DESCRIPTION

Title of Invention

MOBILE BODY CONTROL SYSTEM AND INFORMATION PROCESSING METHOD

Technical Field

[0001]

The present disclosure relates to a mobile body control system and an information processing method.

Background Art

[0002]

Control for suppressing interference between mobile bodies is known. For example, PTL 1 discloses a configuration in which a movement route of a transport vehicle (mobile body) is generated by shortest route search and the transport vehicle is moved along the movement route. PTL 1 discloses that an interference avoidance process is performed as follows. When there is a possibility that the transport vehicles interfere with each other, a movement of the transport vehicle having a higher priority is prioritized, and the transport vehicle having a lower priority is caused to stand by.

Citation List

Patent Literature

[0003]

[PTL 1] Japanese Unexamined Patent Application Publication No. 2016-170580

Summary of Invention

Technical Problem

[0004]

As disclosed in PTL 1, when a shortest route to a destination is always adopted for the movement route, in some cases, the transport vehicle may be delayed in reaching the destination, or may interfere with other work carried out in the same work region. Therefore, it is desirable to improve movement route settings. The term "interference" means that the mobile body hinders work of a worker or another mobile body.

[0005]

The present disclosure has been made in view of the above-described circumstances, and an object of the present disclosure is to provide a mobile body control system and an information processing method, which can improve movement route settings.

Solution to Problem

[0006]

According to the present disclosure, there is provided a mobile body control system including a storage unit that stores weight setting information in which a plurality of route portions through which a mobile body passes and a weight value indicating movement costs of the route portions are associated with each other, and work information including a work order of the mobile body, a weight setting unit that creates a plurality of the weight setting information in accordance with the work information, and a route setting unit that sets a movement route from a movement start position to a destination of the work order by using the weight setting information corresponding to the work information.

[0007]

According to the present disclosure, there is provided an information processing

method including a step of acquiring work information including a work order of a mobile body, a step of creating a plurality of weight setting information in which a plurality of route portions through which the mobile body passes and a weight value indicating movement costs of the route portions are associated with each other, in accordance with the work information, and a step of setting a movement route from a movement start position to a destination of the work order by using the weight setting information corresponding to the work information.

Advantageous Effects of Invention

[0008]

According to the present disclosure, it is possible to improve movement route settings.

Brief Description of Drawings

[0009]

FIG. 1 is a schematic diagram of a mobile body control system according to a first embodiment.

FIG. 2 is a schematic diagram of a system configuration of the mobile body control system.

FIG. 3 is a schematic diagram of a configuration of a mobile body.

FIG. 4 is a schematic block diagram of a control device of the mobile body.

FIG. 5 is a schematic block diagram of a management device.

FIG. 6 is a schematic block diagram of an information processing device.

FIG. 7 is a diagram showing an example of order information included in work information.

FIG. 8 is a schematic diagram showing a first example of weight setting information.

FIG. 9 is a schematic diagram showing a second example of the weight setting information.

FIG. 10 is a flowchart showing an example of a creation operation in which the weight setting information is created by the weight setting unit according to the first embodiment.

FIG. 11 is a flowchart showing an example of a setting operation in which a movement route is set by a route setting unit according to the first embodiment.

FIG. 12 is a diagram for describing a case where a non-transport order is added.

FIG. 13 is a flowchart showing an example of processing when an additional work order is generated.

FIG. 14 is a schematic diagram showing an example of route setting according to a comparative example.

FIG. 15 is a schematic diagram showing an example of route setting according to the first embodiment.

FIG. 16 is a schematic diagram showing an example of weight setting information corresponding to size information.

FIG. 17 is a diagram showing an example of a work order in a second embodiment.

FIG. 18 is a schematic diagram showing an example of route setting according to a comparative example.

FIG. 19 is a schematic diagram showing an example of route setting according to the second embodiment.

FIG. 20 is a diagram showing work information in a third embodiment.

FIG. 21 is a schematic diagram showing an example of an implementation area of a manned work.

FIG. 22 is a schematic diagram showing an example of weight setting information when the implementation area of the manned work is set.

FIG. 23 is a schematic diagram showing an example of route setting according to the third embodiment.

FIG. 24 is a schematic diagram for describing weighting according to a modification example of the third embodiment.

Description of Embodiments

[0010]

Hereinafter, preferred embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. The present disclosure is not limited by the embodiments, and when a plurality of the embodiments are provided, the present disclosure also includes a configuration in which the respective embodiments are combined with each other.

[0011]

[First Embodiment]

(Mobile Body Control System)

FIG. 1 is a schematic diagram of a mobile body control system according to a first embodiment. As shown in FIG. 1, a mobile body control system 1 according to the first embodiment is a system that controls a mobile body 10. The mobile body control system 1 includes a management device 12 and an information processing device 14. The mobile body control system 1 is provided in a facility 200 and controls a movement of the mobile body 10 belonging to the facility 200. For example, the facility 200 is a facility in which logistics management is performed, such as a warehouse, but may be any facility that operates the mobile body 10. In the mobile body control system 1, the mobile body 10 is an unmanned transport device that

transports an object P disposed in a work region of the facility 200. The work region is a region where the object P is installed or the mobile body 10 is moved, and is a floor surface of the facility 200, for example. In the first embodiment, the object P transported by the mobile body 10 is a transport object in which a cargo is loaded on a pallet. However, the object P is not limited to the transport object in which the cargo is loaded on the pallet, and may have any form. For example, the object P may be only the cargo without providing the pallet. In addition, the mobile body 10 is not limited to those which transport the object P, and may be a device that moves inside the facility 200 for any purpose.

[0012]

(Work Region)

As shown in FIG. 1, a work region is set in the facility 200. The work region is a region where the mobile body 10 carries out predetermined work such as cargo handling work. The work region includes a first region AR1 and a second region AR2.

[0013]

Hereinafter, one direction along a floor surface of the work region will be referred to as an X-direction, and a direction along the floor surface that intersects the direction X will be referred to as a Y-direction. The Y-direction is a direction orthogonal to the X-direction. The X-direction and the Y-direction may be referred to as directions along a horizontal plane. In the X-direction and the Y-direction, a direction of an arrow is defined as a + direction (or a + side), and a direction opposite to the + direction is defined as a - direction (or a - side). In addition, a direction orthogonal to the X-direction and the Y-direction, more specifically, a direction toward an upper side in a vertical direction, will be referred to as a Z-direction. In addition, unless otherwise specified, the term "position" refers to a position (coordinate) in a

coordinate system on a two-dimensional plane on the work region.

[0014]

For example, the first region AR1 is a region where the object P loaded on a transport vehicle or the object P unloaded from the transport vehicle is disposed. A plurality of disposition positions for disposing the object P are set in the first region AR1. In FIG. 1, 15 disposition positions of disposition positions e17 to e31 are shown as an example. Depending on a situation of the facility 200, the object P may be disposed at the disposition positions e17 to e31, or may not be disposed at the disposition positions e17 to e31. In the example in FIG. 1, the disposition positions e17 to e31 are set such that five rows of the disposition positions are aligned in the Y-direction and three rows of the disposition positions are aligned in the X-direction. The alignment and the number of the disposition positions may be determined in any way.

[0015]

In addition, a charging position c1 for charging the mobile body 10, standby positions h1 and h2 of the mobile body 10, and the like are set in the first region AR1.

[0016]

The second region AR2 is a storage region for storing the object P. In the second region AR2, a shelf 5 on which the object P can be installed is disposed, and disposition positions e1 to e16 are set for a plurality of the shelves 5. In the example in FIG. 1, the shelves 5 extending along the X-direction are aligned in two rows in the X-direction and in four rows in the Y-direction. Two disposition positions are set in one shelf 5.

[0017]

A passage R through which the mobile body 10 can pass is defined in advance in the work region. The passage R is a route virtually set in an XY-coordinate space

for control of the mobile body 10. The passage R may be provided with a mark (travel line, address marker, or the like) that can be detected by the mobile body 10, or a configuration may be adopted such that the mobile body 10 can travel along the passage R without any mark. The passage R is set to connect at least each of the disposition positions e1 to e31, the charging position c1, and each of the standby positions h1 and h2. The passage R is set to avoid an installation object such as the shelf 5 or an obstacle in the work region. The passage R can be set not only to a route that linearly connects the disposition positions and the like but also to a route that bypasses the installation object such as the shelf 5 (route for passing through a side in a +Y-direction of the disposition positions e1 to e4 or the like).

[0018]

The passage R is divided into a plurality of route portions Rp through which the mobile body 10 passes. Any method for setting the route portion Rp, such as the number of divisions of the passage R (number of the route portions Rp) or a shape of the route portion Rp, may be used. In the first embodiment, the route portion Rp is defined as a segment in which the passage R is divided into substantially constant distances. That is, the passage R is divided by a linear segment (segment) connecting a branching point, a corner, and each work position (disposition position, charging position, or standby position), and each linear segment is defined as the route portion Rp. In addition, the route portion Rp may be defined as a path connecting way points set at a plurality of positions (coordinates) in the work region. The way points do not necessarily have to be set at every constant distance.

[0019]

(System Configuration)

FIG. 2 is a schematic diagram of a system configuration of the mobile body

control system 1. FIG. 2 shows an example in which two information processing devices 14 are provided. The management device 12 is connected to each of the information processing device 14 to be capable of communicating therewith. The management device 12 transmits work information 70 to each of the information processing devices 14. The work information 70 includes order information 72 (refer to FIG. 7) including a plurality of work orders. The work order is information that defines contents of transport work for each of the mobile bodies 10. Each of the information processing devices 14 is connected to each of a plurality of the mobile bodies 10 under management to be capable of communicating therewith. Each of the information processing devices 14 performs operation scheduling to efficiently execute a group of work orders defined in the order information 72. The operation scheduling includes planning a movement route MV (refer to FIG. 15) of the mobile body 10 from a movement start position to a destination, which are designated in the work order. The movement route MV is information for designating the route portion Rp through which the mobile body 10 has to pass. The operation scheduling includes determining a planned start time of each work, based on a priority of the work order and a planned required time for the work. The work order includes movement work and cargo handling work as work units, and the cargo handling work includes loading and unloading. Each of the mobile bodies 10 carries out the work defined in the work order, based on a work instruction received from the information processing device 14 that manages the mobile body 10.

[0020]

(Mobile Body)

FIG. 3 is a schematic diagram of a configuration of the mobile body 10. The mobile body 10 is an unmanned transport device that can be automatically moved and

hold and transport the object P. Furthermore, in the first embodiment, the mobile body 10 is a so-called automated guided vehicle (AGV) or an automated guided forklift (AGF). The mobile body 10 shown in FIG. 3 is the AGF, that is, a forklift that transports the object P. However, the mobile body 10 is not limited to the forklift that transports the object P, and may be any device that can be automatically moved. In the first embodiment, the mobile body 10 is a rechargeable device equipped with a rechargeable battery (not shown), and can be charged at the charging position c1 when remaining battery capacity decreases.

[0021]

As shown in FIG. 3, the mobile body 10 includes a vehicle body 20, wheels 20A, straddle legs 21, a mast 22, a fork 24, a sensor 26A, and a control device 28. The straddle legs 21 are a pair of shaft-shaped members provided in one end portion of the vehicle body 20 in a front-rear direction and protruding from the vehicle body 20. The wheels 20A are provided in each tip of the straddle legs 21 and the vehicle body 20. That is, although a total of three wheels 20A are provided, positions and the number of the wheels 20A may be determined in any way. The mast 22 is movably attached to the straddle legs 21, and moves in the front-rear direction of the vehicle body 20. The mast 22 extends along an up-down direction (herein, the Z-direction) orthogonal to the front-rear direction. The fork 24 is attached to the mast 22 to be movable in the Z-direction. The fork 24 may also be movable with respect to the mast 22 in a lateral direction (direction intersecting the up-down direction and the front-rear direction) of the vehicle body 20. The fork 24 includes a pair of claws 24A and 24B. The claws 24A and 24B extend from the mast 22 toward a front direction of the vehicle body 20. The claw 24A and the claw 24B are disposed to be separated from each other in the lateral direction of the mast 22. Hereinafter, in the front-rear direction, a direction on

a side on which the fork 24 is provided in the mobile body 10 will be referred to as a front direction, and a direction on a side on which the fork 24 is not provided will be referred to as a rear direction.

[0022]

The sensor 26A detects at least one of a position and a posture of the object present around the vehicle body 20. The sensor 26A can detect at least one of the position of the object with respect to the mobile body 10 and the posture of the object with respect to the mobile body 10. In the first embodiment, the sensor 26A is provided in each tip of the straddle legs 21 in the front direction and on a side in the rear direction of the vehicle body 20. However, the position where the sensor 26A is provided is not limited thereto, the sensor 26A may be provided at any position, and the number of provided sensors 26A may be determined in any way.

[0023]

For example, the sensor 26A is a sensor that emits laser light. The sensor 26A emits the laser light while performing scanning in one direction (here, the lateral direction), and detects the position and an orientation of the object from reflected light of the emitted laser light. That is, the sensor 26A can be a so-called two-dimensional (2D)-light detection and ranging (LiDAR) sensor. However, the sensor 26A is not limited to the above-described sensor, and may be a sensor that detects the object P by using any method. For example, a so-called three-dimensional (3D)-LiDAR sensor that performs scanning in a plurality of directions, a so-called one-dimensional (1D)-LiDAR sensor that does not perform the scanning, or a camera.

[0024]

The control device 28 controls the movement of the mobile body 10. The control device 28 will be described later.

[0025]

FIG. 4 is a schematic block diagram of the control device 28 of the mobile body 10. The control device 28 is a device that controls the mobile body 10. The control device 28 is a computer, and includes a communication unit 100, a storage unit 102, and a control unit 104 as shown in FIG. 4. The communication unit 100 is a module used by the control unit 104 for communicating with an external device such as the information processing device 14, and may include an antenna, for example. A communication method of the communication unit 100 is wireless communication in the first embodiment, but the communication method may be determined in any way. The storage unit 102 is a memory that stores various types of information, such as calculation contents of the control unit 104 and programs, and for example, includes at least one of a main storage device, such as a RAM or a ROM, and an external storage device such as an HDD.

[0026]

The control unit 104 is a calculation device, and for example, includes a calculation circuit such as a CPU. The control unit 104 includes a route acquisition unit 110, a movement control unit 112, and an information transmission unit 114. The control unit 104 reads and executes a program (software) from the storage unit 102. In this manner, the route acquisition unit 110, the movement control unit 112, and the information transmission unit 114 are realized to execute processes thereof. The control unit 104 may execute the processes by using one CPU, or may include a plurality of the CPUs to execute the processes by using the plurality of CPUs. In addition, at least a part of the route acquisition unit 110, the movement control unit 112, and the information transmission unit 114 may be realized by a hardware circuit. In addition, a program for the control unit 104 which is stored in the storage unit 102 may be stored

in a recording medium readable by the control device 28.

[0027]

The route acquisition unit 110 acquires information of a route (movement route MV) through which the mobile body 10 moves, the movement control unit 112 controls a movement mechanism such as a drive unit or steering of the mobile body 10 to control the movement of the mobile body 10, and the information transmission unit 114 transmits mobile body information indicating a position of the mobile body 10 and status information of the mobile body 10 including the remaining battery capacity to an external device such as the information processing device 14.

[0028]

(Management Device)

FIG. 5 is a schematic block diagram of the management device 12. The management device 12 is a system that manages logistics in the facility 200. Although the management device 12 is a warehouse control system (WCS) or a warehouse management system (WMS) in the first embodiment, the management device 12 may be any system without being limited to the WCS and the WMS. For example, the management device 12 may be a back-end system such as another production management system. A position where the management device 12 is provided may be determined in any way. The management device 12 may be provided inside the facility 200, or may be provided at a position separated from the facility 200 to manage the facility 200 from the separated position. The management device 12 is a computer, and includes a communication unit 30, a storage unit 32, and a control unit 34, as shown in FIG. 5.

[0029]

The communication unit 30 is a module used by the control unit 34 for

communicating with an external device such as the information processing device 14, and may include an antenna, for example. A communication method of the communication unit 30 is wireless communication in the first embodiment, but any communication method may be adopted.

[0030]

The storage unit 32 is a memory that stores various types of information, such as calculation contents of the control unit 34 and programs, and for example, includes at least one of a main storage device such as the RAM or the ROM and an external storage device such as the HDD. The storage unit 32 stores the work information 70 and the weight setting information 80. The work information 70 is a general term for information of work related to an operation of the mobile body control system 1. The work information 70 includes at least a work order (order information 72) of the mobile body 10. The weight setting information 80 is information in which the plurality of route portions Rp through which the mobile body 10 passes and a weight value W (refer to FIGS. 8 and 9) indicating movement costs of the route portions Rp are associated with each other.

[0031]

The control unit 34 is a calculation device, and for example, includes a calculation circuit such as a CPU. The control unit 34 includes a work order setting unit 40 and a weight setting unit 42. The control unit 34 reads and executes a program (software) from the storage unit 32. In this manner, the work order setting unit 40 is realized to execute a process thereof. The control unit 34 may execute the process by using one CPU, or may include a plurality of the CPUs to execute the process by using the plurality of CPUs. In addition, at least a part of the work order setting unit 40 may be realized by a hardware circuit. In addition, a program for the control unit 34 which

is stored in the storage unit 32 may be stored in a recording medium readable by the management device 12.

[0032]

The work order setting unit 40 sets a work order of the mobile body 10 for each object P. The work order setting unit 40 causes the communication unit 30 to transmit the order information 72 including the set work order. The contents of the work order will be described below.

[0033]

The weight setting unit 42 creates the weight setting information 80 by setting the weight value W for each of the plurality of route portions Rp stored in the storage unit 32. The setting of the weight value W will be described later.

[0034]

The management device 12 may also perform a process other than setting of a target position and weighting. For example, the management device 12 may also set information for controlling a mechanism (for example, an elevator or a door) other than the mobile body 10 provided in the facility 200.

[0035]

(Information Processing Device)

FIG. 6 is a schematic block diagram of the information processing device 14. The information processing device 14 is a device that processes information related to the movement of the mobile body 10 or the like. For example, the information processing device 14 is a fleet control system (FCS), but without being limited thereto, the information processing device 14 may be any device that processes the information related to the movement of the mobile body 10. The information processing device 14 is a computer, and includes a communication unit 50, a storage unit 52, and a control

unit 54 as shown in FIG. 6. The communication unit 50 is a module used for the control unit 54 to communicate with an external device such as the management device 12 and the mobile body 10, and may include an antenna, for example. A communication method of the communication unit 50 is wireless communication in the first embodiment, but any communication method may be adopted.

[0036]

The storage unit 52 is a memory that stores various types of information, such as calculation contents of the control unit 54 and programs, and for example, includes at least one of a main storage device, such as the RAM and the ROM, and an external storage device, such as the HDD. The storage unit 52 stores the weight setting information 80 set by the management device 12.

[0037]

The control unit 54 is a calculation device, and for example, includes a calculation circuit such as the CPU. The control unit 54 includes an acquisition unit 60, a route setting unit 62, and a processing unit 64. The control unit 54 reads and executes a program (software) from the storage unit 52. In this manner, the acquisition unit 60 and the route setting unit 62 are realized to execute processes thereof. The control unit 54 may execute the processes by using one CPU, or may include a plurality of CPUs to execute the processes by using the plurality of CPUs. In addition, at least a part of the acquisition unit 60 and the route setting unit 62 may be realized by a hardware circuit. In addition, a program for the control unit 54 which is stored in the storage unit 52 may be stored in a recording medium readable by the information processing device 14.

[0038]

The acquisition unit 60 acquires the work order transmitted from the

management device 12. The acquisition unit 60 acquires the weight setting information 80 transmitted from the management device 12. The acquisition unit 60 acquires the mobile body information transmitted from the mobile body 10. The route setting unit 62 generates transport instruction information of the mobile body 10, based on the work order. The transport instruction information includes the movement route MV from the movement start position to the destination of the mobile body 10, and a start timing of the movement. The route setting unit 62 sets the movement route MV corresponding to each work order, based on the work order and the weight setting information 80. The processing unit 64 transmits a transport instruction to each of the mobile bodies 10 under management via the communication unit 50, based on the transport instruction information set by the route setting unit 62.

[0039]

In the first embodiment, the management device 12 and the information processing device 14 are separate devices, but may be an integrated device. That is, the management device 12 may have at least some of functions of the information processing device 14, and the information processing device 14 may have at least some of functions of the management device 12.

[0040]

(Order Information)

FIG. 7 is a diagram showing an example of the order information 72 included in the work information 70. The order information 72 includes a group of (a plurality of) work orders. Each work order defined in the order information 72 is set for each object P.

[0041]

As shown in FIG. 7, the work order includes an order ID, information of a

loading position and an unloading position, a priority of the work, and a mobile body ID of the mobile body 10 to which the work is assigned. In an example in FIG. 7, the work order further includes information of a pallet width. Meanwhile, the pallet width will be described later. The loading position is a position where loading is performed on the mobile body 10. The unloading position is a position where unloading is performed from the mobile body 10. For example, the order ID = 101 defines that the mobile body 10 of the ID = 1 performs loading at the disposition position e17, and performs unloading at the disposition position e2. The priority is represented by a natural number of 1 or more, and a smaller value indicates a higher priority. The work order setting unit 40 creates the order information 72 including a group of work orders by collecting a plurality of work orders for each mobile body ID managed by the information processing device 14. The work order setting unit 40 causes the communication unit 30 to transmit the order information 72 to the corresponding information processing device 14.

[0042]

(Weighting)

FIG. 8 is a schematic diagram showing a first example of the weight setting information 80. FIG. 9 is a schematic diagram showing a second example of the weight setting information 80. Here, for convenience of description, an example will be described in which two weight values W of a “small weight” and a “large weight” are set. The weight value W is not limited to two types, and any value can be adopted. In practice, each weight value W is individually set numerical information, and even when the same "small weight" is set, specific numerical values to be set may be different.

[0043]

In examples in FIGS. 8 and 9, the passage R in the work region is divided into

a total of 71 route portions Rp. In the examples in FIGS. 8 and 9, the weight value W for each route portion Rp is represented by two types of arrows shown in an explanatory note. In the first embodiment, the weight setting unit 42 creates a plurality of weight setting information 80 in accordance with the work information 70. Here, two types including weight setting information 80A shown in FIG. 8 and weight setting information 80B shown in FIG. 9, which correspond to the work information 70, are shown. In the weight setting information 80A and the weight setting information 80B, the weight values W for each route portion Rp are at least partially different. The weight setting information 80 is a general term for the plurality of weight setting information 80A and 80B.

[0044]

Specifically, in the first embodiment, the work order included in the work information 70 includes a transport work order and a non-transport order. The weight setting unit 42 creates weight setting information 80A and 80B which are different between the transport work order and the non-transport order. The weight setting information 80A in FIG. 8 is weight setting information for the transport work order, and the weight setting information 80B is weight setting information for the non-transport order.

[0045]

The transport work order is an order in which transport work as main work of the mobile body 10 serving as the unmanned transport device is set as order content. The non-transport order has an order content other than the transport work. For example, the non-transport order includes a work order for charging the mobile body 10 (movement to the charging position c1). For example, the non-transport order includes a work order for standby (movement to a standby position h1 or h2) of the mobile body

10. Here, the standby of the mobile body 10 is a work order for causing the mobile body 10 to temporarily stand by, when the work order to be executed by the mobile body 10 is not present at a certain point in time during an operation of the mobile body control system 1.

[0046]

A method for setting the weight value W by the weight setting unit 42 is not limited to a specific method. For example, the weight setting unit 42 sets the weight value W of each route portion Rp by using typical (virtual) order information 72 in the facility 200 or order information 72 executed in the past, through an optimized simulation. For example, the weight setting unit 42 may optimize the weight value W by using machine learning or reinforcement learning from an operation result (setting result of the movement route MV) or actual information of past interference occurrence in the movement route MV. The weight setting unit 42 can calculate the weight value W in accordance with a preset calculation algorithm, and may set the weight value W in accordance with an operation input of the worker. As shown in FIGS. 8 and 9, the weight setting unit 42 records a set of weight values W set for all of the route portions Rp in the storage unit 32, as weight setting information 80 (80A and 80B).

[0047]

(Generation of Transport Instruction Information)

As shown in FIG. 6, in the information processing device 14, the communication unit 50 receives the order information 72 transmitted from the management device 12 and the weight setting information 80. The acquisition unit 60 acquires the received order information 72 and the received weight setting information 80. The route setting unit 62 generates transport instruction information on the work of the mobile body 10, based on the content of the work order and the weight value W

corresponding to each route portion Rp for each work order included in the order information 72. In the first embodiment, the route setting unit 62 sets the movement route MV from a movement start position to a destination of the work order by using the weight setting information (80A or 80B) corresponding to the work information 70.

[0048]

The route setting unit 62 sets the movement route MV (refer to FIG. 15) from the movement start position to the destination of the mobile body 10, based on the weight value W in each passage direction of the plurality of route portions Rp. The movement route MV is information indicating the route portion Rp of the mobile body 10 passing from the movement start position to the destination. When the mobile body 10 executes the first work order, the movement start position is an initial position of the mobile body 10. When the mobile body 10 executes the second and subsequent work orders, the movement start position is an unloading position of the work order immediately one before. The route setting unit 62 performs route planning by setting the loading position or the unloading position as the destination. For example, the route setting unit 62 sets the movement route MV by shortest route search. The shortest route search is a route setting method for obtaining a route having a minimum movement cost out of the routes from the movement start position to the destination. In the first embodiment, the movement cost is represented by the weight value W. Therefore, the route setting unit 62 adopts a route in which a total of the weight values W of each route portion Rp of the mobile body 10 passing from the movement start position to the destination is minimized, as the movement route MV.

[0049]

Subsequently, the route setting unit 62 determines a planned start time of each work order, based on a priority of each work order and a planned required time of the

cargo handling work at the loading position and the unloading position. In this manner, the route setting unit 62 generates transport instruction information including the movement route MV and the planned start time for each work order. A set of the transport instruction information of each work order forms an operation schedule of each mobile body 10 in the facility 200.

[0050]

The processing unit 64 instructs the mobile body 10 to carry out the work when the mobile body 10 having an ID designated in the work order satisfies a work start condition and the planned start time of the work elapses. For example, the work start condition refers to a case where the mobile body 10 is normally operated and the work instructed in the past (immediately before) is normally completed.

[0051]

(Operation of Mobile Body)

The mobile body 10 carries out the work in accordance with the set transport instruction information. As shown in FIG. 4, the movement control unit 112 of the mobile body 10 controls the movement of the mobile body 10, based on the transport instruction information.

[0052]

In addition, when the mobile body 10 reaches the loading position, the movement control unit 112 causes the sensor 26A to detect a position and a posture of the object P, and sets a route for approaching the object P, based on a detection result thereof. In this manner, the mobile body 10 loads (picks up) the object P in accordance with the set route, and holds a pallet of the object P with a pair of claws 24A and 24B (refer to FIG. 3).

[0053]

After picking up the object P, the movement control unit 112 controls the movement of the mobile body 10 to move toward the unloading position. It is preferable that the route acquisition unit 110 sets a second route (global path), based on a first route (layout path) which is the movement route MV of the transport instruction information transmitted from the information processing device 14. In this case, the route acquisition unit 110 sets the route, based on the first route and information of vehicle specifications of the mobile body 10. For example, the information of the vehicle specifications indicates specifications that affect the route along which the mobile body 10 is movable, such as a size or a minimum turning radius of the mobile body 10.

[0054]

The movement control unit 112 sequentially identifies position information of the mobile body 10 to move the mobile body 10 to pass through the set route (second route). A method for acquiring the position information of the mobile body 10 is used in any way. However, for example, in the first embodiment, a detection body (not shown) is provided in the facility 200, and the movement control unit 112 acquires information of the position and the posture of the mobile body 10, based on detection of the detection body. Specifically, the mobile body 10 emits laser light toward the detection body, and receives reflected light of the laser light from the detection body to detect the position and the posture of the mobile body 10 itself in the facility 200. The method for acquiring the information of the position and the posture of the mobile body 10 is not limited to the method using the detection body, and, for example, simultaneous localization and mapping (SLAM) may be used.

[0055]

(Operation of Mobile Body Control System)

FIG. 10 is a flowchart showing an example of an operation of creating the weight setting information 80 by the weight setting unit 42 according to the first embodiment. As shown in FIG. 10, in the management device 12, the weight setting unit 42 acquires the work information 70 including the work order of the mobile body 10 from the storage unit 32 (Step S10). The weight setting unit 42 creates the weight setting information 80 by setting the weight value W for each of the route portions Rp in accordance with the work information 70 (Step S11). In this case, the weight setting unit 42 creates a plurality of the weight setting information 80 (80A and 80B) in accordance with the work information 70. The weight setting unit 42 stores the created weight setting information 80A and 80B in the storage unit 32, and causes the communication unit 30 to transmit the weight setting information 80A and 80B to the information processing device 14 (Step S12).

[0056]

FIG. 11 is a flowchart showing an example of a setting operation of the movement route MV by the route setting unit 62 according to the first embodiment. As shown in FIG. 11, in the information processing device 14, the acquisition unit 60 acquires the work information 70 from the management device 12 via the communication unit 50 (Step S20). The acquisition unit 60 acquires information (route information) of the route portion Rp and the weight setting information 80A and 80B from the management device 12 via the communication unit 50 (Step S21). Any of Steps S20 and S21 may be performed earlier. The route setting unit 62 sets the movement route MV, based on the order information 72 included in the work information 70, the information of the route portion Rp, and the weight setting information 80 (Step S22). In this case, the route setting unit 62 sets the movement route MV from the movement start position to the destination of the work order by using

the weight setting information (80A or 80B) corresponding to the work information 70. That is, for example, the route setting unit 62 sets the movement route MV by the shortest route search, based on the weight value W of the weight setting information 80A or 80B to be used. In addition, the route setting unit 62 generates transport instruction information including the movement route MV and the planned start time for each work order. Based on the transport instruction information, the processing unit 64 causes the communication unit 50 to transmit an instruction to start the work to the corresponding mobile body 10, for each work order (Step S23).

[0057]

(Addition of Work Order and Resetting of Movement Route)

Next, an operation performed by addition of the non-transport order will be described. In the first embodiment, when an event corresponding to the non-transport order occurs during the work, the weight setting unit 42 creates the non-transport order.

[0058]

FIG. 12 is a diagram showing the addition of the non-transport order. In FIG. 12, as an event corresponding to the non-transport order, a decrease in remaining battery capacity of a storage battery mounted on the mobile body 10 will be described as an example. An upper side in FIG. 12 is the order information 72 before the addition of the non-transport order, and a lower side is the order information 72 after the addition of the non-transport order. The management device 12 acquires status information of each of the mobile bodies 10 including the remaining battery capacity via the information processing device 14. The work order setting unit 40 generates the work order (non-transport order) for charging (movement to the charging position c1), when the remaining battery capacity in the status information of any of the mobile bodies 10 is at a predetermined low level.

[0059]

The work order setting unit 40 adds the non-transport order for charging to the order information 72 to interrupt the work order in progress with the non-transport order for charging at the next priority, and transmits the order information 72 to the information processing device 14 via the communication unit 30. In FIG. 12, an order ID=201 is an additional non-transport order.

[0060]

When the non-transport order is generated, the route setting unit 62 of the information processing device 14 performs resetting of the movement route MV on the work order before the start. That is, when the route setting unit 62 acquires the order information 72 to which the non-transport order is added, the route setting unit 62 re-generates the transport instruction information (resetting of the movement route MV and resetting the movement start time) for all of the work orders before the start (when not started) including the non-transport order. That is, the operation schedule is rescheduled.

[0061]

FIG. 13 is a flowchart showing an example of a process when the additional work order (non-transport order) is generated.

[0062]

As shown in FIG. 13, first, the route setting unit 62 acquires the work information 70 (order information 72) including the additional work order from the management device 12 via the communication unit 50 (Step S30). The route setting unit 62 extracts all of the work orders before the start, including the non-transport order newly added this time, from the work orders included in the order information 72 (Step S31). The extracted work order is a resetting target. The route setting unit 62 resets

the movement route MV for the work order serving as the resetting target (Step S32). In this case, the route setting unit 62 sets the movement route MV for the transport work order in the work orders serving as the resetting targets by using the weight setting information 80A (refer to FIG. 8), and sets the movement route MV for the non-transport order by using the weight setting information 80B (refer to FIG. 9). After the movement route MV is reset, the route setting unit 62 resets the movement start time for each work order, and generates the transport instruction information. Thereafter, based on the transport instruction information, for each work order, the processing unit 64 transmits an instruction of the work start to the corresponding mobile body 10 via the communication unit 50 (Step S33).

[0063]

(Example of Weight Setting)

Next, an example of weight setting in the first embodiment will be described. As described above, in the shortest route search, as the weight value W set in the route portion Rp is smaller, the route portion Rp is more likely to be adopted for the movement route MV of the mobile body 10. As the weight value W set in the route portion Rp is greater, the route portion Rp is less likely to be adopted for the movement route MV of the mobile body 10.

[0064]

As shown in FIGS. 8 and 9, in the first embodiment, the weight setting unit 42 creates the weight setting information 80B for the non-transport order such that the route portion Rp which is likely to be adopted for the movement route MV is less likely to be adopted for the movement route MV for the non-transport order, by using the weight setting information 80A for the transport work order. That is, in the first embodiment, the weighting is performed such that the shortest route is preferentially adopted for the

transport work order, which is the main work, and the weighting is performed such that a bypass route different from the shortest route is preferentially adopted for the other non-transport orders not to hinder the performance of the transport work order.

[0065]

Specifically, in the weight setting information 80A for the transport work order shown in FIG. 8, a small weight value W is uniformly set for all of the route portions Rp. When the shortest route search is performed by using the weight setting information 80A, there is no significant difference in the weight value W. Therefore, the shortest route in which a movement distance between the movement start position and the destination is minimized is adopted as the movement route MV.

[0066]

The transport work of the object P in the transport work order is basically classified into two types of the stock receiving work for storing the unloaded object P in the shelf 5 or stock delivery work for stowing the object P stored in the shelf 5 on the transport vehicle. In any work, any one of the disposition positions e17 to e31 of the first region AR1 and any one of the disposition positions e1 to e16 of the second region AR2 are set as the movement start position or the destination.

[0067]

Therefore, when the route setting for the transport work order is performed by using the weight setting information 80A, the route portion Rp which is likely to be adopted for the movement route MV corresponds to the route portion Rp which forms the shortest route connecting a region at the disposition positions e17 to e31 and a region at the disposition positions e1 to e16. That is, the route portion Rp included in the region MS1 shown in FIG. 8 is the route portion Rp which is likely to be adopted for the movement route MV in the transport work order.

[0068]

Therefore, as shown in FIG. 9, the weight setting unit 42 sets the great weight value W for the route portion Rp included in the region MS1, and sets the small weight value W for the other route portion Rp which is not included in the region MS1, thereby creating the weight setting information 80B for the non-transport order. In this manner, when the route setting is performed by using the weight setting information 80B, the route portion Rp included in the region MS1 is relatively less likely to be adopted for the movement route MV, and the other route portion Rp which is not included in the region MS1 is likely to be adopted for the movement route MV of the non-transport order.

[0069]

Next, an operation when the weight setting information 80A and 80B are set to be different between the transport work order and the non-transport order will be described with reference to a comparative example.

[0070]

(Comparative Example)

FIG. 14 is a schematic diagram showing an example of route setting according to a comparative example. The comparative example shows an example of the route setting when the same weight setting information is used between the transport work order and the non-transport order. In the comparative example, the same weight setting as the weight setting information 80A shown in FIG. 8 is applied. In addition, as the work order, the order information 72 when the non-transport order shown on a lower side in FIG. 12 is added will be set as an example. The mobile body 10 having the mobile body ID = 1 will be referred to as a mobile body 10-1, and the mobile body 10 having a mobile body ID = 2 will be referred to as a mobile body 10-2. In FIG. 14, the

mobile body 10-1 serving as a target of an order ID = 201 in FIG. 12 is present at the disposition position e2 which is the unloading position, since an order ID = 101 is executed immediately before.

[0071]

In the comparative example, since the weight setting in FIG. 8 is used, as a result of the shortest route search, the movement route connecting the movement start position and the destination by using the shortest distance is adopted. Therefore, the movement route MVA which is the shortest route is set as a route from the current position (disposition position e2) to the charging position (c1) in the order ID = 201. The movement route MVA is a route passing through the route portions Rp7, Rp6, Rp5, Rp4, Rp3, and Rp11 from the disposition position e2 and reaching the charging position c1.

[0072]

On the other hand, in FIG. 12, the order ID = 102 is in progress by the mobile body 10-2. In the comparative example, the movement route MVB which is the shortest route is also set for the order ID = 102. The movement route MVB is a route passing through the route portions Rp1, Rp2, Rp3, Rp4, Rp5, and Rp6 from the disposition position e27 and reaching the disposition position e3.

[0073]

Since the movement routes MVA and MVB are routes in which the mobile bodies 10-1 and 10-2 move in both directions in the route portions Rp3, Rp4, Rp5, and Rp6, the mobile bodies 10-1 and 10-2 interfere with each other.

[0074]

In this case, for example, interference avoidance control is performed such that the work order (order ID) having a high priority is prioritized and interference avoidance is performed on the work order having a low priority. For example, in the interference

avoidance control, the mobile body 10-1 is caused to stand by in the route portion Rp7 in front of an interference location until the mobile body 10-2 passes, or the mobile body 10-1 is temporarily retracted to a retract position outside the interference location. When the interference avoidance control is performed, even though the shortest route is set, there is a possibility that processing efficiency (number of processed work orders per unit time) of the work orders by the mobile body 10-1 and the mobile body 10-2 is lowered due to a time loss caused by the interference avoidance.

[0075]

(Case of First Embodiment)

FIG. 15 is a schematic diagram showing an example of the route setting according to the first embodiment. In the first embodiment, the route setting unit 62 performs the shortest route search by properly using the weight setting information 80A and 80B shown in FIGS. 8 and 9, in a case of the work order in FIG. 12, which is the same as the comparative example. As a result, the movement routes MV1 and MV2 shown in FIG. 15 are set.

[0076]

That is, the movement route MV1 set for the non-transport order of the order ID = 201 is a bypass route passing through the route portions Rp21, Rp22, Rp23, Rp24, Rp25, Rp26, Rp27, Rp28, Rp29, Rp30, Rp31, and Rp32 from the disposition position e2 and reaching the charging position c1 by using the weight setting information 80B (refer to FIG. 9). On the other hand, the movement route MV2 set for the transport work order of the order ID = 102 is a route passing through the route portions Rp1, Rp2, Rp3, Rp4, Rp5, and Rp6 from the disposition position e27 and reaching the disposition position e3 by using the weight setting information 80A. In this example, the movement route MV2 is the same route as the movement route MVB in FIG. 14. In a

case in FIG. 15, since the route portions Rp do not overlap each other in the movement routes MV1 and MV2, no interference occurs. Therefore, there is no time loss due to the interference avoidance. As a result, even when the individual movement route MV (movement routes MV1) is not the shortest distance as the movement distance, it is possible to improve processing efficiency of all of the work orders.

[0077]

In the first embodiment, it should be noted that the great weight value W is set for the route portion Rp belonging to the region MS1 which is likely to be adopted for the transport work order in the non-transport order (weight setting information 80B), and the route portion Rp belonging to the region MS1 is not set to passage prohibition. When a certain route portion Rp is set to the passage prohibition, in a case where the route cannot pass through another route portion Rp, when there is a case where there is only a route passing through the route portion Rp of the passage prohibition, the movement route MV cannot be generated. In contrast, in the first embodiment, the great weight value W is set for the route portion Rp belonging to the region MS1. Therefore, even when there is a case where the route cannot be generated unless the route passes through the region MS1, the movement route MV can be generated only by increasing a total sum of the weight values W. That is, in the first embodiment, high redundancy is obtained in the following point. While the route setting is possible to reduce the frequency of the occurrence of interference between the transport work order and the non-transport order, the route setting is possible to allow the occurrence of interference when there is no other option.

[0078]

[Second Embodiment]

Next, a second embodiment will be described. In the second embodiment, an

example of the weight setting different from the weight setting corresponding to a type of the work order will be described. In the second embodiment, elements having configurations common to those in the first embodiment will be omitted in the description.

[0079]

In the second embodiment, the weight setting unit 42 creates a plurality of weight setting information 80 in accordance with the size information set for each work order of the order information 72 in the work information 70.

[0080]

That is, in the second embodiment, the work information 70 includes size information of at least one of the object P or the mobile body 10. In an example in FIG. 7, the work information 70 includes information of a pallet width of the object P for each individual work order included in the order information 72. The pallet width is an example of the size information of the object P. In FIG. 7, the pallet width is set to two types of sizes, such as a "standard" size indicating a width equal to or smaller than a predetermined width and a "large" size indicating a width larger than the predetermined width. However, three or more types may be set, or may be set to specific numerical values (width dimensions).

[0081]

The weight setting unit 42 creates different weight setting information 80 when the size information is equal to or smaller than a predetermined value and when the size information is greater than the predetermined value. That is, the weight setting unit 42 creates the weight setting information 80A when the pallet width is "standard", and the weight setting information 80C when the pallet width is "large". FIG. 16 is a schematic diagram showing an example of the weight setting information 80C corresponding to

the size information.

[0082]

Here, in an example shown in FIG. 16, a region MS2 having a narrow passage width is present in a part of the passage R. It is assumed as follows. When the mobile body 10 transports the object P having a "standard" pallet width, the mobile body 10 can pass through the region MS2 with a normal operation, but when the mobile body 10 transports the object P having a "large" pallet width, the mobile body 10 needs to pass through the region MS2 at a lower speed than a normal speed such that the object P does not come into contact with an obstacle (here, the shelf 5). The region MS2 includes a route portion Rp41 and a route portion Rp42.

[0083]

In the second embodiment, when the size information is greater than the predetermined value, the weight setting unit 42 creates the weight setting information 80C such that predetermined route portions set in advance are less likely to be adopted for the movement route MV. The predetermined route portions set in advance are the route portion Rp41 and the route portion Rp42 which belong to the region MS2. That is, the weight setting unit 42 performs weighting such that the weight value W for the route portion Rp41 and the route portion Rp42 is relatively greater than the weight value W for other route portions Rp. The weighting may increase the weight value W of the route portion Rp41 and the route portion Rp42, or may decrease the weight value W of another route portion Rp other than the route portion Rp41 and the route portion Rp42.

[0084]

In this manner, when the route setting is performed on the work order having the "large" pallet width, the route portions Rp41 and Rp42 for which the relatively great weight value W is set are less likely to be adopted for the movement route MV of the

mobile body 10 by using the weight setting information 80C. As a result of setting the relatively small weight value W for another route portion Rp other than the region MS2, another route portions Rp are likely to be adopted for the movement route MV of the mobile body 10.

[0085]

Therefore, when there exists a route that can reach the destination without passing through the region MS2 (route portions Rp41 and Rp42) where low-speed traveling is required when the pallet width is "large", a route that bypasses the region MS2 is likely to be adopted for the movement route MV of the mobile body 10.

[0086]

On the other hand, the weight setting information 80A for the work order having the "standard" pallet width may be the same as that in FIG. 8. When the pallet width is normal, the low-speed traveling is not required in the region MS2. Therefore, the reason is that the movement route MV does not need to avoid the region MS2.

[0087]

Next, an operation when the different weight setting information 80 is set according to the size information (the pallet width) will be described with reference to a comparative example. FIG. 17 is a diagram showing an example of a work order in the second embodiment. Here, an example of performing the route setting will be used while a loading position (disposition position e17) is set as the movement start position and an unloading position(disposition position e1) is set as the destination for the work order of the order ID = 301 having the "large" pallet width of shown in FIG. 17.

[0088]

(Comparative Example)

FIG. 18 is a schematic diagram showing an example of route setting according

to a comparative example. In the comparative example, the same weight setting as the weight setting information 80A shown in FIG. 8 is applied regardless of the size information (pallet width).

[0089]

In the comparative example, for the work order of the order ID = 301 having the "large" pallet width, as a result of the shortest route search, a route connecting the movement start position (disposition position e17) to the destination (disposition position e1) with the shortest distance is adopted. Therefore, as shown in FIG. 18, the movement route MVC which is the shortest route is set for the order ID = 301. The movement route MVC passes through the route portions Rp41 and Rp42 of the region MS2. Therefore, the mobile body 10-1 needs to travel at a low speed in the region MS2. Due to the low-speed traveling, a movement time is lengthened even though the route is the shortest route. In addition, for example, in a case where another mobile body 10-2 passes through the same region MS2 of the work order having the "standard" pallet width, when the preceding mobile body 10-1 travels at the low speed, the mobile body 10-2 needs to travel at the low speed in accordance with a traveling speed of the mobile body 10-1. As a result, processing efficiency of the work order by the mobile body 10-1 and the mobile body 10-2 is lowered.

[0090]

(Case of Second Embodiment)

FIG. 19 is a schematic diagram showing an example of route setting according to the second embodiment. In the second embodiment, the route setting unit 62 performs the shortest route search by using the weight setting information 80C shown in FIG. 16, for the work order (order ID = 301) having the “large” pallet width, as in the comparative example. As a result, the movement route MV3 shown in FIG. 19 is set.

[0091]

That is, the movement route MV3 is a route on a side in the +X-direction which bypasses the region MS2 (route portions Rp41 and Rp42) without passing through the region MS2 by using the weight setting information 80C. Since the movement route MV3 does not pass through the region MS2 where the low-speed traveling is performed when the pallet width is "large", a time loss caused by a speed decrease does not occur. A time loss of another mobile body 10-2 does not occur in that low-speed traveling is required for another mobile body 10 due to the mobile body 10 with travels at the low speed. As a result, even when the individual movement route MV (movement route MV3) is not the shortest as the movement distance, it is possible to improve the processing efficiency of the work order in all of the work orders.

[0092]

In the second embodiment, the route portions Rp41 and Rp42 belonging to the region MS2 are not set to passage prohibition. Therefore, even when the weight setting information 80C is used for the work order having the “large” pallet width, when there is no other bypass route, it is possible to generate the movement route MV passing through the region MS2 at the low speed. Therefore, high redundancy can be obtained.

[0093]

(Modification Example of Second Embodiment)

In the second embodiment, an example has been described in which the weight setting information 80A and 80C are set in accordance with the size information (pallet width) of the object P. However, the weight setting information 80A and 80C may be set in accordance with the size information of the mobile body 10. That is, when the mobile body 10 installed in the facility 200 includes a plurality of types of mobile bodies 10 having different external dimensions, the size information (vehicle width) of the

mobile body 10 may be set as the work information 70, and, for example, the weight setting information 80C as shown in FIG. 16 may be set for the mobile body 10 having a vehicle width larger than a predetermined width.

[0094]

For example, in FIG. 19, it is assumed as follows. The mobile body 10-2 having the width dimension of the standard type can pass through the region MS2 at a normal speed, but the mobile body 10-1 having the width dimension of the large type needs to travel at a low speed in the region MS2. In this case, when the mobile body 10-1 adopts a route passing through the route portions Rp41 and Rp42, a time loss caused by the low-speed traveling occurs, and when the mobile body 10-2 of the standard type follows, for the mobile body 10-2 also needs the low-speed traveling. Therefore, for the work order (that is, the work order in which the mobile body ID = 1 is designated) in which the mobile body 10-1 of the large type is designated in the mobile body ID, the route setting is performed by using the weight setting information 80C shown in FIG. 16. In this manner, the movement route MV3 that bypasses the region MS2 is likely to be adopted. As a result, it is possible to improve the processing efficiency of all of the work orders.

[0095]

In addition, the weight setting information 80A or 80C may be set in accordance with both the size information (pallet width) of the object P and the size information (vehicle width) of the mobile body 10. The weight setting information 80A may be applied only to the work order in which the pallet width is "standard" and the vehicle width is "standard", and the weight setting information 80C may be applied to the work order in which the mobile body ID of the mobile body 10 having the "large" pallet width or the large vehicle width is designated.

[0096]

[Third Embodiment]

Next, a third embodiment will be described. In the third embodiment, a route setting method when the mobile body 10 and the worker carry out work at the same time will be described. In the third embodiment, elements having configurations common to those in the first embodiment will be omitted in the description.

[0097]

FIG. 20 is a diagram showing the work information 70 in the third embodiment. In the third embodiment, for example, the work information 70 includes information of work carried out by a worker. Hereinafter, in order to distinguish the work carried out by the worker from work carried out by the mobile body 10 in an unmanned manner, the work carried out by the worker will be referred to as "manned work". Specifically, the work information 70 includes information of an implementation area MS3 of the work (manned work) carried out by the worker. The manned work is not particularly limited, and for example, is transport work carried out by a worker who rides on a work vehicle 120 (refer to FIG. 21).

[0098]

FIG. 21 is a schematic diagram showing an example of the implementation area MS3 of the manned work. As shown in FIG. 21, the implementation area MS3 of the manned work is set in a predetermined range inside the work region of the facility 200. The implementation area MS3 of the manned work is registered in advance in the management device 12, for example, together with an implementation time zone (start time, end time), based on a work plan, and is stored in the storage unit 32 (refer to FIG. 5). The information of the implementation area MS3 of the manned work includes position information (coordinates) for specifying the implementation area MS3. In an

example in FIG. 21, the implementation area MS3 is set over an entire length of the work region in the Y-direction in a range of approximately 1/3 on the -X side of the work region. The implementation area MS3 extends over the first region AR1 and the second region AR2. The implementation area MS3 includes disposition positions e1, e2, e5, e6, e9, e10, e13, e14, and e17 to e21 and a plurality of route portions Rp for accessing the disposition positions.

[0099]

When the mobile body 10 passes through the inside of the implementation area MS3 of the manned work, the mobile body 10 travels at a low speed to prevent contact with the worker or the work vehicle 120 operated by the worker. In addition, for example, the mobile body 10 lights a notification lamp (not shown), outputs a notification sound, or the like to cause the worker to recognize the presence of the mobile body 10 inside the implementation area MS3 of the manned work.

[0100]

The weight setting unit 42 creates different weight setting information 80, when the implementation area MS3 of the manned work is not set, and when the implementation area MS3 of the manned work is set (implementation time zone of the manned work). That is, the weight setting unit 42 creates the weight setting information 80A when there is no manned work and the weight setting information 80D (refer to FIG. 22) when the implementation area MS3 of the manned work is set. The weighting when there is no manned work may be the same as the weight setting information 80A in FIG. 8, but may be different from the weight setting information 80A in FIG. 8.

[0101]

FIG. 22 is a schematic diagram showing an example of the weight setting

information 80D when the implementation area MS3 of the manned work is set. As shown in FIG. 22, the weight setting unit 42 creates the weight setting information 80D such that the route portion Rp included in the implementation area MS3 is less likely to be adopted for the movement route MV. That is, the weight setting unit 42 performs weighting such that the weight value W for the route portion Rp included in the implementation area MS3 is relatively greater than the weight value W for another route portion Rp outside the implementation area MS3. The weighting may increase the weight value W of the route portion Rp inside the implementation area MS3, or may decrease the weight value W of another route portion Rp outside the implementation area MS3.

[0102]

In this manner, since the weight setting information 80D is used, the route portion Rp inside the implementation area MS3 in which the relatively great weight value W is set is less likely to be adopted for the movement route MV of the mobile body 10. As a result of setting the relatively small weight value W, another route portion Rp outside the implementation area MS3 is likely to be adopted for the movement route MV of the mobile body 10.

[0103]

Therefore, when there exists a route which can reach the destination without passing through the implementation area MS3 of the manned work, a route which bypasses the implementation area MS3 is likely to be adopted for the movement route MV of the mobile body 10.

[0104]

FIG. 23 is a schematic diagram showing an example of route setting according to the third embodiment. In the third embodiment, when the implementation area MS3

of the manned work is set, the route setting unit 62 performs the shortest route search by using the weight setting information 80D. As a result, as shown in FIG. 23, the movement route MV4 is set for the work order to be executed by the mobile body 10-1, and the movement route MV5 is set for the work order to be executed by the mobile body 10-2.

[0105]

In the work order to be executed by the mobile body 10-1, the disposition position e17 is set as the loading position, and the disposition position e14 is set as the unloading position. In the work order to be executed by the mobile body 10-2, the disposition position e22 is set as the loading position, and the disposition position e13 is set as the unloading position. For these work orders, the shortest route from the loading position to the unloading position is a route on a side in the -X-direction which passes through the route portions Rp51, Rp52, and Rp53. In contrast, in the third embodiment, the weight setting information 80D in which the great weight value W is set for the route portions Rp51, Rp52, and Rp53 inside the implementation area MS3 is used. In this manner, both the movement routes MV4 and MV5 are set to the route which bypasses the side in the +X-direction, instead of the shortest route.

[0106]

In the movement routes MV4 and MV5, the traveling inside the implementation area MS3 requiring the low-speed traveling is avoided as much as possible. Therefore, a time loss caused by the speed decrease is reduced. In addition, entrance of the mobile body 10 into the implementation area MS3 is suppressed. Therefore, a possibility of performing a contact avoidance operation between the mobile body 10 and the worker or the work vehicle 120 is reduced. The frequency of the mobile body 10 entering the implementation area MS3 is reduced. Therefore, a decrease in work efficiency of the

manned work is suppressed. As a result, it is possible to improve operation efficiency of all of the work orders.

[0107]

In the third embodiment, the implementation area MS3 is not set as entrance prohibition. Therefore, even when the weight setting information 80D when the implementation area MS3 of the manned work is set is used, the movement route MV passing through the implementation area MS3 can be generated when there is no bypass route. Therefore, high redundancy can be obtained.

[0108]

(Other Modification Examples of Third Embodiment)

FIG. 24 is a schematic diagram showing weighting according to a modification example of the third embodiment. In the modification example shown in FIG. 24, the weighting is performed such that the route portion Rp located around the implementation area MS3 is less likely to be adopted for the movement route MV as the distance from the implementation area MS3 increases.

[0109]

In FIG. 24, a peripheral area MS4 is set around the implementation area MS3 of the manned work. For example, the peripheral area MS4 may be set in a circumferential (annular) shape to surround the implementation area MS3 of the manned work, or may be set to be adjacent to only one side of the implementation area MS3. The peripheral area MS4 is an area outside the implementation area MS3 of the manned work, but has a possibility that the worker (work vehicle) enters the area.

[0110]

In FIG. 24, the weight setting information 80D corresponding to the implementation area MS3 of the manned work and the peripheral area MS4 is shown in

a graph form. In the graph, a vertical axis indicates the weight value W, and a horizontal axis indicates the route portion Rp for each position along the Y-direction. That is, FIG. 24 shows the weight value W of the plurality of route portions Rp along the Y-direction in a graph.

[0111]

In the modification example, the weight setting unit 42 creates the weight setting information 80 such that the route portion Rp of the peripheral area MS4 located around the implementation area MS3 is less likely to be adopted for the movement route MV as the distance from the implementation area MS3 increases. That is, the weight setting unit 42 decreases the weight value W of the route portion Rp included in the peripheral area MS4 as the distance from the implementation area MS3 increases. In this manner, as the route portion Rp included in the peripheral area MS4 is closer to the implementation area MS3 of the manned work, the route portion Rp is less likely to be adopted for the movement route MV of the mobile body 10. Therefore, the entrance of the mobile body 10 into the implementation area MS3 can be effectively suppressed. On the contrary, even at a peripheral position of the implementation area MS3, the weight value W of the route portion Rp having a large distance from the implementation area MS3 is small, and the route portion Rp is likely to be adopted for the movement route MV. Since the route portion Rp is adopted for the movement route MV, there is a possibility that a bypass distance can be shortened. Although FIG. 24 shows the weight setting along the Y-direction, the weight value W along the X-direction is also set in the same manner.

[0112]

In addition, in the third embodiment and the modification example, the implementation area MS3 of the manned work has been described as a fixed area

(position does not vary) set in advance. However, a position and a range of the implementation area MS3 of the manned work may vary with the lapse of time. For example, the worker carries a mobile terminal that transmits current position information, and transmits the current position information at every moment to the management device 12. The weight setting unit 42 may set the implementation area MS3 (and the peripheral area MS4 in the modification example) around the current position of the worker, based on the current position information of the mobile terminal which is received by the communication unit 30, and may update and set the weight setting information 80D in accordance with the set implementation area MS3 (and the peripheral area MS4).

[0113]

As described above, according to a first aspect of the present disclosure, there is provided the mobile body control system 1 including the storage unit 32 that stores the weight setting information 80 in which the plurality of route portions Rp through which the mobile body 10 passes and the weight value W indicating the movement costs of the route portion Rp are associated with each other, the work information 70 including the work order of the mobile body 10, the weight setting unit 42 that creates the plurality of weight setting information 80 in accordance with the work information 70, and the route setting unit 62 that sets the movement route MV from the movement start position to the destination of the work order by using the weight setting information 80 corresponding to the work information 70.

[0114]

According to this configuration, the plurality of weight setting information 80 are properly used in accordance with the work information 70 to set the movement route MV. Therefore, it is possible to set the appropriate movement route MV corresponding

to the content of the work information 70, which is not limited to the shortest route to the destination. Compared to a case where the same weight setting information 80 is applied to all of the work orders, it is possible to set the route in which the processing efficiency of the work order is improved or the interference with another work carried out in the work region is suppressed. Therefore, the setting of the movement route MV of the mobile body 10 can be improved.

[0115]

According to a second aspect of the present disclosure, in the mobile body control system 1 according to the first aspect, the mobile body 10 is the unmanned transport device that holds and transports the object P. The work order includes the transport work order and the non-transport order. The weight setting unit 42 creates the weight setting information 80A and 80B which are different between the transport work order and the non-transport order. In this manner, the movement route MV can be set by using the separate weight setting information 80A and 80B between the transport work order which is the main work and the other non-transport order. Therefore, it is possible to set the appropriate route corresponding to a type of the work order that the transport work order is prioritized or the non-transport order is prioritized.

[0116]

According to a third aspect of the present disclosure, in the mobile body control system 1 according to the second aspect, the weight setting unit 42 creates the weight setting information 80B for the non-transport order such that the route portion Rp (route portion Rp inside the region MS1) which is likely to be adopted for the movement route MV is less likely to be adopted for the movement route MV in the non-transport order, by using the weight setting information 80A for the transport work order. In this manner, the transport work order can be prioritized, and the bypass route can be easily

adopted for the non-transport order. As a result, it is possible to suppress a possibility that the mobile body 10 performing the transport work order temporarily stands by another mobile body 10 performing the non-transport order or the interference avoidance operation is performed. Therefore, it is possible to set the route that improves the processing efficiency of the transport work order.

[0117]

According to a fourth aspect of the present disclosure, in the mobile body control system 1 according to any one of the first aspect to the third aspect, the mobile body 10 is the unmanned transport device that holds and transports the object P. The work information 70 includes the size information of at least one of the object P or the mobile body 10. The weight setting unit 42 creates the different weight setting information 80A and 80C when the size information is equal to or smaller than a predetermined value and when the size information is greater than the predetermined value. In this manner, in a case where a plurality of types of the objects P having different sizes (pallet widths) are mixed, or in a case where a plurality of types of the mobile bodies 10 having different sizes (vehicle widths) are mixed, appropriate route setting can be performed in accordance with the size of the object P or the mobile body 10 by using the weight setting information 80A or 80C corresponding to the size information.

[0118]

According to a fifth aspect of the present disclosure, in the mobile body control system 1 according to the fourth aspect, when the size information is greater than the predetermined value, the weight setting unit 42 creates the weight setting information 80C such that the predetermined route portion Rp set in advance is less likely to be adopted for the movement route MV. In this manner, in the passage R, when the low-

speed traveling is required or there is the region MS2 where alternate passage is required due to the size (pallet width) of the object P or the size (vehicle width) of the mobile body 10, a configuration can be adopted such that the predetermined route portions Rp41 and Rp42 belonging to the region MS2 are less likely to be adopted for the movement route MV. Since the movement route MV that does not pass through the region MS2 can be preferentially set in accordance with the size information, the processing efficiency of the work order can be improved.

[0119]

According to a sixth aspect of the present disclosure, in the mobile body control system 1 according to any one of the first aspect to the fifth aspect, the work information 70 includes the information of the implementation area MS3 of the work (manned work) carried out by the worker. The weight setting unit 42 creates the weight setting information 80D such that the route portion Rp included in the implementation area MS3 is less likely to be adopted for the movement route MV. In this manner, entrance of the mobile body 10 into the implementation area MS3 can be suppressed by simply setting the implementation area MS3 of the manned work in advance. Therefore, it is possible to avoid a decrease in the processing efficiency of the work order which is caused by the mobile body 10 traveling at the low speed or hindering the manned work.

[0120]

According to a seventh aspect of the present disclosure, in the mobile body control system 1 according to the sixth aspect, the weight setting unit 42 creates the weight setting information 80 such that the route portion Rp located around the implementation area MS3 is less likely to be adopted for the movement route MV as the distance from the implementation area MS3 increases. In this manner, the movement route MV of the mobile body 10 is less likely to be adopted for the mobile body 10 as

the mobile body 10 is closer to the implementation area MS3 of the manned work. Therefore, it is possible to effectively suppress the entrance of the mobile body 10 into the implementation area MS3. On the contrary, even at the peripheral position of the implementation area MS3, the route portion Rp having the large distance from the implementation area MS3 is relatively likely to be adopted for the movement route MV. Therefore, even when the route is set to bypass the implementation area MS3, there is a possibility that the bypass distance can be shortened.

[0121]

According to an eighth aspect of the present disclosure, there is provided an information processing method including Step S10 of acquiring the work information 70 including the work order of the mobile body 10, Step S11 of creating the plurality of weight setting information 80 in which the plurality of route portions Rp through which the mobile body 10 passes and the weight value W indicating the movement costs of the route portion Rp are associated with each other in accordance with the work information 70, and Step S22 of setting the movement route MV from the movement start position to the destination of the work order by using the weight setting information 80 corresponding to the work information 70.

[0122]

According to this configuration, the plurality of weight setting information 80 are properly used in accordance with the work information 70 to set the movement route MV. Therefore, it is possible to set the appropriate movement route MV corresponding to the content of the work information 70, which is not limited to the shortest route to the destination. Compared to a case where the same weight setting information 80 is applied to all of the work orders, it is possible to set the route in which the processing efficiency of the work order is improved or the interference with another work carried

out in the work region is suppressed. Therefore, the setting of the movement route MV of the mobile body 10 can be improved.

[0123]

Although the embodiments of the present disclosure have been described above, the embodiments are not limited by the details of the embodiments. In addition, the above-described configuration elements include those which can be easily assumed by those skilled in the art, those which are substantially the same, and those which have a so-called equal range. Furthermore, the above-described configuration elements can be combined with each other as appropriate. In addition, various omissions, replacements, or modifications of the configuration elements can be made within the scope not departing from the concept of the above-described embodiments.

[0124]

For example, the respective configurations of the first embodiment to the third embodiment and the modification examples thereof can be combined in any way. For example, when the first, second, and third embodiments are combined, the weight setting information 80 may be created in eight ways by combining whether the order is the transport work order or the non-transport order, whether the size information is equal to or smaller than the predetermined value or is greater than the predetermined value, and whether the implementation area MS3 of the manned work is set. That is, the number of weight setting information 80 corresponding to the work information 70 may be created, such as the weight setting information 80 of "transport work order, size standard, and implementation area of the manned work is absent" or the weight setting information 80 of "non-transport work order, large size, and implementation area of manned work is present".

Reference Signs List

[0125]

1: mobile body control system

5: shelf

10: mobile body

12: management device

14: information processing device

20: vehicle body

20A: wheel

21: straddle leg

22: mast

24: fork

24A: claw

24B: claw

26A: sensor

28: control device

30: communication unit

32: storage unit

34: control unit

40: work order setting unit

42: weight setting unit

50: communication unit

52: storage unit

54: control unit

60: acquisition unit

62: route setting unit

64: processing unit

70: work information

72: order information

80, 80A, 80B, 80C, 80D: weight setting information

100: communication unit

102: storage unit

104: control unit

110: route acquisition unit

112: movement control unit

114: information transmission unit

200: facility

AR1: first region

AR2: second region

c1: charging position

e1 to e31: disposition position

h1, h2: standby position

MS1, MS2: region

MS3: implementation area

MS4: peripheral area

MV, MV1, MV2, MV3, MV4, MV5, MVA, MVB, MVC: movement route

P: object

R: passage

Rp: route portion

Rp1 to Rp7, Rp11, Rp21 to Rp32, Rp41, Rp42, Rp51 to Rp53: route portion

W: weight value