

DESCRIPTION

INVENTION TITLE: SMART LOGISTICS VEHICLE CONTROL METHOD AND
CONTROL DEVICE

5

Technical Field

[1] The present disclosure relates to a control method and a control device for a smart logistics vehicle, which control the movement and operations of the smart logistics vehicle.

10 [2]

Background Art

[3] Recently, not only in general logistics warehouses and factories, but also in smart factories where products with
15 different specifications are manufactured by using various parts, a smart logistics vehicle has been introduced in order to flexibly and efficiently supply and transport parts.

[4] A smart logistics vehicle is a general term that encompasses an autonomous mobile robot (AMR) and an automated
20 guided vehicle (AGV), and such a smart logistics vehicle can perform movement and operations under the control of a control system.

[5] A smart logistics vehicle can move and perform operations based on pre-input map information and can also move and perform
25 operations while recognizing the surrounding environment.

[6] However, if information on the surrounding environment recognized during the movement and operation of the smart logistics vehicle differs from the pre-input map information, the smart logistics vehicle may misrecognize its location as
5 another position or move to a location different from a position in the pre-input map information. As a result, the conventional movement and operation of the smart logistics vehicle may not be carried out smoothly. In this way, the smart logistics vehicle may fail to perform movement and
10 operations under the control of the control system, thereby causing problems in ensuring smooth process execution.

[7] Therefore, it is necessary to provide a method for detecting whether map misrecognition has occurred in the smart logistics vehicle and effectively correcting the current
15 position of the smart logistics vehicle when such misrecognition occurs.

[8]

[9] The matters described above as background art are provided only to enhance the understanding of the background
20 of the present disclosure, and should not be construed as an acknowledgment that they correspond to the prior art already known to those skilled in the art.

[10]

25 **Disclosure**

Technical Problem

[11] The present disclosure has been proposed to solve these problems, and is intended to provide a control method and a control device for a smart logistics vehicle, which detect
5 whether map misrecognition has occurred in a smart logistics vehicle and correct the position of the smart logistics vehicle when such misrecognition occurs.

[12]

[13] The technical objectives intended to be achieved in the
10 present disclosure are not limited to the technical objectives mentioned above, and other technical objectives not mentioned will be clearly understood by those skilled in the art to which the present disclosure belongs from the description below.

[14]

15

Technical Solution

[15] In order to accomplish the above objectives, a smart logistics vehicle control method according to the present disclosure include: controlling a smart logistics vehicle to
20 execute a mission based on pre-shared map data; receiving information on a map matching rate determined based on the map data from the smart logistics vehicle during the mission execution; and transmitting location initialization information to the smart logistics vehicle so that the smart

logistics vehicle performs re-localization based on the received information on the map matching rate.

[16]

[17] In addition, in order to accomplish the above objectives,
5 a smart logistics vehicle control device according to the present disclosure includes: a communication unit configured to communicate with at least one smart logistics vehicle; and a map management unit configured to control the at least one smart logistics vehicle to execute a mission based on pre-
10 shared map data, to receive information on a map matching rate determined based on the map data from the at least one smart logistics vehicle during the mission execution, and to transmit location initialization information to the at least one smart logistics vehicle so that the at least one smart logistics
15 vehicle performs re-localization based on the received information on the map matching rate.

[18]

Advantageous Effects

20 **[19]** According to the control method and the control device for a smart logistics vehicle, the smart logistics vehicle performs re-localization when a map matching rate is low based on information on the map matching rate, thereby effectively correcting the current position of the smart logistics vehicle

when the smart logistics vehicle misrecognizes the position thereof.

[20]

[21] Effects obtainable from the present disclosure are not
5 limited to the effects mentioned above, and other effects not
explicitly mentioned can be clearly understood by those skilled
in the art to which the present disclosure pertains from the
following description.

[22]

10

Description of Drawings

[23] FIG. 1 is a block diagram illustrating an example of the
configuration of a smart factory that may be applied to
embodiments of the present disclosure.

15 **[24]** FIG. 2 is a block diagram illustrating an example of the
configuration of a control device that may be applied to
embodiments of the present disclosure.

[25] FIG. 3 is a block diagram illustrating an example of the
configuration of a smart logistics vehicle that may be applied
20 to embodiments of the present disclosure.

[26] FIG. 4 is a perspective view illustrating an example of
the exterior of the smart logistics vehicle that may be
applied to embodiments of the present disclosure.

[27] FIG. 5 is a flowchart illustrating an example of a traveling process of the smart logistics vehicle that may be applied to embodiments of the present disclosure.

[28] FIG. 6 is a diagram schematically illustrating a control
5 system provided with a smart logistics vehicle control device according to an embodiment of the present disclosure.

[29] FIG. 7 is a diagram illustrating the re-localization of the smart logistics vehicle according to an embodiment of the present disclosure.

10 [30] FIG. 8 is a diagram illustrating a smart logistics vehicle control method according to an embodiment of the present disclosure.

[31]

15 **Mode for Invention**

[32] In describing embodiments disclosed in the present specification, if it is decided that the detailed description of known technologies related to the present disclosure makes the subject matter of the embodiments described herein
20 unclear, the detailed description is omitted. Further, the accompanying drawings are provided only for easy understanding of embodiments disclosed in the specification, and the technical spirit disclosed in the specification is not limited by the accompanying drawings, and all changes, equivalents,

and replacements should be understood as being included in the spirit and scope of the present disclosure.

[33] Terms including ordinal numbers such as "first" and "second", etc. may be used to describe various components, 5 but the components are not to be construed as being limited to the terms. The terms are used only to distinguish one component from another component.

[34] It is to be understood that when one component is referred to as being "connected to" or "coupled to" another 10 component, it may be connected directly to or coupled directly to another component or be connected to or coupled to another component, but still another component may intervene therebetween. On the other hand, it should be understood that when one component is referred to as being "connected directly 15 to" or "coupled directly to" another component, it is connected to or coupled to another component without still another component intervening therebetween.

[35] Singular forms are intended to include plural forms unless the context clearly indicates otherwise.

20 **[36]** It will be further understood that terms such as "comprise" or "have" used in this specification specify the presence of stated features, steps, operations, components, parts, or a combination thereof, but do not preclude the presence or addition of one or more other features, numerals,

steps, operations, components, parts, or a combination thereof.

[37] Hereinafter, embodiments disclosed in the present specification will be described in detail with reference to
5 the accompanying drawings, and identical or similar components are denoted by the same reference numerals regardless of the drawing numbers, and redundant descriptions thereof will be omitted.

[38] In describing embodiments disclosed in the present
10 specification, if it is decided that the detailed description of known technologies related to the present disclosure makes the subject matter of the embodiments described herein unclear, the detailed description is omitted. Further, the accompanying drawings are provided only for easy understanding
15 of embodiments disclosed in the specification, and the technical spirit disclosed in the specification is not limited by the accompanying drawings, and all changes, equivalents, and replacements should be understood as being included in the spirit and scope of the present disclosure.

20 **[39]** Terms including ordinal numbers such as "first" and "second", etc. may be used to describe various components, but the components are not to be construed as being limited to the terms. The terms are used only to distinguish one component from another component.

[40] It is to be understood that when one component is referred to as being "connected to" or "coupled to" another component, it may be connected directly to or coupled directly to another component or be connected to or coupled to another component, but still another component may intervene therebetween. On the other hand, it should be understood that when one component is referred to as being "connected directly to" or "coupled directly to" another component, it is connected to or coupled to another component without still another component intervening therebetween.

[41] Singular forms are intended to include plural forms unless the context clearly indicates otherwise.

[42] It will be further understood that terms such as "comprise" or "have" used in this specification specify the presence of stated features, steps, operations, components, parts, or a combination thereof, but do not preclude the presence or addition of one or more other features, numerals, steps, operations, components, parts, or a combination thereof.

[43] Hereinafter, embodiments disclosed in the present specification will be described in detail with reference to the accompanying drawings, and identical or similar components are denoted by the same reference numerals regardless of the drawing numbers, and redundant descriptions thereof will be omitted.

[44] In addition, the term "unit" or "control unit" included in the names of internal components of a smart logistics vehicle or a control device is merely a term widely used to refer to a controller that controls specific functions, and
5 does not indicate a generic functional unit. For example, each controller may include a modem/transceiver for communication with other controllers or sensors to perform control of a corresponding function, a memory for storing an operating system, logic instructions, and input/output
10 information, and one or more processors configured to perform determinations, computations, and decisions necessary for controlling the corresponding function. Depending on the implementation, a single processor may perform computations for a plurality of controllers.

15 **[45]**

[46] First, the configuration of a smart factory in which a smart logistics vehicle is deployed and operated according to an embodiment will be described with reference to FIG. 1.

[47] FIG. 1 is a block diagram illustrating an example of the
20 configuration of a smart factory that may be applied to embodiments.

[48] Referring to FIG. 1, a smart factory (100) may include a smart logistics vehicle (110), a production device (120), a monitoring device (130), and a control device (140).

[49] The smart factory (100) may be provided with a plurality of smart logistics vehicles (110), a plurality of production devices (120), and a plurality of monitoring devices (130) according to the production processes of products and target
5 production rates.

[50] First, the smart logistics vehicle (110) may include an autonomous mobile robot (hereinafter referred to as "AMR") and an automated guided vehicle (hereinafter referred to as "AGV"). Depending on the operating policy of the smart
10 logistics vehicle (110) in the smart factory (100), only one type of AGV and AMR may be operated, or both AGV and AMR may be operated together within a single smart factory (100).

[51] An AGV generally performs operations (such as movement, direction change, and stop) required within the smart factory
15 (100) by recognizing and following guidance facilities disposed on the floor for guiding AGV. Here, the guidance facilities may include optically recognizable markers (spots, 2D codes, etc.), tags that can be contactlessly recognized at close range (for example, NFC tags, RFID tags, etc.), magnetic
20 strips, wires, etc., but these are merely examples and are not intended to be limiting. The guide facilities may be arranged continuously on the floor or discontinuously to be spaced apart from each other. Since the AGV performs operations primarily by recognizing and following the guide
25 facilities, the guide facilities are required to be installed

in advance before operation. Therefore, when it is necessary to move the AGV to a new path or modify an existing path, the installation or modification of the guide facilities must be physically performed. In addition, since the AGV does not
5 deviate from a path set through the guide facilities, the AGV generally stops when an obstacle is detected on or near the path until the detected obstacle disappears or separate control is provided. In the operation of the AGV, since the control device (140) must control the AGV based on the guide
10 facilities, the control device (140) may transmit to the AGV commands such as "travel until a third marker is recognized" or "turn a heading direction by 90 degrees when the third marker is recognized," either as individual command units or as mission units including a plurality of commands (for
15 example, retrieval, supply, charging, patrol, etc.).

[52] An AMR may determine its current position (i.e., positioning) by sensing a surrounding environment, and, by using positioning and a map, the AMR may perform its own path planning, which is a main distinction from an AGV.
20 Accordingly, when a map with coordinate compatibility is shared between the AMR and the control device (140), the control device (140) may control the AMR by instructing it on a coordinate-based path. In addition, when an obstacle is detected during travel, the AMR may independently set an
25 avoidance path to bypass the obstacle and then return to an

original path thereof. The function of the control device (140) in setting one or more intermediate coordinates for the path of the AMR may be referred to as global path planning, and the function of the AMR in setting a travel path or an avoidance path between the intermediate coordinates according to global path planning may be referred to as local path planning.

[53] A more detailed configuration of the smart logistics vehicle (110) will be described with reference to FIGS. 3 and 4, and the traveling control process of the AMR will be described with reference to FIG. 5.

[54] Next, the production device (120) may refer to a device that performs a production process of a product within the smart factory (100) (for example, a robot arm, a conveyor belt, etc.), and, in a broader sense, may refer to a device deployed to assist the smart logistics vehicle (110) in performing missions such as access when the production process is carried out by a human. The device deployed to assist in performing missions may include, but is not limited to, a device that detects the status of a designated location where the smart logistics vehicle (110) may place or pick up a pallet within an area where a specific production process is performed, a device that determines the progress of the process, and means for restricting entry into the area.

[55] For example, the production device (120) may be controlled through a programmable logic controller (PLC) and may communicate with the control device (140) regarding the progress of the process.

5 **[56]** The monitoring device (130) may perform the function of acquiring information to assess a situation within the smart factory (100) and transmitting the information to the control device (140). For example, the monitoring device (130) may include a camera, a proximity sensor, or the like, but is not
10 limited thereto.

[57] The control device (140) may communicate with the aforementioned components (110, 120, 130) to acquire information necessary for operating the smart factory (100) or to control each of the components. For example, the
15 control device (140) may perform operations such as dispatching the smart logistics vehicle (110), setting its path, assigning missions, managing processes for each product, and managing materials.

[58] In an implementation, the control device (140) may
20 include an AMR/AGV control system (ACS) that controls surrounding process equipment based on the position of an AGV or AMR and performs mission-based control of the AGV/AMR, and a mobile robot integrated monitoring system (MoRIMS) that integrates and monitors two or more ACSs. The MoRIMS may
25 monitor the status and paths of all smart logistics vehicles

(110) within the smart factory (100) as well as perform logistics flow settings and traffic control based on information from each of the ACSs. For example, when the ACSs are provided for smart logistics robots of the same
5 manufacturer or model, the MoRIMS may perform integrated control to prevent collisions, such as analyzing bottleneck levels in intersecting or overlapping areas, controlling acceleration and deceleration during travel, and regenerating avoidance paths, through traffic distribution control between
10 heterogeneous systems based on information acquired from the plurality of ACSs.

[59] In addition, the MoRIMS may also have, as its upper-level control entity, a manufacturing execution system (MES), and the manufacturing execution system (MES) may in turn be
15 linked with an advanced planning & scheduling (APS) system.

[60] In addition to the aforementioned components (110, 120, 130, 140) of the smart factory (100), devices for communication between components, such as beacons, repeaters, and access points (APs), chargers for charging the smart
20 logistics vehicle (110), loading spaces for storing or loading parts, spaces for storing finished or intermediate products, traffic lights, barriers, and standby spaces for idle smart logistics vehicles (110) may be appropriately arranged within the smart factory (100).

[61] Hereinafter, with reference to FIG. 2, the configuration of the control device (140) that may be applied to embodiments of the present disclosure will be described.

[62] FIG. 2 is a block diagram illustrating an example of the configuration of the control device that may be applied to
5 embodiments of the present disclosure. Components shown in FIG. 2 mainly represent components related to the embodiments of the present disclosure, and, in actual implementation of the control device (140), more or fewer components may be
10 included.

[63] Referring to FIG. 2, the control device (140) may include a firmware management unit (141), a traffic control unit (142), a process management unit (143), a production/logistics management unit (144), an inventory
15 management unit (145), a communication unit (146), a vehicle monitoring unit (147), and a map management unit (148).

[64] The firmware management unit (141) may obtain the latest firmware of the smart logistics vehicle (110) through the communication unit (146) and transmit it to the smart
20 logistics vehicle (110), thereby performing a firmware update to keep the firmware of the smart logistics vehicle (110) up to date.

[65] The traffic control unit (142) controls traffic lights and barriers based on the paths of the smart logistics vehicle

(110), and may recalculate the paths of the smart logistics vehicle (110) according to traffic conditions.

[66] The process management unit (143) may define processes for each product and may manage missions such as process
5 progress and execution positions.

[67] The production/logistics management unit (144) may dispatch the smart logistics vehicle (110) based on missions.

[68] The inventory management unit (145) manages the location and quantity of each material, and such information may be
10 useful for more efficient process operation, such as dispatching the smart logistics vehicle (110) to a destination for pallet pickup or retrieval in advance of the actual detection of assembly or consumption of the material.

[69] The communication unit (146) may communicate not only
15 with the internal components of the smart factory (100), such as the smart logistics vehicle (110), the production device (120), and the monitoring device (130), but also with external entities, such as a firmware update server.

[70] The vehicle monitoring unit (147) may monitor the
20 location, path, battery status, communication status, and powertrain status of each smart logistics vehicle (110). Here, the path refers to a concept including a waypoint-based global path and a real-time local path. In addition, the battery status may include information such as voltage,
25 current, temperature, peak values of voltage and current,

state of charge (SOC), and state of health (SOH). The communication status may include information on a currently active communication protocol (e.g., Wi-Fi), a connected access point (AP), a distance to the AP, and a channel in use.

5 Furthermore, the powertrain status may include load, temperature, and RPM of a drivetrain.

[71] In addition, the vehicle monitoring unit (147) may check a mission, operation mode, firmware version, etc. currently assigned to each smart logistics vehicle (110).

10 **[72]** The map management unit (148) acquires grid map-type map data generated by the AMR among the smart logistics vehicle (110) as the AMR travels inside the smart factory (100) and may provide a tool that allows a factory administrator to edit the acquired map data. Through editing of the map data, zones
15 in which one or more preset operations are performed when the smart logistics vehicle (110) enters, virtual lanes, intersections, and no-entry areas may be set, but these are merely examples and not limiting. In addition, the map management unit (148) may distribute an initially generated
20 grid map obtained through the actual travel of a specific smart logistics vehicle (110) to other smart logistics vehicles (110) via the communication unit (146).

[73] Next, the smart logistics vehicle will be described with reference to FIGS. 3 and 4.

[74] FIG. 3 is a block diagram illustrating an example of the configuration of the smart logistics vehicle that may be applied to embodiments of the present disclosure.

[75] Referring to FIG. 3, the smart logistics vehicle (110) may include a traveling unit (111), a sensing unit (112), a loading unit (113), a communication unit (114), and a control unit (115). Each of the components will be described below.

[76] The traveling unit (111) may include a driving source, wheels, suspension, etc. involved in the movement, steering, and stopping of the smart logistics vehicle (110). The driving source may be implemented by using an electric motor powered by a built-in battery (not shown). The wheels may include one or more drive wheels that receive driving force from the driving source and non-drive wheels that rotate as a vehicle body moves without receiving driving force. Depending on the implementation, when a plurality of drive wheels are provided, a driving source may be matched to each drive wheel so that the rotation of each drive wheel may be independently controlled. In this case, steering may be achieved by making the rotational directions of different drive wheels different to rotate the vehicle body without the need for separate steering means. At least some of the non-drive wheels may be configured as caster-type wheels, but this is merely illustrative and is not limited thereto.

[77] The sensing unit (112) is configured to detect the surrounding environment or the operational state of the smart logistics vehicle (110), and may include at least one of a 2D laser scanner (e.g., LiDAR), a 3D vision (stereo) camera, a multi-axis gyro sensor, an acceleration sensor, a wheel encoder, and a proximity sensor.

[78] The encoder may output information for determining how much a wheel has rotated by using light emitted from a light-emitting element (e.g., a light-emitting diode). For example, the encoder may count the number of slits arranged along the circumferential direction of a wheel or of a disk that rotates together with the wheel during a unit time. The control unit (115) may perform odometry, which estimates displacement by analyzing the amount of positional change over time based on data acquired through the encoder and the gyro sensor. However, due to the slip or wear of the wheel (such as a change in the effective radius of the wheel), the displacement estimated based on the encoder data may differ from actual displacement. Therefore, when performing odometry, the control unit (115) may correct noise and errors by applying a predetermined algorithm (for example, an extended Kalman filter (EKF)) to information collected from the wheel and gyro sensor, thereby outputting results that tend to be closer to actual values. This odometry may be particularly useful when

localization by using a 2D laser scanner to be described later is unavailable.

[79] The 2D laser scanner may scan the surrounding environment by emitting laser beams through a rotating mirror and detecting reflected signals. In this case, by analyzing the intensity of the reflected signals and time difference between emission and reception, detection results in the form of a point cloud may be output.

[80] The 3D vision camera may calculate a distance to an object based on disparity between two cameras spaced apart from each other by a predetermined distance, that is, pixel disparity between images captured by each of the cameras. In this case, a texture projector that projects a predetermined pattern of infrared light may be provided to enable detection even on uniformly colored planar surfaces (for example, a white wall).

[81] Generally, a 2D laser scanner is used for mapping, navigation, and object recognition, while a 3D camera may be utilized especially for avoiding an obstacle during navigation, but this is merely illustrative and is not necessarily limited thereto.

[82] The loading unit (113) serves as a means for loading products to be transported and may take the form of the upper plate itself on the vehicle body, a table arranged on the upper plate, a lift, a turntable rotating along a vertical

axis, a forklift, a conveyor, or a combination thereof. The forklift may support telescopic and tilting functions similar to those of a forklift truck.

[83] The communication unit (114) may communicate with other
5 components within the smart factory (100), such as the production device (120) and the control device (140), support communication between the smart logistics vehicle (110), and communicate with a charger during execution of a charging mission.

10 **[84]** The control unit (115) acts as an entity performing overall control of the aforementioned components (111, 112, 113, 114), and may perform functions such as managing a current mission, determining a current location and a destination, planning a path, and controlling the loading unit
15 based on information acquired from the control device (140) through the communication unit (114).

[85] FIG. 4 is a perspective view illustrating an example of the exterior of the smart logistics vehicle that may be applied to embodiments of the present disclosure.

20 **[86]** Referring to FIG. 4, an example of an AMR as the smart logistics vehicle (110) is illustrated. The vehicle body may have a track-type flat shape with a long axis extending along a first axis direction. One drive wheel (111-1) is arranged at the center of the vehicle body along the first axis
25 direction and may be arranged on a first side in a second axis

direction, while another drive wheel (not shown) may be arranged on a second side in the second axis direction to face the one drive wheel (111-1). This arrangement of the drive wheels may be referred to as a "differential drive (DD)" configuration. Although not shown in FIG. 4, two or more non-drive wheels may be disposed at the lower portion of the vehicle body. In this case, when the two drive wheels rotate at the same speed in the same direction, the robot may move forward or backward along the first axis direction, and when they rotate at the same speed in opposite directions, the robot may extend along the third axis direction and rotate about a rotational axis passing through the planar center (C) of the vehicle body. In addition, the sensing unit (112) may be disposed on the front surface of the vehicle body, and the loading unit (113) may be disposed on the upper surface thereof. The loading unit (113) may be configured to move up and down along the third axis direction, and racks or trays may be fixed on the upper surface via guides (113-1).

[87] However, the form of the AMR shown in FIG. 4 is merely illustrative, and the AGV may have a form similar to that of the AMR or that the AMR may have a different form.

[88] Next, with reference to FIG. 5, the traveling process of the mart logistics vehicle (110) will be described.

[89] FIG. 5 is a flowchart illustrating an example of the traveling process of the mart logistics vehicle (110) that

may be applied to embodiments of the present disclosure. In FIG. 5, for convenience, it is assumed that the smart logistics vehicle (110) is an AMR capable of positioning and local path setting.

5 **[90]** Referring to FIG. 5, the AMR may first travel within the smart factory (100) and acquire a measured grid map through a LiDAR, etc. (S501).

[91]

[92] When the AMR transmits the acquired grid map to the control device (140), a grid map editing and matching process may be performed by the map management unit (148) of the control device (140) (S502). Here, the editing process may include setting various zones in the aforementioned grid map and assigning costs to individual grid cells. Here, the cost assignment may be performed such that cells closer to obstacles or no-entry areas are assigned higher costs, preventing the AMR from moving into areas near the obstacles or the no-entry areas. This is because, when setting a local path, the AMR selects as a path a set of cells between waypoints that have the lowest total cost.

[93] In addition, the map matching process may refer to the process of aligning coordinates among a CAD map used in designing the smart factory (100), a measured grid map (LiDAR map), and a topology map obtained through the editing process.

[94] Next, the control device (140) may share the topology map with all AMRs in a factory through the communication unit 146 (S503).

[95] The subsequent steps may be processes applied to
5 individual AMRs.

[96] The AMR may determine its current position on a map (localization) by using sensor data from the sensing unit (112) and the acquired map (S504). For example, the AMR may determine its current position by comparing a surrounding
10 terrain acquired via LiDAR with the map based on feature points.

[97] The control device (140) may select a specific AMR and assign a mission thereto, wherein the mission may generally include one or more waypoints determined through global path
15 planning. The waypoints may be defined as coordinates on the map and may include information regarding a direction (i.e., heading) that the AMR should take at the corresponding coordinates. Based on such mission assignment, a destination may be set for the AMR (Yes in S505), and the AMR may perform
20 local path planning between the waypoints based on the costs of the topology map (S506).

[98] When the path is determined, the AMR may start traveling (S507), and when an obstacle is detected through the sensing unit (112) during travel (Yes in S508), the AMR may perform
25 local path searching to bypass the detected obstacle and

execute an avoidance maneuver (S509). In some cases, depending on the avoidance maneuver or the failure thereof, the control device (140) may update the mission of the corresponding AMR.

5 **[99]** In addition, the AMR may correct its positional error during travel by using the aforementioned odometry techniques until it reaches the destination (S510).

[100] After that, when the AMR reaches the destination (S511), the AMR may perform mission-based maneuvers (S512). For
10 example, the AMR may determine whether conditions for entering a specific process area are met, retrieve an empty pallet at the destination, or drop products loaded on the loading unit (113).

[101]

15 **[102]** In an embodiment of the present disclosure, it is intended to enable the movement and operation of a smart logistics vehicle to be performed according to predetermined control commands.

[103] Hereinafter, a smart logistics vehicle control system
20 according to an embodiment of the present disclosure will be described with reference to FIG. 6.

[104] FIG. 6 is a diagram schematically illustrating a control system provided with a smart logistics vehicle control device according to an embodiment of the present disclosure.

[105] Referring to FIG. 6, the smart logistics vehicle control device (140) according to an embodiment of the present disclosure may include the communication unit (146) configured to communicate with at least one smart logistics vehicle (110-1, 110-2, 110-3), and the map management unit (148) configured to control the at least one smart logistics vehicle (110-1, 110-2, 110-3) to execute a mission based on pre-shared map data, to receive information on a map matching rate determined based on the map data from the at least one smart logistics vehicle (110-1, 110-2, 110-3) during the mission execution, and to transmit location initialization request information to the at least one smart logistics vehicle (110-1, 110-2, 110-3) so that the at least one smart logistics vehicle (110-1, 110-2, 110-3) performs re-localization based on the received information on the map matching rate. The at least one smart logistics vehicle (110-1, 110-2, 110-3) may respectively include a sensing unit (112-1), a communication unit (114-1), and a control unit (115-1).

[106] FIG. 6 illustrates the control system including one smart logistics vehicle control device (140) and a plurality of smart logistics vehicles (110-1, 110-2, 110-3). However, hereinafter, for the convenience of description, only a first smart logistics vehicle (110-1), which is one of them, will be described. However, it should be understood that the same applies to each of the plurality of smart logistics vehicles

(110-1, 110-2, 110-3). In addition, the smart logistics vehicle control device (140) may be regarded as being identical to the control device (140) provided in the above-described smart factory (100).

5 **[107]** The smart logistics vehicle control device (140) may control the first smart logistics vehicle (110-1) to execute a mission based on a pre-shared map data. In this case, the pre-shared map data may include point cloud data mapped based on the location of the first smart logistics vehicle (110-1)
10 while the first smart logistics vehicle (110-1) executes a previous mission. When a plurality of smart logistics vehicles (110-1, 110-2, 110-3) are provided, the map data may refer to data provided to correspond to each of the plurality of smart logistics vehicles (110-1, 110-2, 110-3). In
15 addition, the map data may include point cloud data generated by collecting data sensed by the sensing unit (112-1) provided in the first smart logistics vehicle (110-1) during the execution of a previous mission of the first smart logistics vehicle (110-1) and mapping the collected data according to
20 the location of the first smart logistics vehicle (110-1). However, this is merely illustrative, and is not necessarily limited thereto.

[108] Hereinafter, the specific functions of the at least one smart logistics vehicle and the control device (140) will be
25 described.

[109] First, the communication unit (146) may communicate with the communication unit (114-1) of the first smart logistics vehicle (110-1), and through this communication, may receive and check information including the location and task execution status of the first smart logistics vehicle (110-1). In addition, the communication unit (146) may transmit the received information to the map management unit (148) or receive a command generated by the map management unit (148) and transmit the command to the communication unit (114-1) of the first smart logistics vehicle (110-1).

[110] The communication unit (146) may collect location information of the first smart logistics vehicle (110-1) in order to control the first smart logistics vehicle (110-1) to execute a mission based on pre-shared map data, and may provide the collected location information of the first smart logistics vehicle (110-1) to the map management unit (148).

[111] The map management unit (148) may pre-select map data corresponding to the location of the first smart logistics vehicle (110-1) based on the provided location information. The map management unit (148) may transmit the selected map data to the first smart logistics vehicle (110-1) through the communication unit (146) so as to control the first smart logistics vehicle (110-1) to perform a mission based on the map data. In particular, the map management unit (148) may generate a control command for the first smart logistics

vehicle (110-1) based on the selected map data, and may transmit the generated control command to the first smart logistics vehicle (110-1) through the communication unit (146) so that the first smart logistics vehicle (110-1) performs
5 the mission according to the generated control command.

[112] In addition, the map management unit (148) may receive, from the first smart logistics vehicle (110-1), information on the map matching rate determined based on the map data during the mission execution of the first smart logistics
10 vehicle (110-1). Specifically, during the mission execution of the first smart logistics vehicle (110-1), the first smart logistics vehicle (110-1) may collect surrounding sensing data through the sensing unit (112-1). In this case, the surrounding sensing data may include point cloud data mapped
15 by the first smart logistics vehicle (110-1) sensing surroundings thereof during the mission execution of the first smart logistics vehicle (110-1). In collecting the surrounding sensing data, the first smart logistics vehicle (110-1) may collect the surrounding sensing data through the
20 sensing unit (112-1) when the first smart logistics vehicle (110-1) reaches a specific location during the mission execution or periodically at each preset reference time. However, this is merely illustrative and is not necessarily limited thereto.

[113] The sensing unit (112-1) of the first smart logistics vehicle (110-1) transmits the collected surrounding sensing data to the control unit (115-1) via the communication unit (114-1), and the control unit (115-1) may determine the map matching rate based on the pre-shared map data and the surrounding sensing data collected by the sensing unit (112-1). In particular, the control unit (115-1) may determine the map matching rate by comparing the point cloud data of the map data with the point cloud data included in the surrounding sensing data. However, this is merely illustrative and is not necessarily limited thereto. For example, the control unit (115-1) may generate travelling map data corresponding to the map data based on the surrounding sensing data collected for comparison thereof with the map data, and may determine the map matching rate by comparing the generated travelling map data with the map data.

[114] The control unit (115-1) may transmit information on the determined map matching rate to the communication unit (146) of the control device (140) through the communication unit (114-1), and the map management unit (148) may receive the information on the map matching rate transmitted from the communication unit (146).

[115] Meanwhile, the control unit (115-1) of the first smart logistics vehicle (110-1) may determine the map matching rate and generate a warning notification when the determined map

matching rate is equal to or below a preset reference matching rate. In this case, a comparison determination between the map matching rate to determine whether to generate the warning notification and the preset reference matching rate may be performed by the control unit (115-1) of the first smart logistics vehicle (110-1) or by the map management unit (148) of the control device (140). For example, when the comparison determination is performed by the control unit (115-1), the warning notification may be immediately generated based on the result of the determination, included in the information on the map matching rate, and transmitted to the control device (140). For another example, when the comparison determination is performed by the map management unit (148), the result of the determination may be transmitted to the first smart logistics vehicle (110-1), and the first smart logistics vehicle (110-1) may generate the warning notification based on the transmitted result of the determination and then transmit it back to the control device (140). However, this is merely illustrative and is not necessarily limited thereto.

[116] In addition, the generated warning notification may be transmitted to the control device (140), and when transmitting the above-described information on the map matching rate, the warning notification may also be included and transmitted to the communication unit (146) of the control device (140). In

this case, the map management unit (148) may receive the information on the map matching rate including the warning notification for the first smart logistics vehicle (110-1).

[117] Subsequently, the map management unit (148) may generate
5 and transmit location initialization information to the first smart logistics vehicle (110-1) so that the first smart logistics vehicle (110-1) performs re-localization based on the information on the map matching rate received from the first smart logistics vehicle (110-1). In this case, the map
10 management unit (148) does not transmit the location initialization information so that the first smart logistics vehicle (110-1) unconditionally performs the re-localization, but may determine prerequisites based on the information on the map matching rate and determine whether to cause the first
15 smart logistics vehicle (110-1) to perform the re-localization according to the determination result.

[118] As described above, the first smart logistics vehicle (110-1) may perform the mission according to the control command generated based on the pre-shared map data from the
20 control device (140). In this case, the first smart logistics vehicle (110-1) may sense surroundings thereof and recognize a location thereof during the mission execution through the sensing of the surroundings. However, the surrounding environment may differ from the pre-shared map data, and as a
25 result, the first smart logistics vehicle (110-1) may

recognize the location thereof as a different location or may move to a completely different location that was not originally intended. In this case, the first smart logistics vehicle (110-1) may encounter the problem that the first smart logistics vehicle (110-1) cannot perform the mission according to the control command generated based on the pre-shared map data.

[119] To solve this, the first smart logistics vehicle (110-1) may determine the map matching rate, and the map management unit (148) may transmit location initialization information to the first smart logistics vehicle (110-1) so that the first smart logistics vehicle (110-1) performs the re-localization based on the information on the map matching rate received from the first smart logistics vehicle (110-1).

[120] The re-localization process of the smart logistics vehicle will be described in detail with reference to FIG. 7 regarding.

[121]

[122] FIG. 7 is a diagram illustrating the re-localization of the smart logistics vehicle according to an embodiment of the present disclosure.

[123] FIG. 7 schematically illustrates only a specific area within the smart factory (100) for convenience of explanation. In addition, in FIG. 7, it is assumed that, among the plurality of smart logistics vehicles (110-1, 110-2, 110-3) included in

the smart logistics vehicle control system according to an embodiment of the present disclosure, the first smart logistics vehicle (110-1) has determined that the map matching rate is equal to or below a preset reference matching rate.

5 [124] Referring to FIG. 7, for example, the first smart logistics vehicle (110-1) may misrecognize a current location thereof as position A even though the actual current location thereof is position B based on the determined map matching rate. Alternatively, the first smart logistics vehicle (110-1) may actually be located at position A when it is required
10 to move to location B.

[125] Accordingly, it is necessary to perform the re-localization of the first smart logistics vehicle (110-1) to correct its misjudged position so that it can properly execute
15 its mission according to a control command generated based on pre-shared map data. However, the subsequent re-localization may be performed differently depending on the current location of the first smart logistics vehicle (110-1).

[126] Therefore, the map management unit (148) collects
20 information on a map matching rate determined by each of the plurality of smart logistics vehicles (110-1, 110-2, 110-3) and may check whether there exists a smart logistics vehicle that has determined the map matching rate to be equal to or below the preset reference matching rate based on the
25 collected information on the map matching rate. For example,

when the map matching rate determined by the first smart logistics vehicle (110-1) among the plurality of smart logistics vehicles (110-1, 110-2, 110-3) is equal to or below the reference matching rate, the map management unit (148) may identify the first smart logistics vehicle (110-1) as a smart logistics vehicle that has determined the map matching rate to be equal to or below the preset reference matching rate. In this case, the map management unit (148) may request the location initialization information for the first smart logistics vehicle (110-1) from a separately provided location initialization information generation unit (150).

[127] Meanwhile, the map management unit (148) may control the first smart logistics vehicle (110-1), which has determined the map matching rate to be equal to or below the preset reference matching rate, to stop the mission that was being performed according to control commands generated based on pre-shared map data. As a result, the map management unit (148) may determine that the first smart logistics vehicle (110-1) is stationary at its collected current location. However, this is merely illustrative and is not necessarily limited thereto.

[128] Referring to FIG. 6, the location initialization information generation unit (150) may be provided to communicate with the control device (140), and in particular, may operate only when requested by the map management unit

(148). However, this is merely illustrative and is not necessarily limited thereto. For example, the location initialization information generation unit (150) may be provided as a component included in the control device (140),
5 and operating conditions thereof may be set in various ways.

[129] When the location initialization information is requested by the map management unit (148), the location initialization information generation unit (150) may determine the current location of the first smart logistics
10 vehicle (110-1), which has determined the map matching rate to be equal to or below a preset reference matching rate. For example, the location initialization information generation unit (150) may determine the current location of the first smart logistics vehicle (110-1), which has determined the map
15 matching rate to be equal to or below the reference matching rate, based on at least one of surrounding recognition information of at least one other smart logistics vehicle located around the first smart logistics vehicle (110-1) and signal information of each of a plurality of communication
20 devices located around the first smart logistics vehicle (110-1).

[130] Specifically, a plurality of smart logistics vehicles (110-1, 110-2, 110-3) may be provided within the smart factory (100), and at least one other smart logistics vehicle may
25 travel to perform the mission around the first smart logistics

vehicle (110-1), which has determined the map matching rate to be equal to or below the reference matching rate. The at least one other smart logistics vehicle may travel while recognizing surroundings thereof, and the location initialization information generation unit (150) may collect surrounding recognition information from the at least one other smart logistics vehicle and determine the current location of the first smart logistics vehicle (110-1) based on this information.

10 **[131]** In addition, a plurality of communication devices (APs, not shown) may be provided within the smart factory (100), and when there exists the first smart logistics vehicle (110-1), which has determined the map matching rate to be equal to or below the reference matching rate, the current location of the first smart logistics vehicle (110-1) may be determined through the plurality of communication devices located around the first smart logistics vehicle (110-1). Each of the plurality of communication devices may generate a signal with a predetermined boundary, and the location initialization information generation unit (150) may collect signal information generated from each of the plurality of communication devices and determine the current location of the first smart logistics vehicle (110-1) based on the collected information.

[132] However, this is merely illustrative, and in addition to the methods described above, various other methods may also be applied to determine the current location of a smart logistics vehicle which has determined the map matching rate to be equal to or below the reference matching rate. For example, the current location of the smart logistics vehicle which has determined the map matching rate to be equal to or below the reference matching rate may be determined through a vehicle-to-vehicle (V2V) communication method.

[133] The location initialization information generation unit (150) may generate location initialization information for the first smart logistics vehicle (110-1) based on the determined current location. The location initialization information may include at least one of the speed, new location information, heading direction information, and rotation angle information of the first smart logistics vehicle (110-1).

[134] In this case, the new location information may be information generated based on the current location of the first smart logistics vehicle (110-1) determined through the above-described method, but this is merely illustrative and is not necessarily limited thereto. For example, the new location information may be information selected and entered by an administrator who manages the smart factory (100) from outside the control system. The administrator may select and

input the new location information by using at least one of a LiDAR map obtained based on a LiDAR sensor, a CAD map of the smart factory (100), and a topology map of the smart factory (100).

5 **[135]** In addition, the heading direction information may information on a target heading direction to which the first smart logistics vehicle (110-1) is required to be directed for re-localization, and the rotation angle information may be information on the angle of rotation required to align from
10 the current heading direction to the target heading direction. However, this is merely illustrative, and the location initialization information is not limited to the details described above and may include less or more information.

[136] In addition, the location initialization information
15 generation unit (150) may transmit the generated location initialization information to the map management unit (148). The map management unit (148) may then send the provided location initialization information to the first smart logistics vehicle (110-1) so that the first smart logistics
20 vehicle (110-1) can perform re-localization. In this case, the re-localization may be performed based on the new location information included in the location initialization information.

[137] For example, referring to FIG. 7, when the first smart
25 logistics vehicle (110-1) is determined to be located at

position A and to require re-localization to position B, the location initialization information generation unit (150) may generate the location initialization request information that includes at least one of speed required for the first smart
5 logistics vehicle (110-1) to move from position A to position B, new location information including coordinate information for position B, heading direction information for moving from position A to position B, and rotation angle information required to adjust the current heading direction of the first
10 smart logistics vehicle (110-1) to move from position A to position B.

[138] The location initialization information generation unit (150) may transmit the generated location initialization information to the map management unit (148), the map
15 management unit (148) may transmit the generated location initialization information to the first smart logistics vehicle (110-1) located at position A, and the first smart logistics vehicle (110-1) may then perform re-localization from position A to position B based on the transmitted
20 location initialization information. However, this is merely illustrative and is not necessarily limited thereto. For example, the location initialization information generation unit (150) may generate the location initialization information so that the first smart logistics vehicle (110-1)
25 performs re-localization not based on a specific position

(position A or position B) of the first smart logistics vehicle (110-1) but rather based on a specific zone (such as zone 1 or zone 3) that includes the specific location of the first smart logistics vehicle (110-1). Additionally, the re-
5 localization may be performed by manually operating the first smart logistics vehicle (110-1) by considering at least one of the state of the first smart logistics vehicle (110-1) and the situation of the smart factory (100).

[139]

10 **[140]** Referring back to FIG. 6, the first smart logistics vehicle (110-1) may perform re-localization based on the location initialization information generated and transmitted by the map management unit (148). In addition, the first smart logistics vehicle (110-1) performing the re-
15 localization based on the location initialization information may transmit information on the updated location to the control device (140). The control device (140) may then control the first smart logistics vehicle (110-1) to resume the mission, which had been interrupted due to the
20 determination that the map matching rate is degraded, at the updated location.

[141]

[142] Hereinafter, based on the configuration of the smart logistics vehicle control device described above with
25 reference to FIGS. 6 to 7, a smart logistics vehicle control

method according to an embodiment will be described with reference to FIG. 8. As described with reference to FIGS. 6 and 7, even when the control system includes the plurality of smart logistics vehicles (110-1, 110-2, 110-3), the functions of the smart logistics vehicle control device (140) may be applied in the same manner to each of the plurality of smart logistics vehicles (110-1, 110-2, 110-3). Therefore, for convenience of description, each function of the smart logistics vehicle control device (140) and a single smart logistics vehicle (110) will be described.

[143] FIG. 8 is a diagram illustrating the smart logistics vehicle control method according to an embodiment of the present disclosure.

[144] Referring to FIG. 8, the smart logistics vehicle control device (140) may collect the location information of the smart logistics vehicle (110) by receiving the location information from the communication unit (114) of the smart logistics vehicle (110) via the communication unit (146) (S801). In addition, the communication unit (146) may transmit the collected location information to the map management unit (148) (S802).

[145] The map management unit (148) may preselect map data corresponding to the location information collected based on the collected location information (S803). In addition, the map management unit (148) may transmit information on the

selected map data to the communication unit (146) (S804), and the control device (140) may transmit a control command to the communication unit (114) of the smart logistics vehicle (110) through the communication unit (146) so that the smart logistics vehicle (110) executes the mission based on the map data (S805-1). In addition, the communication unit (114) may transmit the transmitted control command to the control unit (115) (S805-2) so that the control unit (115) controls the smart logistics vehicle (110) based on the control command.

10 **[146]** While the smart logistics vehicle (110) is executing the mission thereof based on the map data, the sensing unit (112) may collect surrounding sensing data and provide the surrounding sensing data to the control unit (115) (S806). In addition, the control unit (115) may determine the map matching rate based on the pre-shared map data and the collected surrounding sensing data (S807).

15 **[147]** The control unit (115) may transmit information on the determined map matching rate to the communication unit (114) (S808-1), and the communication unit (114) may transmit the information on the map matching rate determined by the control unit (115) to the communication unit (146) of the control device (140) (S808-2). In this case, the control unit (115) may determine both the map matching rate and whether the map matching rate is equal to or below a preset reference matching rate, or alternatively, the control unit (115) may determine

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only the map matching rate while the map management unit (148) determines whether the map matching rate is equal to or below the preset reference matching rate.

[148] The map management unit (148) may receive the
5 information on the map matching rate from the communication unit (146) (S809), and may determine whether there exists a smart logistics vehicle (110) which has determined the map matching rate to be equal to or below a preset reference matching rate (S810).

10 **[149]** When there is a smart logistics vehicle (110) which has determined the map matching rate to be equal to or below the preset reference matching rate, the map management unit (148) may request location initialization information for the corresponding smart logistics vehicle from the location
15 initialization information generation unit (150) (S811).

[150] In addition, the location initialization information generation unit (150) may determine the current location of the corresponding smart logistics vehicle and generate the location initialization information based on the determined
20 current location (S812). A detailed description of this is omitted here since it has been described above with reference to FIGS. 6 and 7. Subsequently, the location initialization information generation unit (150) may transmit the generated location initialization information to the map management unit
25 (148) (S813-1).

[151] The map management unit (148) transmits the location initialization information to the communication unit (114) of the smart logistics vehicle (110) (S813-2), and the communication unit (114) may transmit the transmitted
5 information back to the control unit (115) (S813-3). Then, the control unit (115) may perform re-localization based on the location initialization information (S814).

[152] Subsequently, the control unit (115) may determine the updated location of the smart logistics vehicle (110) after
10 performing the re-localization and may transmit the information on the determined updated location to the control device (140) through the communication unit (114) (S815-1, S815-2).

[153]

[154] According to the control method and control system for the smart logistics vehicle according to the above-described embodiment of the present disclosure, the smart logistics vehicle performs re-localization when a map matching rate is low based on information on the map matching rate, thereby
20 effectively correcting the current location of the smart logistics vehicle when the smart logistics vehicle misrecognizes the position thereof.

[155]

[156] Although the present disclosure has been illustrated and
25 described with respect to specific embodiments, it will be

apparent to those skilled in the art that the present disclosure may be variously modified and altered without departing from the technical spirit of the present disclosure as provided by the following claims.

5 [157] The present disclosure described above can be implemented as computer-readable code on a program-recorded medium. Computer-readable media include all types of recording devices that store data that can be read by a computer system. Examples of computer-readable media include
10 a hard disk drive (HDD), a solid state disk (SSD), a silicon disk drive (SDD), ROM, RAM, a CD-ROM, a magnetic tape, a floppy disk, and an optical data storage device, etc. Accordingly, the above detailed description should not be construed as restrictive in all respects and should be
15 considered illustrative. The scope of the present disclosure must be determined by reasonable interpretation of the attached claims, and all changes within the equivalent scope of the present disclosure are included in the scope of the present disclosure.

20 [158]

[159] <Description of the Reference Numerals in the Drawings>

[160] 100: Smart factory

[161] 110: Smart logistics vehicle

[162] 120: Production device

25 [163] 130: Monitoring device

[164] 140: Control device

CLAIMS

[Claim 1] A smart logistics vehicle control method comprising:

5 controlling a smart logistics vehicle to execute a mission based on pre-shared map data;

 receiving information on a map matching rate determined based on the map data from the smart logistics vehicle during the mission execution; and

10 transmitting location initialization information to the smart logistics vehicle so that the smart logistics vehicle performs re-localization based on the received information on the map matching rate.

15 [Claim 2] The method of claim 1, wherein the map data comprises point cloud data mapped based on a location of the smart logistics vehicle during execution of a previous mission of the smart logistics vehicle.

20 [Claim 3] The method of claim 1, wherein the controlling comprises:

 collecting location information of a smart logistics vehicle;

 sharing map data corresponding to the collected location
25 information; and

controlling the smart logistics vehicle to execute a mission based on the shared map data.

[Claim 4] The method of claim 1, wherein the receiving
5 comprises receiving the information on the map matching rate determined based on surrounding sensing data collected by the smart logistics vehicle during the mission execution and the map data.

10 [Claim 5] The method of claim 4, wherein the surrounding sensing data comprises point cloud data mapped by the smart logistics vehicle sensing surroundings thereof during the mission execution.

15 [Claim 6] The method of claim 4, wherein the surrounding sensing data is collected by the smart logistics vehicle when the smart logistics vehicle reaches a specific location during the mission execution or periodically at each preset reference time.

20

[Claim 7] The method of claim 1, wherein the receiving
comprises receiving the information on the map matching rate when the determined map matching rate is equal to or below a preset reference matching rate, the information comprising a
25 warning notification generated by the smart logistics vehicle.

[Claim 8] The method of claim 1, wherein the location initialization information comprises at least one of speed, new location information, heading direction information, and
5 rotation angle information of the smart logistics vehicle.

[Claim 9] The method of claim 1, wherein the transmitting comprises transmitting the location initialization information to a smart logistics vehicle, which has determined the map
10 matching rate to be equal to or below a preset reference matching rate based on the received information on the map matching rate, so that the smart logistics vehicle performs re-localization.

15 [Claim 10] The method of claim 9, wherein the transmitting comprises:

determining a current location of the smart logistics vehicle, which has determined the map matching rate to be equal to or below the reference matching rate, when the smart
20 logistics vehicle is identified;

generating the location initialization information of the smart logistics vehicle based on the determined current location; and

transmitting the generated location initialization
25 information to the smart logistics vehicle so that the smart

logistics vehicle performs the re-localization.

[Claim 11] The method of claim 10, wherein the determining comprises determining the current location of the smart logistics vehicle based on at least one of surrounding recognition information of at least one other smart logistics vehicle located around the smart logistics vehicle and signal information of each of a plurality of communication devices located around the smart logistics vehicle.

10

[Claim 12] The method of claim 1, further comprising:
collecting updated location information of the smart logistics vehicle that has performed the re-localization based on the location initialization information after the transmitting.

15

[Claim 13] A smart logistics vehicle control device comprising:

a communication unit configured to communicate with at least one smart logistics vehicle; and

20

a map management unit configured to control the at least one smart logistics vehicle to execute a mission based on pre-shared map data, to receive information on a map matching rate determined based on the map data from the at least one smart logistics vehicle during the mission execution, and to

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transmit location initialization information to the at least one smart logistics vehicle so that the at least one smart logistics vehicle performs re-localization based on the received information on the map matching rate.

5

[Claim 14] The device of claim 13, wherein the map management unit further configured to collect location information of the at least one smart logistics vehicle through the communication unit, shares map data corresponding to the collected location information, and controls the at least one smart logistics vehicle to execute a mission based on the shared map data.

[Claim 15] The device of claim 13, wherein the map management unit further configured to receive, through the communication unit, the information on the map matching rate determined based on surrounding sensing data collected by the at least one smart logistics vehicle during the mission execution and the map data.

20

[Claim 16] The device of claim 15, wherein the at least one smart logistics vehicle collects the surrounding sensing data when the at least one smart logistics vehicle reaches a specific location during the mission execution or periodically at each preset reference time.

[Claim 17] The device of claim 13, wherein the map management unit further configured to receive, through the communication unit, the information on the map matching rate
5 when the determined map matching rate is equal to or below a preset reference matching rate, the information comprising a warning notification generated by the at least one smart logistics vehicle.

10 [Claim 18] The device of claim 13, wherein the map management unit further configured to determine whether there exists a smart logistics vehicle among the at least one smart logistics vehicle which has determined the map matching rate to be equal to or below a preset reference matching rate based
15 on the received information on the map matching rate, and to transmit the location initialization information to the smart logistics vehicle, which has determined the map matching rate to be equal to or below the reference matching rate, so that the smart logistics vehicle performs re-localization.

20

[Claim 19] The device of claim 18, wherein the map management unit further configured to receive location initialization information generated based on a current location of the smart logistics vehicle among the at least one
25 smart logistics vehicle, which has determined the map matching

rate to be equal to or below the reference matching rate, when the smart logistics vehicle is identified, and transmits the received location initialization information to the smart logistics vehicle so that the smart logistics vehicle performs
5 the re-localization.

[Claim 20] The device of claim 13, wherein the map management unit further configured to collect updated location information of the at least one smart logistics vehicle that
10 has performed the re-localization based on the location initialization information after transmitting the location initialization information.