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 setting a movement route of a mobile body to move the mobile body along the movement route is known. For example, PTL 1 discloses a technology in which a movement route of a transport vehicle (mobile body) is generated by shortest route search to move the transport vehicle 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 in PTL 1, when a shortest route to a destination is always adopted for the movement route, a bidirectional movement occurs on overlapping routes, and an occurrence frequency of interference increases. When the interference occurs, the mobile body needs to stand by in front of an interference point or needs to temporarily retreat outward of a route. Therefore, in some cases, processing efficiency of work carried out by the mobile body may decrease. In the present specification, the term "the interference" means that some of the movement routes of different mobile bodies intersect or overlap each other to cause a possibility of collision or the like.

[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 suppress an occurrence frequency of interference of movement routes.

Solution to Problem

[0006]

A mobile body control system according to the present disclosure includes a storage unit that stores a plurality of route portions through which a mobile body passes and weight values indicating movement costs of the route portions in association with each other, a weight setting unit that sets the weight values individually for each passage direction of the route portions for at least some of the plurality of route portions, and a route setting unit that sets a movement route from a movement start position to a destination of the mobile body, based on the weight values for each passage direction of

the plurality of route portions.

[0007]

A mobile body control system according to the present disclosure includes a storage unit that stores a plurality of route portions through which a mobile body passes and weight values indicating movement costs of the route portions in association with each other, a route setting unit that sets a movement route from a movement start position to a destination of the mobile body, based on the weight values of the plurality of route portions, and a weight setting unit that sets the weight values of the route portions, based on the movement route set in the past.

[0008]

An information processing method according to the present disclosure includes a step of acquiring weight values individually set for each passage direction of route portions for at least some of a plurality of the route portions through which a mobile body passes, and a step of setting a movement route from a movement start position to a destination of the mobile body, based on the weight values for each passage direction of the plurality of route portions.

[0009]

An information processing method according to the present disclosure includes a step of acquiring a plurality of route portions through which a mobile body passes and weight values indicating movement costs of the route portions, a step of setting a movement route from a movement start position to a destination of the mobile body, based on the weight values of the plurality of route portions, and a step of setting the weight values of the route portions, based on the movement route set in the past.

Advantageous Effects of Invention

[0010]

According to the present disclosure, it is possible to suppress an occurrence frequency of interference of movement routes.

Brief Description of Drawings

[0011]

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.

FIG. 8 is a schematic diagram showing an example of weighting a plurality of route portions.

FIG. 9 is a flowchart showing an example of a weighting operation for each route portion which is performed by a weight setting unit according to the first embodiment.

FIG. 10 is a flowchart showing an example of a setting operation of a movement route which is performed by a route setting unit according to the present embodiment.

FIG. 11 is a schematic diagram showing an example of route setting according to a comparative example.

FIG. 12 is a schematic diagram showing an example of route setting according to the first embodiment.

FIG. 13 is a diagram showing an example of operation record data according to

a second embodiment and an example of weight setting information based on the operation record data.

FIG. 14 is a flowchart showing a weighting operation (first example) performed by a weight setting unit according to the second embodiment.

FIG. 15 is a diagram for describing a method for setting a weight value according to a second example of the second embodiment.

FIG. 16 is a diagram showing an example of the movement route.

FIG. 17 is a flowchart showing an example of a weighting operation (second example) performed by the weight setting unit according to the second embodiment.

Description of Embodiments

[0012]

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.

[0013]

[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.

[0014]

(Work Region)

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.

[0015]

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 in the work region.

[0016]

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.

[0017]

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.

[0018]

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 the respective 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.

[0019]

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).

[0020]

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.

[0021]

(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 issues order information 70 (refer to FIG. 7) including a plurality of work orders to each information processing device 14. 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 such that a group of work orders defined in the order information 70 can be efficiently executed. The operation scheduling includes planning a movement route MV (MV1 and MV2, refer to FIG. 12) of the mobile body 10 from a movement start position to a destination which are designated in the work order. 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 mobile body 10 carries out the work defined in the work order, based on the movement route MV or the work instruction received from the information processing device 14 that manages the mobile body 10.

[0022]

(Mobile Body)

FIG. 3 is a schematic diagram of a configuration of the mobile body 10. The

mobile body 10 is a device that can automatically move and that can 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 automatically move.

[0023]

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.

[0024]

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, and the sensor 26A may be provided at any position, and the number of provided sensors 26A may be determined in any way.

[0025]

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, the sensor 26A may be 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.

[0026]

The control device 28 is a device that controls the mobile body 10. FIG. 4 is a schematic block diagram of the control device 28 of 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, and any communication method may be adopted. 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.

[0027]

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.

[0028]

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 to an external device such as the information processing device 14.

[0029]

(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.

[0030]

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.

[0031]

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 a plurality of route portions Rp through which the mobile body 10 passes and weight values W indicating movement costs of the route portions Rp in association with each other.

[0032]

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.

[0033]

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 set work order. The contents of the work order will be described below.

[0034]

The weight setting unit 42 sets the weight value W (refer to FIG. 8) 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.

[0035]

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.

[0036]

(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.

[0037]

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 weight setting information in which the plurality of route portions Rp and weight values W are associated with each other and which is set by the management device 12.

[0038]

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.

[0039]

The acquisition unit 60 acquires the work order transmitted from the management device 12. The acquisition unit 60 acquires the weight setting information 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. The processing unit 64 transmits a work 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.

[0040]

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 functions of the management device 12.

[0041]

(Order Information)

FIG. 7 is a diagram showing an example of the order information 70. Each work order defined in the order information 70 is set for each object P.

[0042]

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. 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 work of an order ID = 101 defines that the mobile body 10 of a mobile body ID = 1 performs loading at the disposition position e17 and performs unloading at the disposition position e14. The work order setting unit 40 creates the order information 70 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 70 to the corresponding information processing device 14.

[0043]

(Weighting)

FIG. 8 is a schematic diagram showing an example of weighting the plurality of route portions Rp. 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. In an example in FIG. 8, the weight value W of the route portion Rp is represented by two types of arrows shown in an explanatory note. 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.

[0044]

In the example in FIG. 8, the passage R in the work region is divided into a total of 59 route portions Rp. In the first embodiment, the weight setting unit 42 individually sets the weight value W for each passage direction of the route portion Rp for at least some of the plurality of route portions Rp. FIG. 8 shows an example in which the weight value W is set individually for each passage direction for all of the 59 route portions Rp. Since the weight value W for each passage direction is shown, for each route portion Rp, an arrow (weight value W) in one direction and an arrow (weight value W) in the other direction opposite to the one direction are individually shown. In each of the route portions Rp, at a location where the weight value W in one direction and the weight value W in the other direction are equal to each other, the weight value W may not be set for each passage direction.

[0045]

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 70 in the facility 200 or order information 70 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 a setting record of the weight value W and record information of interference occurrence in the past (implementation of interference avoidance). 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 FIG. 8, the weight setting unit 42 records a set of the weight values W set for all of the route portions Rp in the storage unit 32, as weight setting information.

[0046]

(Generation of Transport Instruction Information)

As shown in FIG. 6, in the information processing device 14, the communication unit 50 receives the order information 70 transmitted from the management device 12 and the weight setting information. The acquisition unit 60 acquires the received order information 70 and the received weight setting information. 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 70 (refer to FIG. 7).

[0047]

The route setting unit 62 sets the movement route MV (refer to FIG. 12) from the loading position to the unloading position of the mobile body 10, based on the weight values W (refer to FIG. 8) for 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 immediately preceding work order. 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 the route portions Rp through which the mobile body 10 passes from the movement start position to the destination is minimized, as the movement route MV.

[0048]

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.

[0049]

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 order instructed in the past (immediately preceding) is normally completed.

[0050]

(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.

[0051]

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).

[0052]

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.

[0053]

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 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.

[0054]

(Operation of Mobile Body Control System)

FIG. 9 is a flowchart showing an example of a weighting operation for each route portion Rp by the weight setting unit 42 according to the first embodiment. As shown in FIG. 9, in the management device 12 (refer to FIG. 5), the weight setting unit 42 acquires information of each route portion Rp forming the passage R from the storage unit 32 (Step S10). The weight setting unit 42 sets the weight value W for each acquired route portion Rp (Step S11). In this case, the weight setting unit 42 individually sets the weight value W for each passage direction of the route portion Rp for at least some of the plurality of route portions Rp (refer to FIG. 8). The weight setting unit 42 stores the weight setting information in which the route portion Rp and the weight value W of the route portion Rp are associated with each other in the storage unit 32, and transmits the weight setting information to the information processing

device 14 via the communication unit 30 (Step S12).

[0055]

FIG. 10 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. 10, in the information processing device 14 (refer to FIG. 6), the acquisition unit 60 acquires the order information 70 from the management device 12 via the communication unit 50 (Step S20). The acquisition unit 60 acquires the information of the route portion Rp and the weight setting information from the management device 12 via the communication unit 50 (Step S21). In this manner, the acquisition unit 60 acquires the weight value W (refer to FIG. 8) individually set for each passage direction of the route portion Rp. 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 70, the information of the route portion Rp, and the weight setting information (Step S22). That is, the route setting unit 62 sets the movement route MV from the movement start position to the destination of the mobile body 10, for example, by the shortest route search, in accordance with the weight value W for each passage direction of the plurality of route portions Rp. 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 included in the order information 70. 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).

[0056]

(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.

[0057]

Therefore, in the first embodiment, the weight value W is set for each passage direction with respect to the route portion Rp. In this manner, a direction in which the mobile body 10 needs to preferentially pass can be set. That is, in each route portion Rp, the weight value W in the direction (one direction) in which the mobile body 10 needs to preferentially pass is set to be small, or the weight value W in the direction (other direction) opposite to the direction in which the mobile body 10 needs to preferentially pass is set to have a great value. As a result, a movement route MV passing through the route portion Rp in one direction is easily created. In other words, since the weight value W is set for each passage direction, a passage frequency in one direction and a passage frequency in the other direction in the specific route portion Rp of each mobile body 10 can be freely adjusted.

[0058]

The setting of the weight value W for each passage direction will be described with reference to FIG. 8. In the example in FIG. 8, the weight setting unit 42 sets the weight values W such that the mobile body 10 is likely to pass in one direction and the mobile body 10 is less likely to pass in the other direction opposite to the one direction, with respect to a series of consecutive route portions Rp. Specifically, the weight setting unit 42 performs the weighting on a series of route portions Rp extending to cross a plurality of work positions. Here, the work position is a position coordinate set as a

loading position or an unloading position of the work order, and is a concept including the disposition positions e1 to e31, the charging position c1, and the standby positions h1 and h2. The weight setting unit 42 performs the weighting on a series of the route portions Rp located at a boundary between the first region AR1 and the second region AR2.

[0059]

In FIG. 8, areas 72A, 72B, and 72C will be described as examples of a series (plurality of) route portions Rp.

[0060]

The areas 72A and 72B are a group of the continuous route portions Rp passing in the X-direction between the shelves 5 facing each other in the Y-direction. Therefore, the areas 72A and 72B are areas that cross the plurality of work positions. The area 72A crosses the disposition positions e1 to e8. The area 72B crosses the disposition positions e9 to e16. Therefore, the areas 72A and 72B are likely to cause interference since each of the mobile bodies 10 highly frequently enters and exits the areas 72A and 72B. In the example in FIG. 8, in the areas 72A and 72B, the weight value W in the +X-direction is smaller than the weight value W in the -X-direction. Therefore, in the route setting, a route passing through the areas 72A and 72B in the +X-direction (one direction) is likely to be adopted, and a route passing through the areas 72A and 72B in the -X-direction (other direction) is less likely to be adopted.

[0061]

The area 72C is a group of the route portions Rp continuous in the X-direction, which is located at a boundary between a first region AR1 where the object P departs and arrives (furthermore, charging or standby) and a second region AR2 where the object P is stored. The area 72C corresponds to a connection path between the first region

AR1 and the second region AR2. Most of the work orders include the movement between the positions (disposition positions e17 to e31) belonging to the first region AR1 and the positions (disposition positions e1 to e16) belonging to the second region AR2. Therefore, the area 72C is likely to cause interference since each mobile body 10 more frequently passes through the area 72C. In the area 72C, the weight value W in the -X-direction is smaller than the weight value W in the +X-direction. Therefore, in the route setting, a route passing through the area 72C in the -X-direction (one direction) is likely to be adopted, and a route passing through the area 72C in the +X-direction (other direction) is less likely to be adopted.

[0062]

A direction in which the mobile body 10 is likely to pass (direction which is likely to be adopted for the movement route MV) in the areas 72A and 72B and a direction in which the mobile body 10 is likely to pass in the area 72C are opposite directions. Therefore, in the example in FIG. 8, an annular route in a single direction in which the mobile body 10 advances in the +X-direction in the area 72A and the area 72B and advances in the -X-direction in the area 72C is likely to be adopted for the movement route MV. As a result, when each of the mobile bodies 10 enters the disposition positions e1 to e16 of the respective shelves 5 or exits from the disposition positions e1 to e16 of the respective shelves 5, the mobile bodies 10 more frequently advance in the +X-direction in the areas 72A and 72B. When each of the mobile bodies 10 moves from the second region AR2 to the first region AR1 or moves from the first region AR1 to the second region AR2, the mobile bodies 10 more frequently advance in the -X-direction in the area 72C.

[0063]

Next, an operation performed by setting the weight value W will be described

with reference to a comparative example. Here, for convenience of description, the movement route from the movement start position to the loading position will be omitted, and only the movement route from the loading position to the unloading position will be described. It is conceivable that two work orders are executed by two mobile bodies 10-1 and 10-2. It is assumed that the mobile body 10-1 is designated for the first work order while the loading position is the disposition position e14 and the unloading position is the disposition position e17. It is assumed that the mobile body 10-2 is designated for the second work order while the loading position is the disposition position e22 and the unloading position is the disposition position e13.

[0064]

(Route Setting According to Comparative Example)

FIG. 11 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 weighting is not performed for each passage direction. When the weighting is not performed for each passage direction, essentially, a length of the route portion Rp, that is, a movement distance is the weight value W. As a result of the shortest route search, a movement route connecting the loading position and the unloading position with the shortest distance is adopted. Therefore, for the first work order, a movement route MVA on a side in the -X-direction which passes through the route portions Rp1, Rp2, Rp3, Rp4, and Rp5 is set from the disposition position e14. For the second work order, a movement route MVB on the side in the -X-direction which passes through the route portions Rp7, Rp6, Rp4, Rp3, and Rp2 is set from the disposition position e22. Since the movement routes MVA and MVB are routes in which the mobile bodies 10-1 and 10-2 advance in both directions in the route portions Rp2, Rp3, and Rp4, the mobile bodies 10-1 and 10-2 interfere with each other.

[0065]

In this case, the interference avoidance control is performed such that the work order having a high priority (for example, the first work order) is prioritized and the work order having a low priority (the second work order) is caused to perform the interference avoidance. For example, in the interference avoidance control, the mobile body 10-2 is caused to stand by in the route portion Rp6 in front of an interference location until the mobile body 10-1 passes, or the mobile body 10-2 is temporarily retreated to a retreat position outside the interference location. When the interference avoidance control is performed, even when the shortest route is set, there is a possibility that processing efficiency of the mobile bodies 10-1 and 10-2 decreases due to influence of a time loss caused by the interference avoidance. In the present specification, a decrease in the processing efficiency means that the number of the work orders processed per predetermined time decreases.

[0066]

(Route Setting According to First Embodiment)

FIG. 12 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 using the weight setting information for each passage direction shown in FIG. 8 in a case of the work order similar to that of the comparative example. As a result, movement routes MV1 and MV2 shown in FIG. 12 are set. That is, for the first work order, the movement route MV1 on the side in the +X-direction which passes through the route portions Rp11, Rp12, Rp13, Rp14, Rp15, Rp16, Rp6, and Rp5 is set from the disposition position e14 by reflecting the weight setting of the area 72B and the area 72C. For the second work order, a movement route MV2 on the side in the -X-direction which passes through the route portions Rp7, Rp6,

Rp4, Rp3, and Rp2 is set from the disposition position e22. In this example, the movement route MV2 is the same route as the movement route MVB in FIG. 11. In the case in FIG. 12, the movement route MV1 and the movement route MV2 overlap only in a portion of the route portion Rp6. When passage timings in the route portion Rp6 are different between the mobile body 10-1 and the mobile body 10-2, the interference avoidance is not required, and even when the passage timings overlap, an overlapping portion is minimal. Therefore, a time loss caused by the interference avoidance is small. Therefore, the occurrence frequency of interference is reduced. 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.

[0067]

In the first embodiment, it should be noted that the weight value W for each passage direction is set for the route portion Rp, and the route portion Rp is not set as a one-way route. When a certain route portion Rp is set as the one-way route, in a case where the mobile body 10 cannot pass through another route portion Rp, and when in some cases, there exists only a route in which the mobile body 10 travels in a reverse direction in the route portion Rp as the one-way route, the movement route MV cannot be generated. In contrast, in the first embodiment, the weight value W is set for each passage direction. Therefore, even in a case where the route cannot be generated unless the mobile body 10 travels in the reverse direction in the route portion Rp (that is, the mobile body 10 passes in a direction in which the weight value W is great), 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 that a route can be set in which the interference is allowed to occur when there is no other option

while the occurrence frequency of the interference can be reduced.

[0068]

(Modification Example)

In the first embodiment, the description has been made on a premise that all of the mobile bodies 10 are of the same type. When the mobile bodies 10 having different types are mixed, the weight value W may be set for each type of the mobile body 10. For example, the type of the mobile body 10 is a type based on external dimensions of the mobile body 10, and is particularly based on a difference in width dimensions of the mobile body 10. For example, in the mobile body 10 of a first type having a small width dimension, two mobile bodies 10 of the first type can pass each other within a range of a width of the passage R, but in the mobile body 10 of a second type having a large width dimension, the mobile body 10 cannot pass another mobile body 10. In this case, the weighting for each passage direction may be applied only to mobile body 10 of the second type.

[0069]

[Second Embodiment]

Next, a second embodiment will be described. In the second embodiment, a method for setting the weight value W, which is different from the setting of the weight value W for each passage direction, will be described. In the second embodiment, elements having configurations common to those in the first embodiment will be omitted in the description.

[0070]

In the second embodiment, the mobile body control system 1 includes the storage unit 32 (refer to FIG. 5) that stores 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 portions Rp in association with each other, the route setting unit 62 (refer to FIG. 6) that sets the movement route MV from the movement start position to the destination of the mobile body 10, based on the weight values W of the plurality of route portions Rp, and the weight setting unit 42 (refer to FIG. 5) that sets the weight value W of the route portion Rp. In the second embodiment, one weight value W may be set for each movement route MV regardless of the passage direction.

[0071]

In the second embodiment, the weight setting unit 42 sets the weight value W of the route portion Rp, based on the movement route MV set in the past. As an example of the method for setting the weight value W by the weight setting unit 42, a first example and a second example will be described.

[0072]

(First Example)

In a first example, the weight setting unit 42 sets the weight values W such that the mobile body 10 is less likely to pass through the route portion Rp having a large number of passages. That is, the management device 12 stores past operation record data 80 (refer to FIG. 13) in the storage unit 32. The operation record data 80 includes the number of passages of the mobile body 10 in each route portion Rp. The number of passages of the mobile body 10 corresponds to the number of times at which the movement route MV is adopted in the past in the route setting unit 62. That is, the operation record data 80 is statistical information of the movement route MV set in the past.

[0073]

FIG. 13 is a diagram showing an example of the operation record data 80 according to the second embodiment and an example of the weight setting information

82 based on the operation record data 80. In FIG. 13, for convenience, the operation record data 80 and the weight setting information 82 are shown in a bar graph form. In the operation record data 80, a horizontal axis represents the route portion Rp, and a vertical axis represents the number of passages of the mobile body 10. In the weight setting information 82, the horizontal axis represents the route portion Rp, and the vertical axis represents the weight value W. With regard to the horizontal axis, identification numbers are individually assigned to the plurality of route portions Rp included in the passage R, and the arrangement in the order of the identification numbers of the route portions Rp is shown. For example, an item on the leftmost side of the horizontal axis indicates the weight value W corresponding to the number of passages in the route portion Rp having an identification number i = 1. FIG. 8 shows an example in which the passage R is divided into 59 route portions Rp, and FIG. 13 shows 10 route portions Rp of i = 1 to 10.

[0074]

The weight setting unit 42 increases the weight value W as the number of passages increases, and decreases the weight value W as the number of passages decreases. In an example in FIG. 13, since the number of passages of the route portions Rp having identification numbers i = 4, 5, 6, and 7 is large, the weight setting unit 42 sets the weight values W of the route portions Rp to have a relatively great value. Since the number of passages of the route portions Rp having identification numbers i of 1, 2, 3, 8, 9, and 10 is small, the weight setting unit 42 sets the weight values W of the route portions Rp to be small. The smallest weight value W is set for the route portion Rp of i = 9 having the smallest number of passages.

[0075]

In this manner, in the past operation record, a relatively great weight value W is

set for the route portion Rp having a high passage frequency. As a result, in the shortest route search performed by the route setting unit 62, the route portion Rp having a great weight value W is less likely to be adopted for the movement route MV of the mobile body 10. On the contrary, as a result of setting a relatively small weight value W for the route portion Rp having a low passage frequency, the route portion Rp having a small weight value W is likely to be adopted for the movement route MV of the mobile body 10.

[0076]

Therefore, when there exists a route in which the mobile body 10 can reach a destination (loading position or unloading position) without passing through the route portion Rp having the high passage frequency, a route that bypasses the route portion Rp having the high passage frequency is likely to be adopted for the movement route MV of the mobile body 10. Therefore, passage frequencies of the respective route portions Rp are equalized, and the occurrence frequency of the interference of the movement route MV is reduced.

[0077]

FIG. 14 is a flowchart showing a weighting operation (first example) performed by the weight setting unit 42 according to the second embodiment. In the first example, as a premise, for a fixed period of time, the movement route MV is set by using the weight setting information 82 set in advance, and the work of the mobile body 10 is carried out, based on the set movement route MV. As a result, the operation record data 80 is accumulated and recorded in the storage unit 32. When the operation record data 80 is recorded, as shown in FIG. 10, the mobile body control system 1 performs each process of Step S20 of acquiring the order information 70, Step S21 of acquiring the information of the route portion Rp and the weight value W, Step S22 of setting the

movement route MV in accordance with the weight value W, and Step S23 of instructing the mobile body 10 to start the work.

[0078]

As shown in FIG. 14, in the management device 12, the weight setting unit 42 acquires the information of each route portion Rp forming the passage R from the storage unit 32 (Step S30). The weight setting unit 42 acquires the operation record data 80 for each route portion Rp from the storage unit 32 (Step S31). Any of Steps S30 and S31 may be performed earlier.

[0079]

The weight setting unit 42 sets the weight value W for each acquired route portion Rp, based on the operation record data 80 (Step S32). In this case, the weight setting unit 42 sets the weight values W such that the mobile body 10 is less likely to pass (the weight value W is increased) through the route portion Rp having a larger number of passages. The weight setting unit 42 records the weight setting information 82 in which the route portion Rp and the weight value W of the route portion Rp are associated with each other, in the storage unit 32. The weight setting unit 42 transmits the weight setting information 82 to the information processing device 14 via the communication unit 30. In this manner, the acquisition unit 60 of the information processing device 14 acquires the weight setting information 82, and records the weight setting information 82 in the storage unit 52.

[0080]

Thereafter, as shown in FIG. 10, the route setting unit 62 sets the movement route MV, based on the newly set weight setting information 82.

[0081]

In the first example, the weight setting unit 42 can regularly update the weight

setting information 82 stored in the storage unit 32. That is, after the weight value W is set, the weight setting unit 42 may update the weight setting information 82 by performing Steps S30 to S32 again, when a fixed period of time elapses and the operation record data 80 obtained by the set weight value W is accumulated.

[0082]

(Second Example)

A second example is a method for setting the weight values W in the order information 70 including a group of the work orders such that the mobile body 10 is less likely to pass through the route portion Rp passing along the previously set movement route MV.

[0083]

FIG. 15 is a diagram for describing the method for setting the weight value W according to the second example of the second embodiment.

[0084]

In the second example, the route setting unit 62 preferentially sets the movement route MV in descending order of the priority in the order information 70. In FIG. 15, the respective work orders included in the order information 70 are aligned and shown in order of priority. Here, the priority is represented by a natural number equal to or greater than 1, and a smaller value indicates a higher priority. That is, "priority = 1" has a highest priority. Therefore, the route setting unit 62 sets the movement route MV in order from the work order having a smaller value of the priority.

[0085]

The weight setting unit 42 sets the weight values W such that the mobile body 10 is less likely to pass through the route portion Rp passing along the previously set movement route MV in the order information 70. That is, the weight setting unit 42

increases the weight value W of the route portion Rp passing along the previously set movement route MV from a current value, or decreases the weight value W of another route portion Rp other than the route portion Rp passing along the previously set movement route MV from the current value.

[0086]

In this manner, when the route setting unit 62 sets the movement route MV for next work order having a lower priority, the route setting unit 62 performs the shortest route search, based on the new weight setting information adjusted by the weight setting unit 42.

[0087]

For example, in FIG. 15, it is assumed that the movement route MV3 shown in FIG. 16 is set for the work order of priority = 1. FIG. 16 is a diagram showing an example of the movement route. The movement route MV3 passes through the route portions Rp11, Rp12, Rp13, Rp14, Rp15, Rp16, Rp6, and Rp5 from the disposition position e14. In this case, the weight setting unit 42 creates the weight setting information 82 in which the weight value W of each of the route portions Rp of Rp11, Rp12, Rp13, Rp14, Rp15, Rp16, Rp6, and Rp5 is relatively increased with respect to the other route portions Rp. For the work order of priority = 2 in FIG. 15, the route setting unit 62 creates the movement route MV, based on the new weight setting information 82 (weight setting information 82 set, based on the movement route MV3 in the past (priority = 1)).

[0088]

Similarly, when the movement route MV for the work order having priority = 2 is set, the weight setting unit 42 creates (updates) the weight setting information 82 in which the weight value W of the route portion Rp through which the movement route

MV passes is relatively increased. The route setting unit 62 creates the movement route MV for the work order having priority = 3, based on the updated weight setting information 82.

[0089]

In this manner, in the second example, the weight value W of each route portion Rp is updated and set in accordance with the record of the movement route MV set for each work order forming one order information 70. The route portion Rp previously adopted for the movement route MV is less likely to be adopted for the movement route MV of the subsequent work order. Therefore, the passage frequencies of the respective route portions Rp are equalized, and the interference of the movement route MV is suppressed.

[0090]

In the second example, the weight setting unit 42 may perform a process of returning (resetting) the weight value W adjusted based on the movement route MV set in the past, to an initial value when a fixed period of time elapses. For example, the weight setting unit 42 may reset an adjustment amount of the weight value W by the movement route MV when the mobile body 10 passes through the movement route MV used for adjusting the weight value W or when the work order corresponding to the movement route MV is completed. In addition, for example, the weight setting unit 42 may reset the weight values W of all of the route portions Rp set (adjusted) by the order information 70, to the initial value, at a timing at which the entire group of work orders included in the order information 70 is completed. The initial value of the weight value W may be a fixed value, or may be a value determined based on the past operation record according to the first example described above. In this manner, it is possible to suppress a possibility that the passage frequency of the route portion Rp is fixed.

[0091]

FIG. 17 is a flowchart showing an example of a weighting operation (second example) performed by the weight setting unit 42 according to the second embodiment. As shown in FIG. 17, in the information processing device 14, the acquisition unit 60 acquires the order information 70 including the group of work orders from the management device 12 (Step S40). The acquisition unit 60 acquires the information of the route portion Rp and the weight value W at a current time (weight setting information 82) from the management device 12 (Step S41). The route setting unit 62 selects an unset order having the highest priority from the order information 70 (Step S42). The unset order means a work order for which the movement route MV is not set. Next, the route setting unit 62 sets the movement route MV, for example, by the shortest route search in accordance with the weight value W of the weight setting information 82 with respect to the selected unset order (Step S43), and generates transport instruction information. The route setting unit 62 transmits the information of the set movement route MV to the management device 12 via the communication unit 50. In this manner, the weight setting unit 42 acquires the information of the movement route MV transmitted from the information processing device 14 via the communication unit 30.

[0092]

The weight setting unit 42 sets (adjusts) the weight values W such that the weight value W of the route portion Rp through which the mobile body 10 passes along the movement route MV is relatively increased, based on the acquired information of the movement route MV, and creates (updates) the weight setting information 82 (Step S44).

[0093]

The route setting unit 62 determines whether or not all of the unset orders of the order information 70 are completely set (Step S45). When the unset order exists, the process returns to Step S41, the latest weight value W (weight setting information 82) is acquired, and Steps S42 to S44 are performed. Therefore, the weight setting information 82 is updated each time the movement route MV for the unset order is set. When the unset order does not exist, the processing unit 64 transmits an instruction to start the work to the mobile body 10 via the communication unit 50, based on the transport instruction information (Step S46).

[0094]

In adjusting the weight value W according to the second example, only some of the movement routes MV of the order information 70 may be considered. For example, only the movement route MV of the work order having an odd-numbered or even-numbered priority may be considered.

[0095]

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 plurality of route portions Rp through which the mobile body 10 passes and the weight values W indicating the movement costs of the route portions Rp in association with each other, the weight setting unit 42 that sets the weight values W individually for each passage direction of the route portions Rp for at least some of the plurality of route portions Rp, and the route setting unit 62 that sets the movement route MV (MV1 and MV2) from the movement start position to the destination of the mobile body 10, based on the weight values W for each passage direction of the plurality of route portions Rp.

[0096]

According to this configuration, since the weight value W is set for each passage

direction with respect to the route portion Rp, a direction in which the mobile body 10 needs to preferentially pass can be set. As a result, the movement route MV passing through the route portion Rp in a specific direction is relatively easily created. In this manner, even when the shortest route search is performed by the route setting unit 62, the frequency of setting the movement route MV that passes through the same route portion Rp in both directions is reduced. As a result, the occurrence frequency of the interference of the movement route MV can be suppressed.

[0097]

According to a second aspect of the present disclosure, in the mobile body control system 1 according to the first aspect, for a series of consecutive route portions Rp, the weight setting unit 42 sets the weight values W such that the mobile body 10 is likely to pass in one direction and is less likely to pass in the other direction opposite to the one direction. In this manner, for the work position located in an intermediate portion of a series of the route portions Rp, a route for the mobile body 10 to advance and reach the work position in one direction is preferentially set, and the frequency of setting the route for the mobile body 10 to advance and reach the work position in the other direction is reduced. As a result, the interference of the movement route MV can be effectively suppressed.

[0098]

According to a third aspect of the present disclosure, there is provided the mobile body control system 1 including the storage unit 32 that stores the plurality of route portions Rp through which the mobile body 10 passes and the weight values W indicating the movement costs of the route portions Rp in association with each other, the route setting unit 62 that sets the movement route MV from the movement start position to the destination of the mobile body 10, based on the weight values W of the

plurality of route portions Rp, and the weight setting unit 42 that sets the weight values W of the route portions Rp, based on the movement route MV set in the past.

[0099]

According to this configuration, the weight value W in each route portion Rp, that is, easy adoption for the movement route MV can be set, based on an adoption record in the movement route MV set in the past. Therefore, for example, when there is the route portion Rp which is likely to cause the interference from the movement route MV set in the past, the weight value W is set such that the route portion Rp is relatively less likely to be adopted. In this manner, the passage frequency of the route portion Rp which is likely to cause the interference (that is, the adoption frequency for the movement route MV) can be reduced, and the other route portions Rp can be easily adopted. In this manner, the occurrence frequency of the interference of the movement route MV can be suppressed.

[0100]

According to a fourth aspect of the present disclosure, in the mobile body control system 1 according to the third aspect, the weight setting unit 42 sets the weight values W such that the mobile body 10 is less likely to pass through the route portion Rp having a large number of passages. In this manner, when there is the route portion Rp having the high passage frequency of the mobile body 10 and which is likely to cause the interference, from the past passage record, a configuration can be adopted such that the route portion Rp is less likely to be adopted for the movement route MV. As a result, the passage frequencies of the respective route portions Rp are equalized. Therefore, the occurrence frequency of the interference of the movement route MV can be suppressed.

[0101]

According to a fifth aspect of the present disclosure, in the mobile body control system 1 according to the third aspect or the fourth aspect, the storage unit 32 stores the order information 70 including a group of the work orders in which the loading position and the unloading position of the mobile body 10 and the priority are defined. The route setting unit 62 preferentially sets the movement route MV in descending order of the priority in the order information 70. The weight setting unit 42 sets the weight values W in the order information 70 such that the mobile body 10 is less likely to pass through the route portion Rp passing along the previously set movement route MV. In this manner, the route portion Rp previously adopted for the movement route MV is less likely to be adopted as the movement route MV of the subsequent work order in accordance with the record of the movement route MV set for each work order forming one order information 70. As a result, when each work order forming the order information 70 is executed, the passage frequencies of the respective route portions Rp are equalized. Therefore, the occurrence frequency of the interference of the movement route MV can be suppressed.

[0102]

According to a sixth aspect of the present disclosure, there is provided the information processing method including Step S21 of acquiring the weight values W individually set for each passage direction of the route portions Rp for at least some of the plurality of route portions Rp through which the mobile body 10 passes, and Step S22 of setting the movement route MV from the movement start position to the destination of the mobile body 10, based on the weight values W for each passage direction of the plurality of route portions Rp.

[0103]

According to this configuration, since the weight value W is set for each passage

direction with respect to the route portion Rp, a direction in which the mobile body 10 needs to preferentially pass can be set. As a result, the movement route MV passing through the route portion Rp in a specific direction is relatively easily created. In this manner, even when the shortest route search is performed by the route setting unit 62, the frequency of setting the movement route MV that passes through the same route portion Rp in both directions is reduced. As a result, the occurrence frequency of the interference of the movement route MV (MV1 and MV2) can be suppressed.

[0104]

According to a seventh aspect of the present disclosure, there is provided the information processing method including steps (S21 and S41) of acquiring 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 portions Rp, steps (S22 and S43) of setting the movement route MV from the movement start position to the destination of the mobile body 10, based on the weight values W of the plurality of route portions Rp, and steps (S32 and S44) of setting the weight values W of the route portions Rp, based on the movement route MV set in the past.

[0105]

According to this configuration, the weight value W in each route portion Rp, that is, easy adoption for the movement route MV can be set, based on an adoption record in the movement route MV set in the past. Therefore, for example, when there is the route portion Rp which is likely to cause the interference from the movement route MV set in the past, the weight value W is set such that the route portion Rp is relatively less likely to be adopted. In this manner, the passage frequency (adoption frequency for the movement route MV) of the route portion Rp which is likely to cause the interference can be reduced, and the other route portions Rp can be easily adopted. In

this manner, the occurrence frequency of the interference of the movement route MV can be suppressed.

[0106]

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.

Reference Signs List

[0107]

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

24A, 24B: claw

24: fork

26A: sensor

28: control device

30, 50, 100: communication unit

32, 52, 102: storage unit

34, 54, 104: control unit

40: work order setting unit

42: weight setting unit

60: acquisition unit

62: route setting unit

64: processing unit

70: order information

72A, 72B, 72C: area

80: operation record data

82: weight setting information

200: facility

AR1: first region

AR2: second region

c1: charging position

h1, h2: standby position

MV, MV1, MV2, MV3, MVA, MVB: movement route

P: object

R: passage

Rp, Rp1 to Rp7, Rp11 to Rp16: route portion

e1 to e31: disposition position

W: weight value