claims.

#### INDUSTRIAL APPLICABILITY

[0060]

According to the above-described embodiment, it is possible to provide an autonomous mobile device management system, an autonomous mobile device management method, and a program which are capable of suitably controlling a plurality of autonomous mobile devices even when they are of different types.

#### REFERENCE SIGNS LIST

[0061]

1 Autonomous mobile device management system

10 Management device

20 Autonomous mobile device

101 Communication unit

102 Control unit

|    |                                                |
|----|------------------------------------------------|
|    | 103 Storage unit                               |
|    | 121 Information acquisition unit               |
|    | 122 List creation and updating unit            |
|    | 123 List updating necessity determination unit |
| 5  | 124 Instruction information creation unit      |
|    | 125 Operation result creation unit             |
|    | 201 Communication unit                         |
|    | 202 Region measurement sensor                  |
|    | 203 Movement mechanism unit                    |
| 10 | 204 Control unit                               |
|    | 205 Storage unit                               |
|    | 241 Information acquisition unit               |
|    | 242 Operation information creation unit        |
|    | 251 Instruction information storage unit       |
| 15 | 252 Map storage unit                           |

## CLAIMS

[Claim 1]

An autonomous mobile device management system comprising:

a plurality of autonomous mobile devices that move autonomously within a

5 building based on instruction information; and

a management device that manages the plurality of autonomous mobile devices,  
wherein

the autonomous mobile device includes

an operation information transmission unit that transmits operation information

10 including a current point, a moving speed, and a moving destination to the management  
device, and

an instruction information reception unit that receives the instruction  
information transmitted from the management device,

the management device includes

15 an operation information reception unit that receives the operation information  
transmitted from each of the autonomous mobile devices,

a list creation unit that creates a movement list for each of the autonomous  
mobile devices including one or more via-points to be passed through when the  
autonomous mobile device is autonomously moved from a current point to a final target  
20 point,

a list updating unit that updates the movement list for each of the autonomous  
mobile devices which is created by the list creation unit, and

an instruction information transmission unit that transmits instruction  
information to each of the autonomous mobile devices based on the movement list for

25 each of the autonomous mobile devices created by the list creation unit or based on the

movement list for each of the autonomous mobile devices which is updated by the list updating unit, and

the list updating unit updates the movement list for one of the autonomous mobile devices which is created by the list creation unit based on the operation

5 information of the plurality of autonomous mobile devices received by the operation information reception unit.

[Claim 2]

The autonomous mobile device management system according to claim 1, wherein

10 a priority of movement is set for each of the autonomous mobile devices, and the list updating unit updates the movement list based on the priority of each of the autonomous mobile devices.

[Claim 3]

An autonomous mobile device management method performed by an  
15 autonomous mobile device management system including a plurality of autonomous mobile devices that autonomously move within a building based on instruction information and a management device that manages the plurality of autonomous mobile devices, the autonomous mobile device management method comprising:

causing the autonomous mobile device to transmit operation information  
20 including a current point, a moving speed, and a moving destination to the management device;

causing the autonomous mobile device to receive the instruction information transmitted from the management device;

causing the management device to receive the operation information transmitted  
25 from each of the autonomous mobile devices;

causing the management device to create a movement list for each of the autonomous mobile devices including one or more via-points to be passed through when the autonomous mobile device is autonomously moved from a current point to a final target point;

- 5 causing the management device to update the movement list for each of the autonomous mobile devices which is created in the creating of the movement list; and
- causing the management device to transmit instruction information to each of the autonomous mobile devices based on the movement list for each of the autonomous mobile devices created in the creating of the movement list or based on the movement list
- 10 for each of the autonomous mobile devices which is updated in the updating of the movement list,
- wherein the movement list for one of the autonomous mobile devices which is created in the creating of the movement list is updated based on the operation information of the plurality of autonomous mobile devices received in the receiving of
- 15 the operation information.

[Claim 4]

- A program for an autonomous mobile device management system that causes a first computer to function as a plurality of autonomous mobile devices that move autonomously within a building based on instruction information, and causes a second
- 20 computer to function as a management device that manages the plurality of autonomous mobile devices, the program executing operations comprising:

- causing the first computer to function as
- an operation information transmission unit that transmits operation information including a current point, a moving speed, and a moving destination to the management
- 25 device, and

an instruction information reception unit that receives the instruction information transmitted from the management device; and

causing the second computer to function as

an operation information reception unit that receives the operation information transmitted from each of the autonomous mobile devices,

a list creation unit that creates a movement list for each of the autonomous mobile devices including one or more via-points to be passed through when the autonomous mobile device is autonomously moved from a current point to a final target point,

a list updating unit that updates the movement list for each of the autonomous mobile devices which is created by the list creation unit, and

an instruction information transmission unit that transmits instruction information to each of the autonomous mobile devices based on the movement list for each of the autonomous mobile devices created by the list creation unit or based on the movement list for each of the autonomous mobile devices which is updated by the list updating unit,

wherein the list updating unit updates the movement list for one of the autonomous mobile devices which is created by the list creation unit based on the operation information of the plurality of autonomous mobile devices received by the operation information reception unit.