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UPDATING DEVICE

Abstract

An updating device for updating software stored in a moving object includes a memory storing program instructions and a processor configured to execute the program instructions to determine whether or not an updating of the software is possible. In a first case that update target information satisfies a predetermined condition; the processor executes the program instructions to determine whether or not the updating of the software is possible by a first method. In a second case that the update target information does not satisfy the predetermined condition, the processor executes the program instructions to determine whether or not the updating of the software is possible by a second method that has a higher security level than the first method.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority based on the Japanese application of the application number 2024-022675, filed Feb. 19, 2024, the entire disclosure of which is hereby incorporated by reference.

BACKGROUND

Field

[0002] This disclosure relates to an updating device.

Related Art

[0003] A technique for operating a vehicle unmanned by remote control in a manufacturing process of a vehicle is known (for example, refer to JP2017-538619A).

[0004] Software for controlling a vehicle may need to be updated if a problem occurs in a vehicle manufacturing process. It is necessary to carry out the predetermined certification procedure for the update of the software concerned, and there is a problem that the time required for the update of the software increases for the certification procedure. On the other hand, if the security level of the authentication condition is lowered, it becomes difficult to guarantee the security of the software. Such issues are not limited to a vehicle, but also apply to any moving object.

SUMMARY

[0005] In accordance with one aspect of the present disclosure, there is provided an updating device for updating software stored in a moving object. The control device includes a memory storing program instructions and a processor configured to execute the program instructions to determine whether or not an updating of the software is possible. In a first case that update target information satisfies a predetermined condition, the processor executes the program instructions to determine whether or not the updating of the software is possible by a first method. In a second case that the update target information does not satisfy the predetermined condition, the processor executes the program instructions to determine whether or not the updating of the software is possible by a second method that has a higher security level than the first method.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a conceptual diagram showing the configuration of a system of the first embodiment,

[0007] FIG. 2 is a block diagram showing a configuration of a system of the first embodiment,

[0008] FIG. 3 is a flow chart showing the process of the travel control of a vehicle in the first embodiment,

[0009] FIG. 4 is a flow chart showing the procedure of the updating process in the first embodiment,

[0010] FIG. 5 is a flow chart showing the procedure of the updating process in the second embodiment,

[0011] FIG. 6 is a block diagram showing a configuration of a system in the third embodiment, and

[0012] FIG. 7 is a flow chart showing the process of the travel control of a vehicle according to the third embodiment.

DETAILED DESCRIPTION

A. First Embodiment

A-1. System Configuration:

[0013] FIG. 1 is a conceptual diagram showing the configuration of system 10 of the first

embodiment. System **10** comprises one or more vehicle **100** as a moving object, a server device **200**, one or more external sensor **300**, and a process control device **400** that controls the fabrication of the vehicle **100** in a plant FC.

[0014] In this disclosure, “the moving object” or “moving objects” means a moving object or moving objects, such as a vehicle or an electrically powered vertical takeoff and landing vehicle (so-called flying vehicle). The vehicle may be a vehicle driven by wheels or a vehicle driven by infinite tracks, for example, passenger cars, trucks, buses, motorcycles, automobiles, tanks, construction a vehicle, and the like. The vehicle includes electric vehicle (BEV: Battery Electric Vehicle), gasoline-powered vehicle, hybrid-powered vehicle, and fuel-cell vehicle. When the moving object is other than a vehicle, the expression “a vehicle” and “vehicles” in the present disclosure can be appropriately replaced with “a moving object,” and the expression “driving” can be appropriately replaced with “moving.”

[0015] The vehicle **100** is configured to be able to travel by unmanned driving. “Unmanned driving” means driving that does not depend on the traveling operation of the passenger. Traveling operation means an operation relating to “running”, “turning” or “stopping” of the vehicle **100**. Unmanned driving may be accomplished by automated or manual remote control using a device located external to the vehicle **100**, or by autonomous control of the vehicle **100**. An occupant who does not perform the traveling operation may be aboard the vehicle **100** that is traveling by unmanned driving. The passengers who do not perform the traveling operation include, for example, those who are simply seated in the seats of the vehicle **100** and those who are performing operations that differ from the traveling operation such as assembling, inspecting, and operating switches on the vehicle **100**. Incidentally, the driving by the traveling operation of the passenger is sometimes referred to as “manned driving”.

[0016] In this specification, “remote control” includes “full remote control” in which all of the operations of the vehicle **100** are completely determined from the outside of the vehicle **100**, and “partial remote control” in which a part of the operations of the vehicle **100** are determined from the outside of the vehicle **100**. Further, “autonomous control” includes “fully autonomous control” in which the vehicle **100** autonomously controls the operation of itself without receiving any information from the device outside the vehicle **100**, and “partially autonomous control” in which the vehicle **100** autonomously controls the operation of itself using information received from the device outside the vehicle **100**. In the following explanation, the control for the traveling of the vehicle **100** realized by remote control or autonomous control is also referred to as “traveling control”. The travel control corresponds to “movement control” in the present disclosure.

[0017] In this embodiment, system **10** is used in the plant FC of manufacturing the vehicle **100**. The plant FC frame of reference is the global coordinate system GC. That is, any position in the plant FC is represented by X,Y,Z coordinates in the global coordinate system GC. The plant FC has a 1st location PL1 and the 2nd location PL2. The 1st location PL1 and the 2nd location PL2 are connected by a runway TR on which the vehicle **100** can travel. The plant FC has a number of external sensors **300** installed along the runway TR. The position of the external sensor **300** in the plant FC is pre-adjusted. The **100v** . . . the vehicle **100** moves through the runway TR from the 1st location PL1 to the 2nd location PL2 by unmanned operation.

[0018] The external sensor **300** is a sensor located outside the vehicle **100** and acquires information about the vehicle **100**. The external sensor **300** in this embodiment is a sensor for capturing the vehicle **100** from the outside of the vehicle **100**. Specifically, the external sensor **300** is configured by a camera. Camera as the external sensor **300** captures a captured image including the vehicle **100**, and outputs a captured image as a detected result. The external sensor **300** includes a communication device (not shown) and is capable of communicating with other devices, such as the server device **200**, via wired or wireless communication.

[0019] FIG. 2 is a block diagram showing a configuration of the system **10** of the first embodiment. The vehicle **100** includes a vehicle controller **110** for controlling the various parts of the vehicle

100, an actuator group **120** including one or more actuators driven under the control of the vehicle controller **110**, and a communication device **130** for wireless communication with an external the device such as a server device **200**. The actuator group **120** includes an actuator of the drive the device for accelerating the vehicle **100**, an actuator of the steering the device for changing the heading of the vehicle **100**, and an actuator of the braking the device for decelerating the vehicle **100**. In addition, the vehicle **100** may include various sensors (not shown) such as a vehicle speed sensor and a yaw rate sensor.

[0020] The vehicle controller **110** is constituted by a computer including a processor **111**, a memory **112**, an input/output interface **113**, and an internal bus **114**. Processor **111**, memory **112**, and the input/output interface **113** are connected to be able to communicate in both directions via internal bus **114**. An actuator group **120** and interface are connected to the input/output interface **113**. The processor **111** implements various functions including functions as the vehicle controller **115** by executing a program PG1 stored in memory **112**. In this embodiment, the processor **111** functions as a vehicle controller **115**, a determination part **116**, a permitting part **117**, and a renewal part **118**.

[0021] The vehicle controller **115** drives the vehicle **100** by controlling the actuator group **120**. The vehicle controller **115** can drive the vehicle **100** by controlling the actuator group **120** using the travel control signaling received from the server device **200**. The travel control signal is a control signal for traveling the vehicle **100**. In the present embodiment, the travel control signaling includes the accelerations and steering angles of the vehicle **100** as parameters. In other embodiments, the travel control signaling may include the velocity of the vehicle **100** as a parameter in lieu of or in addition to the accelerations of the vehicle **100**.

[0022] The determination part **116** determines whether the software stored in the vehicle **100** can be updated. In the present exemplary embodiment, the determination part **116** determines whether or not to update the software by determining whether or not the authentication information output from the terminal device **500** satisfies the authentication condition. The terminal device **500** is a device that is operated by the user to update the software stored in the vehicle **100**. In the present exemplary embodiment, the program PG1 stored in the memory **112** of the vehicle **100** corresponds to “software.” Incidentally, the “software” is not limited to the program PG1 and includes software previously stored in the memory **112** and, if required, downloaded from the server device **200** and stored in the memory **112**, and includes software for implementing various functions for, for example, part assembly and inspection processes executed in the manufacturing process of the vehicle **100**. The terminal device **500** may be provided with a plurality in the plant FC, also may be provided only one. The terminal device **500** is not limited to a stationary device as shown in FIG. 1 but may be a portable terminal such as a smartphone.

[0023] When updating the software, the terminal device **500** outputs the authentication data to the vehicle **100** to be updated. “Credentials” means the information used to determine whether or not software can be updated in the update process to be described later. The authentication information includes, for example, the login password of the application for updating the software, the user ID that identifies the user that executes the updating process, the device ID that identifies the terminal device **500** that executes the updating process, and the information that specifies the software to be updated.

[0024] The permitting part **117** allows the terminal device **500** to renew software when it determines that the credentials meet the credentials. When software update is permitted, the renewal part **118** updates the software in response to a software update request made by the terminal device **500**. That is, the renewal part **118** updates the software if it determines that the credentials meet the credentials. Processor **111** may not include a permitting part **117**.

[0025] As described above, the vehicle controller **110** of this embodiment functions as the determination part **116**, the permitting part **117**, and the renewal part **118** to update the software stored in the vehicle **100** when the authentication information satisfies the authentication condition. That is, the vehicle controller **110** of the present embodiment corresponds to the “updating device”

in the present disclosure.

[0026] The server device **200** consists of a computer with processor **201**, the memory **202**, the input/output interface **203** and the internal bus **204**. Processor **201**, memory **202**, and the input/output interface **203** are connected to be able to communicate in both directions via internal bus **204**. The input/output interface **203** is connected to a communication device **205** for communication with various the device external to the server device **200**. The communication device **205** may communicate with the vehicle **100** via wireless communication and may communicate with the external sensor **300** and the process control device **400** via wired or wireless communication.

[0027] The processor **201** implements various functions, including functions as a remote control part **210**, by executing the program PG2 stored in memory **202**. In this embodiment, processor **201** functions as a remote control part **210** and a corresponding part **211**.

[0028] The remote control part **210** acquires the detection result by the external sensor **300**. The remote control part **210** causes the vehicle **100** to travel by remote control by generating a travel control signal instructing control details of the actuator group **120** of the vehicle **100** using the acquired detection result and transmitting the travel control signal to the vehicle **100**. The processing procedure of the travel control realized by the remote control of the present embodiment will be described later. The remote control part **210** may generate and output not only a travel control signal but also a control signal for controlling various accessories provided in the vehicle **100** and actuators for operating various equipment such as a wiper, a power window, and a lamp. That is, the remote control part **210** may operate such various equipment and various accessories by remote control.

[0029] The corresponding part **211** responds to an inquiry when there is an inquiry from the determination part **116** in the updating process described below. The process of the corresponding part **211** when there is an inquiry from the determination part **116** will be described later.

[0030] The process control device **400** is a device for controlling the manufacturing process of the vehicle **100**. The process control device **400** is constituted by a computer. The process control device **400** acquires information from various the plant FC facilities, generates information on the manufacturing process of the vehicle **100**, and manages it for each the vehicle **100**. In the following description, the information about the manufacturing process of the product is referred to as process information. In the present embodiment, the process information includes information indicating when, where, and which worker is to perform what work in which product, information indicating when, where, and where, and which worker has performed what work, and information indicating the progress of the work. The process control device **400** is equipped with a communication device not shown and transmits process data to the server device **200** via wired or wireless communication. The function of the process control device **400** may be implemented on the same device as that of the server device **200**. Further, system **10** may not include a process control device **400**.

A-2. Drive Control:

[0031] FIG. **3** is a flow chart showing a process sequence of the travel control of the vehicle **100** in the first embodiment. In step **S1**, the remote control part **210** acquires a vehicle position data of the vehicle **100** using the detected data output from the external sensor **300**. The vehicle location information is the underlying location information that generates the travel control signaling. In this embodiment, a vehicle location includes the location and orientation of the vehicle **100** in the plant FC's global coordinate system GC. Specifically, in step **S1**, the remote control part **210** acquires a vehicle position data using the captured images acquired from the cameras that are the external sensor **300**.

[0032] Specifically, in the step **S1**, the remote control part **210** acquires the position of the vehicle **100**, for example, by detecting the outer shape of the vehicle **100** from the captured image, calculating the coordinates of the positioning point of the vehicle **100** in the coordinate system of

the captured image, that is, the local coordinate system, and converting the calculated coordinates into the coordinates in the global coordinate system GC. The external shape of the vehicle **100** included in the captured image can be detected by, for example, inputting the captured image into an artificial intelligent the detection-model DM. The detection-model DM is prepared, for example, in the system **10** or outside of the system **10** and pre-stored in memory **202** of the server device **200**. The detection-model DM includes, for example, trained machine-learning modeling that is trained to realize either semantic segmentation or instance segmentation. As the machine learning model, for example, a convolutional neural network (hereinafter, CNN) learned by supervised learning using a data set for learning can be used. The training dataset includes, for example, a plurality of training images including the vehicle **100** and labels indicating whether each area in the training image is an area indicating the vehicle **100** or an area indicating other than the vehicle **100**. When CNN is learned, the parameters of CNN are preferably updated by back propagation to reduce the error between the detection-model DM and the labeling. In addition, the remote control part **210** can acquire the orientation of the vehicle **100** by estimating, for example, based on the orientation of the moving vector of the vehicle **100** calculated from the positional change of the minutiae of the vehicle **100** between the frames of the captured images using the optical flow method.

[0033] In step S2, the remote control part **210** determines a target position to which the vehicle **100** is to be directed next. In the present embodiment, the target position is represented by the coordinates of X, Y, Z in the global coordinate system GC. The memory **202** of the server device **200**, the reference path RR is previously stored, which is the route the vehicle **100** should travel. The path is represented by a node indicating the starting point, a node indicating the transit point, a node indicating the destination, and a link connecting each node. The remote control part **210** uses a vehicle location data and the reference path RR to determine the target location to be directed to by the vehicle **100** next. The remote control part **210** determines the target position on the reference path RR prior to the current location of the vehicle **100**.

[0034] In step S3, the remote control part **210** generates a travel control signaling to cause the vehicle **100** to travel toward the determined target position. The remote control part **210** calculates the traveling speed of the vehicle **100** from the transition of the position of the vehicle **100** and compares the calculated traveling speed with the target speed. Overall, the remote control part **210** determines the acceleration so that the vehicle **100** accelerates when the traveling speed is lower than target speed and determines the acceleration so that the vehicle **100** decelerates when the traveling speed is higher than target speed. In addition, the remote control part **210** determines the steering angle and acceleration so that the vehicle **100** does not deviate from the reference path RR when the vehicle **100** is positioned on the reference path RR, and determines the steering angle and acceleration so that the vehicle **100** may return to the reference path RR when the vehicle **100** is not positioned on the reference path RR, in other words, when the vehicle **100** is deviated from the reference path RR.

[0035] In step S4, the remote control part **210** transmits the generated travel control signaling to the vehicle **100**. At a predetermined cycle, the remote control part **210** repeats acquiring the position of the vehicle **100**, determining the target position, generating the travel control signal, and transmitting the travel control signal.

[0036] In step S5, the vehicle controller **115** receives a transit control signaling from the server device **200**. In step S6, the vehicle controller **115** uses the received travel control signal to control the actuator group **120** so as to drive the vehicle **100** at the accelerations and steering angles indicated by the travel control signal. The vehicle controller **115** repeats receiving the travel control signal and controlling the actuator group **120** at predetermined intervals. According to the system **10** of the present exemplary embodiment, the vehicle **100** can be driven by remote control, and the vehicle **100** can be moved without using a transportation facility such as a crane or a conveyor.

A-3. Updating Process:

[0037] FIG. 4 is a flow chart showing the sequence of the updating process in the first embodiment. The “updating process” is a process of updating the software stored in the vehicle **100** according to a request from the terminal device **500**. The terminal device **500** outputs the above-mentioned credentials when a predetermined start operation is entered by the user, and the update processing starts when the credentials are output from the terminal device **500**.

[0038] In step **S102**, the determination part **116** acquires the certification data outputted from the terminal device **500**.

[0039] In step **S104**, the determination part **116** determines whether or not the vehicle **100** is present in a software-updatable environment. The term “environment in which software can be updated” means an environment that is preset as an environment that does not interfere with control of the vehicle **100** even when software updating is executed. The determination part **116** determines that the software is present in an environment in which the vehicle **100** can update the software when, for example, “the vehicle **100** is stopped and the software to be updated is not in use” is set, and the determination part **116** matches when the present environment of the vehicle **100** is applied. If it is determined that there is no software in the updatable environment (**S104**: No of steps), the permitting part **117** disables the software-related update, and the update process ends.

[0040] If it is determined to be present in the updating environment (step **S104**: Yes), at step **S106**, the determination part **116** determines whether or not the determination of the step **S108** to be described later can be performed at the vehicle **100**. As will be described later, in the present embodiment, the determination is performed using the position information of the vehicle **100** in step **S108**. “The vehicle **100** location information” is information regarding the vehicle **100** to be updated and corresponds to “the update target information” in this disclosure. In step **S106**, when the vehicle **100** grasps the position of itself, the determination part **116** determines that the determination of the step **S108** can be executed in the vehicle **100**. “When the vehicle **100** grasps the position information of itself” means, for example, when the vehicle **100** receives and stores the position information of the vehicle **100** together with the travel control signal or when the vehicle **100** includes a position sensor such as a GPS sensor and the position information of the vehicle **100** is detected by the position sensor.

[0041] If it is determined to be able to be determined by the vehicle **100** (step **S106**: Yes), it is determined whether or not the vehicle **100** is located in the plant FC by the determination part **116** at the step **S108**. “In the plant FC” corresponds to “a predetermined area” in the present disclosure. Further, “the vehicle **100** is located in the plant FC” corresponds to “a predetermined conditional” in the present disclosure.

[0042] If it is determined by the vehicle **100** that the determination cannot be made (Step **S106**: No), the determination part **116** inquiries about the server device **200** in Step **S110**. Upon receipt of the query, at the server device **200**, the corresponding part **211** responds to the determination part **116** with a vehicle location described above. In addition, instead of a vehicle position information, the corresponding part **211** may answer to the determination part **116** when it determines whether or not the vehicle **100** is located in plant FC by using a vehicle position information. Thereafter, the determination part **116** performs **S108** of steps described above.

[0043] If it is determined that the vehicle **100** is located within the plant FC (step **S108**: Yes), in Step **S112**, the determination part **116** determines whether or not the authentication information satisfies the first authentication condition. Here, “determining whether or not the authentication information satisfies the first authentication condition” corresponds to determination by “the first method” in the present disclosure. In the present exemplary embodiment, the determination part **116** determines whether or not the login password is correct as the first authentication criterion. Instead of determining whether or not the log-in password is correct, the determination part **116** may determine whether or not the terminal device **500** the user is the person having the software update permission or whether or not the terminal device **500** is approved as a device capable of performing the software update. “The **100v** . . . the vehicle **100** is determined to be located in the

plant FC” corresponds to “the first case” in the present disclosure.

[0044] When it is determined that the first authentication condition is satisfied (step S112: Yes), at step S116, the permitting part 117 permits the software update to the terminal device 500, and at step S118, the renewal part 118 updates the software corresponding to the update contents of the software by the terminal device 500. After that, the update processing ends.

[0045] If it is determined that the first authentication condition is not satisfied (step S112: No), in step S120, the permitting part 117 does not permit updating of the software. After that, the update processing ends.

[0046] If it is determined in the above-described step S108 that the vehicle 100 is not located in the plant FC (step S108: No), in the step S114, the determination part 116 determines whether or not the authentication information satisfies the second authentication condition. Here, “determining whether or not the authentication information satisfies the second authentication condition” corresponds to determination by “the second method” in the present disclosure. In the present embodiment, the determination part 116 determines, as the second authentication criterion, whether or not the login password is correct, whether or not the user of the terminal device 500 is a person who has the software update authority, and whether or not the terminal device 500 is approved as a device that updates the software. In other words, the second authentication condition has many conditions that should be satisfied compared with the first authentication condition. Therefore, the second authentication condition may be higher in security level than first authentication condition, while the second method using the second authentication condition has a higher security level than first method using the first authentication condition. “The vehicle 100 is determined not to be located in the plant FC” corresponds to “the second case” in the present disclosure.

[0047] If it is determined that the second authentication criterion is satisfied (step S114: Yes), the above-described step S116 and step S118 are performed. After that, the update processing ends.

[0048] If it is determined that the second authentication criterion is not satisfied (step S114: No), the above-described step S120 is executed. After that, the update processing ends.

[0049] As described above, in the present embodiment, when it is determined that the vehicle 100 is located in the plant FC, the authentication is performed by the first authentication condition having a lower security level than second authentication condition when it is determined that the vehicle 100 is not located in the plant FC. If the vehicle 100 is located in plant FC, then the software-update operator is likely to be limited to the plant FC operator because of the lower security risk compared to when the vehicle 100 is located outside the plant FC. That is, generally, the determination part 116 appropriately uses the first method using the first authentication condition and the second method using the second authentication condition according to a predetermined condition related to a security risk for updating software. In addition, if the vehicle 100 is located in the plant FC and he tries to update the software, it is considered that he is trying to eliminate some kind of problem that occurred in the manufacturing process of the vehicle 100, because prompt action is required.

[0050] According to the system 10 of the first embodiment described above, when it is determined that the vehicle 100 is located in the plant FC, as the authentication condition, it is determined whether or not the first authentication condition is satisfied, and when it is determined that the vehicle 100 is not located in the plant FC, as the authentication condition, it is determined whether or not the second authentication condition having a higher security level than first authentication condition is satisfied. Therefore, when it is determined that the vehicle 100 is located in the plant FC, the authentication can be easily performed by the first authentication condition having a lower security level compared to the second authentication condition, and thus an increase in the duration for updating the software can be suppressed. Further, when it is determined that the vehicle 100 is not located in the plant FC, the authentication can be performed by the second authentication condition having a higher security level compared to the first authentication condition, and the deterioration of the security level can be suppressed compared to the form in which the

authentication is performed constantly according to the first authentication condition.

[0051] In addition, the first certification condition and the second certification condition can be appropriately used depending on whether or not the vehicle **100** is located in the plant FC.

B. Second Embodiment

[0052] FIG. **5** is a flow chart showing the sequence of the updating process in the second embodiment. As shown in FIG. **5**, the system **10** of the second embodiment is different from the system **10** of the first embodiment in that, in the updating process, step **S108** is replaced with step **S108a**. Since another procedure in the system **10** the device configuration and updating process of the second embodiment is the same as the system **10** of the first embodiment, the same configuration and the same procedure are denoted by the same reference numerals, and a detailed description thereof will be omitted.

[0053] In the step **S106** shown in FIG. **5**, the determination part **116** determines whether or not the determination of the step **S108a** to be described later can be performed on the vehicle **100**. As will be described later, in the present embodiment, in step **S108a** determination according to the application of the software to be updated is performed. “Applications of the software to be updated” are related to the software to be updated and correspond to “the update target information” in this disclosure. In the step **S106** of the present embodiment, when the software for controlling the vehicle **100** is stored in the memory **112** of the vehicle **100** so as to be able to determine the purpose of use, the determination part **116** determines that the determination of the step **S108a** can be executed in the vehicle **100**. For example, when the software for controlling the vehicle **100** is recognizably stored, for example, when the database for managing the application of each software is stored in the memory **112** in advance, or when the extension of each software is predetermined according to the application of each software.

[0054] When it is determined to be able to be determined in the vehicle **100** (step **S106**: Yes), the determination part **116** determines whether or not the use of the software to be updated is for the plant in step **S108a**. In this case, “the software to be updated is for the plant” means that the software is used when the vehicle **100** exists in the plant FC and is not used when the vehicle **100** exists outside the plant FC. More specifically, “software used when the vehicle **100** is present in the plant FC and not used when the vehicle **100** is present outside the plant FC” corresponds to software used to realize various functions for the component assembly process and the inspection process executed in the manufacturing process of the vehicle **100**, and does not include software used to realize functions that can be used by the user of the vehicle **100** after shipping of the vehicle **100**, for example, a software used to realize an object detecting function using an in-a vehicle sensor.

[0055] For example, in the above-described database, when the application of the software to be updated is said to be for the plant, or when the extension of the software to be updated is the same as the extension predetermined as the extension indicating that the extension is for the plant, the determination part **116** determines that the application of the software is for the plant. “The purpose of the software to be updated is for the plant” corresponds to “predetermined conditions” in the present disclosure.

[0056] If it is determined by the vehicle **100** that the determination cannot be made (step **S106**: No), the determination part **116** inquiries about the server device **200** in step **S110**. Upon receiving an inquiry, at the server device **200**, the corresponding part **211** answers to the determination part **116** the use of the software to be updated. For example, the corresponding part **211** identifies the application of the software to be updated by referring to a pre-stored database that manages the application of the software and responds to the determination part **116** for the specified application. Instead of using the software to be updated, the corresponding part **211** may answer to the determination part **116** when it determines whether or not the intended use is for the plant. Thereafter, the determination part **116** performs step **S108a** described above.

[0057] If it is determined that the application of the software to be updated is for the plant (step

S108a: Yes), the determination part **116** executes the above-described step **S112**. “When it is determined that the use of the software to be updated is for the plant” corresponds to “the first case” in the present disclosure. On the other hand, when it is determined that the use of the software to be updated is not for the plant (step **S108a:** No), the determination part **116** executes the above-described step **S114**. “When it is determined that the use of the software to be updated is not for the plant” corresponds to “the second case” in the present disclosure.

[0058] As described above, in the present embodiment, when it is determined that the use of the software to be updated is for the plant, the authentication is performed by the first authentication condition having a lower security level than second authentication condition when it is determined that the use of the software to be updated is not for the plant. When the application of the software to be updated is for the plant, the software to be updated is not used for the vehicle **100** the user, so it can be said that the effect of software updating on the user of the vehicle **100** is minimal. In addition, when updating the plant software, it is probable that the vehicle **100** is trying to eliminate some kind of problem that occurred in the manufacturing process, and prompt action is required.

[0059] According to the system **10** of the second embodiment described above, when it is determined that the use of the software to be updated is for the plant, it is determined as the authentication condition whether the first authentication condition is satisfied, and when it is determined that the use of the software to be updated is not for the plant, it is determined as the authentication condition whether the second authentication condition having a higher security level than first authentication condition is satisfied. Therefore, the first certification condition and the second certification condition can be properly used depending on whether the software to be updated is for the plant or not.

C. Third Embodiment

[0060] FIG. **6** is a block diagram showing a configuration of a system **10v** in the third embodiment. In the present embodiment, the system **10v** differs from the first embodiment in that it does not include the server device **200**. In addition, the vehicle **100v** according to this embodiment can be driven by the autonomous control of the vehicle **100v**. For other configurations, unless otherwise described, it is the same as the first embodiment.

[0061] In the present exemplary embodiment, the processor **111v** of the vehicle controller **110v** functions as a vehicle controller **115v**, a determination part **116**, a permitting part **117**, and a renewal part **118** by executing a program **PG1** stored in a memory **112v**. The vehicle controller **115v** generates a travel control signal using a vehicle position information. The generated travel control signal is output to operate the actuator group **120**, so that the vehicle **100v** can be driven by autonomous control. In the present embodiment, in addition to the program **PG1**, the detection-model **DM** and the reference path **RR** are stored in the memory **112v** in advance.

[0062] Like the vehicle controller **110** of the first embodiment, the vehicle controller **110v** of the present embodiment functions as the determination part **116**, the permitting part **117**, and the renewal part **118** to update the software stored in the vehicle **100** when the authentication information satisfies the authentication condition. That is, the vehicle controller **110v** of the present embodiment corresponds to “the updating device” in the present disclosure.

[0063] In the present exemplary embodiment, since the system **10v** does not have the server device **200**, when it is determined that the determination is not possible at the vehicle **100** in the updating process (step **S106:** No), the determination part **116** may perform the above-described step **S110** and determine whether or not the authentication information satisfies the second authentication condition. According to this aspect, when the determination is possible in the vehicle **100** (step **S106:** Yes) and the vehicle **100** is located in the plant **FC** (**S108:** Yes of steps), the software can be updated as long as the first authentication condition with a lower security level than second authentication condition is satisfied, and thus the software can be updated in the same manner as the above-described embodiment.

[0064] FIG. **7** is a flow chart showing the process of the travel control of the vehicle **100v** in the

third embodiment. In Step S11, the processor 111v acquires a vehicle position data using the data output from the external sensor 300. In step S11 in the present embodiment, the processor 111v acquires a vehicle position information using the captured image and the a vehicle speed as in step S1 of FIG. 3. In step S12, the processor 111v determines the target position to which the vehicle 100v is to go next. In step S13, the processor 111v generates a travel control signaling to drive the vehicle 100v toward the determined target position. In step S14, the processor 111v uses the generated drive control signal to control the actuator group 120 to drive the vehicle 100v according to the parameter represented in the drive control signal. The processor 111v repeats acquiring a vehicle position data, determining the target position, generating the travel control signal and controlling the actuator group 120 in a predetermined cycle. According to the system 10v of the present exemplary embodiment, the vehicle 100v can be driven by the autonomous control of the vehicle 100v without having to remotely control the server device 200. In addition, the system 10v according to the present exemplary embodiment, as in the above-described exemplary embodiment, the first authentication condition and the second authentication condition can be appropriately used, and a decrease in the security level can be suppressed while suppressing an increase in times for updating software.

D. Other Embodiments

[0065] (D1) In the above embodiment, the determination part 116, the permitting part 117, and the renewal part 118 are provided with the vehicle controller 110, but the present disclosure is not limited thereto. The determination part 116, the permitting part 117 and the renewal part 118 may be provided by the server device 200. In such a configuration, the server device 200 corresponds to “the updating device” in the present disclosure. Incidentally, when the server device 200 functions as an updating device, the step S106 and the step S110 in the updating process are not executed, and when it is determined as “Yes” in the step S104, the step S108 may be executed.

[0066] (D2) In the above embodiment, the determination part 116 determines whether or not the vehicle 100 is located in the plant FC by using the position info of the vehicle 100, but the present disclosure is not limited thereto. Determination part 116 may use the process info to determine whether or not the vehicle 100 is located in the plant FC. For example, the determination part 116 may determine whether or not the vehicle 100 is located in the plant FC according to whether or not the vehicle 100 is located in the previous process than predetermined process. More specifically, when it is determined that the vehicle 100 is positioned in the previous process than final testing process by using the process information of the vehicle 100, the determination part 116 may determine that the vehicle 100 is positioned in the plant FC. On the other hand, if the process data of the vehicle 100 is used to identify that the vehicle 100 is located in a later process than final testing process, the determination part 116 may determine that the vehicle 100 is not located in the plant FC. In such a mode, when the process information is not stored in the memory 112 of the vehicle 100, in the above-described step S110, the determination part 116 may inquire about the process information to the process control device 400 in place of the server device 200 and obtain the process information from the process control device 400. According to such embodiments, it achieves the same effect as the above embodiment.

[0067] (D3) In the above-described embodiment, the vehicle 100 may include a first control device that stores software for the plant and a second control device that stores software for applications other than plant. In this embodiment, when the software to be updated is stored in the first control device, the determination part 116 may perform the authentication under the first authentication condition assuming that the software is for the plant. On the other hand, when the software to be updated is stored in the second control device, the determination part 116 may perform the authentication under the second authentication condition assuming that the software is not for the plant. According to this aspect, since the software having different applications is stored in different control the device, it is possible to easily manage the software, it is possible to easily determine S108a of steps in the updating process of the second embodiment. In such a form, the “first control

the device for executing the software for the plant” corresponds to the “predetermined the device” in the present disclosure.

[0068] In addition, the vehicle **100** may include, in the vehicle controller **110**, a first the plant that stores software for the plant and a second the memory that stores software for applications other than a vehicle. In this embodiment, when the software to be updated is stored in the first memory, the determination part **116** may perform the authentication under the first authentication condition assuming that the software is for the plant. On the other hand, when the software to be updated is stored in the second memory, the determination part **116** may authenticate according to the second certification requirement, assuming that the software is not for the plant. Even in such a configuration, since software of different applications is stored in different the memory each other, software can be easily managed, and determination of step **S108a** in the updating process of the second embodiment can be facilitated. In this embodiment, the first memory for storing the software for the plant corresponds to a predetermined the device in the present disclosure.

[0069] (D4) In the above embodiments, the external sensor **300** is a camera. In contrast, the external sensor **300** may not be a camera. For example, it may be a ranging the device. The ranging device may be, for example, LiDAR (Light Detection And Ranging). In this instance, the detected data output by the external sensor **300** may be three-dimensional point cloud data representing the vehicle **100**. In this instance, the server device **200** or the vehicle **100** may acquire a vehicle position information by template matching using the three-dimensional point cloud data as the detection result and the reference point cloud data prepared in advance.

[0070] (D5) In the above-described first exemplary embodiment, the process from the acquiring of a vehicle position information to the generation of the travel control signal is executed by the server device **200**. In contrast, at least a part of the process from the acquiring of a vehicle position information to the generation of the travel control signal may be executed by the vehicle **100**. For example, it may be in the form of (1) to (3) below.

[0071] (1) The server device **200** may acquire a vehicle location information, determine a target position to be directed next by the vehicle **100**, and generate a path from the current location of the vehicle **100** to the target position represented by the acquired a vehicle location information. The server device **200** may generate a route to the target position between the present location and the destination or may generate a route to the destination. The server device **200** may transmit the generated path to the vehicle **100**. The vehicle **100** may create a travel control signal such that the vehicle **100** travels on a route received from the server device **200** and control the actuator group **120** using the generated travel control signal.

[0072] (2) The server device **200** may acquire a vehicle location information and transmit the acquired a vehicle location information to the vehicle **100**. The vehicle **100** may determine a target position to be directed next by the vehicle **100**, generate a route from the present location to the target position of the vehicle **100** represented by the received a vehicle position information, create a travel control signal such that the vehicle **100** travels on the generated route, and control the actuator group **120** using the generated travel control signal.

[0073] (3) In the above-described forms (1) and (2), the internal sensor is mounted on the vehicle **100**, and at least one of generation of the route and generation of the travel control signal may be used as the detection result outputted from the internal sensor. The inside sensor is the sensor mounted on the vehicle **100**. The inner sensors may include, for example, sensors that detect the motion state of the vehicle **100**, sensors that detect the operation state of each part of the vehicle **100**, and sensors that detect the ambient environment around the vehicle **100**. Specifically, the inner sensors may include, for example, cameras, LiDAR, millimeter-wave radars, ultrasonic sensors, GPS sensors, accelerometers, gyrosensors, etc. For example, in the form of (1) above, the server device **200** may acquire the detection result of the internal sensor and reflect the detection result of the internal sensor in the path when generating the path. In the form of (1), the vehicle **100** may acquire the detection result of the internal sensor and reflect the detection result of the internal

sensor in the travel control signal when creating the travel control signal. In the form of (2) described above, the vehicle **100** may acquire the detection result of the internal sensor and reflect the detection result of the internal sensor in the path when generating the path. In the form of (2) described above, the vehicle **100** may acquire the detection result of the internal sensor and reflect the detection result of the internal sensor in the travel control signal when creating the travel control signal.

[0074] (D6) In the above-described third embodiment, the internal sensor may be mounted on the vehicle **100v**, and at least one of generation of the route and generation of the travel control signal may be used as the detection result outputted from the internal sensor. For example, the vehicle **100v** may obtain the detection result of the internal sensor and reflect the detection result of the internal sensor in the path when generating the path. The vehicle **100v** may acquire the detection result of the internal sensor and reflect the detection result of the internal sensor in the travel control signal when creating the travel control signal.

[0075] (D7) In the above-described embodiment in which the vehicle **100** can be driven by the autonomous control, the vehicle **100** acquires a vehicle position information using the detection result of the external sensor **300**. In contrast, an internal sensor is mounted in the vehicle **100**, and the vehicle **100** acquires a vehicle position information using the detection result of the internal sensor, the vehicle **100** determines the target position to be directed to the next, generates a route from the current location of the vehicle **100** represented by the acquired a vehicle position information to the target position, creates a travel control signal for traveling the generated route, and controls the actuator of the vehicle **100** using the generated travel control signal. In this instance, the vehicle **100** may run without using any of the findings of the external sensor **300**. The vehicle **100** may acquire the target arrival time and the congestion information from the outside of the vehicle **100** and reflect the target arrival time and the congestion information in at least one of the routes and the travel control signal. Further, the functional configuration of system **10** may be all provided in the vehicle **100**. In other words, the process realized by system **10** in the present disclosure may be realized by the vehicle **100** alone.

[0076] (D8) In the above-described first exemplary embodiment, the server device **200** automatically generates a travel control signal to be transmitted to the vehicle **100**. In contrast, the server device **200** may generate a travel control signaling for transmission to the vehicle **100** in accordance with the manipulation of an external operator located outside the vehicle **100**. For example, an external operator may operate a control the device including a display for displaying captured images outputted from the external sensor **300**, a steering for remotely operating the vehicle **100**, an accelerator pedal, a brake pedal, and a communication device for communicating with the server device **200** through wired or wireless communication, and the server device **200** may create a travel control signal corresponding to an operation applied to the control the device.

[0077] (D9) In the above embodiments, the vehicle **100** may have a configuration that can be moved by unattended operation, and may, for example, be in the form of a platform that includes the configuration described below. Specifically, the vehicle **100** may be provided with at least a control the device for controlling the traveling of the vehicle **100** and actuators such as a drive the device, a steering the device, and a braking the device in order to perform three functions of “traveling,” “turning,” and “stopping” by unattended operation. If the vehicle **100** acquires data from an external source for unmanned operation, the vehicle **100** may further include communication device. That is, the vehicle **100** that can be moved by unmanned operation may not have at least a part of the interior components such as the driver's seat and the dashboard mounted, may not have at least a part of the exterior components such as the bumper and the fender mounted, and may not have the body shell mounted. In this instance, the remaining components, such as the body shell, may be attached to the vehicle **100** until the vehicle **100** is shipped from the plant FC, or the remaining components, such as the body shell, may be attached to the vehicle **100** after the vehicle **100** is shipped from the plant FC without the remaining components, such as the body

shell, being attached to the vehicle **100**. The components may be mounted from any direction, such as the upper side, lower side, front side, rear side, right side or left side of the vehicle **100**, and may be mounted from the same direction or from different directions. Also, with respect to the form of a platform, location can be determined in the same manner as in the vehicle **100** in the first embodiment.

[0078] (D10) the vehicle **100** may be manufactured by combining a plurality of modules. Module means a unit composed of one or more components summarized according to the configuration and functions of the vehicle **100**. For example, the platform of the vehicle **100** may be manufactured by combining a front module which constitutes a front portion of the platform, a central module which constitutes a central portion of the platform, and a rear module which constitutes a rear portion of the platform. The number of modules constituting the platform is not limited to three, it may be two or less or four or more. Also, in addition to or in place of the platform, parts of the vehicle **100** that differ from the platform may be modularized. The various modules may also include any exterior components, such as bumpers and grills, and any interior components, such as seats and consoles. Further, not limited to the vehicle **100**, the moving object of any aspect may be manufactured by combining a plurality of modules. Such modules, for example, may be manufactured by joining a plurality of parts by welding or fasteners or the like, it may be manufactured by integrally molding at least a portion of the module as one part by casting. Molding method for integrally molding at least a portion of the module as one part, also referred to as giga-cast or mega-cast. By using Giga cast, conventionally, each portion of the moving object which has been formed by joining a plurality of components, can be formed as a part. For example, the front module and the central module and the rear module described above may be manufactured using giga casts.

[0079] (D11) Using the travel of the vehicle **100** by unmanned operation to convey the vehicle **100** is also referred to as “self-propelled conveyance.” The configuration for realizing self-propelled transportation is also called “a vehicle Remotely Controlled Autonomous Transfer the system”. The production method that uses self-propelled conveyance to produce the vehicle **100** is also called “self-propelled production.” In self-propelled manufacturing, for example, at least a portion of the conveyance of the vehicle **100** in the plant FC of manufacturing the vehicle **100** is realized by self-propelled conveyance.

[0080] (D12) In each of the above embodiments, some or all of the functions and processing implemented in software may be implemented in hardware. In addition, some or all of the functions and processes implemented in hardware may be implemented in software. As hardware for realizing various functions in the above embodiments, for example, it may be used various circuits such as integrated circuits and discrete circuits.

[0081] The present disclosure is not limited to the above-described embodiments and can be realized with various configurations without departing from the spirit thereof. For example, the technical features in each embodiment may be replaced or combined as appropriate in order to solve some or all of the above-described problems or to achieve some or all of the above-described effects. In addition, if the technical features are not described as indispensable in this specification, they can be deleted as appropriate. For example, the present disclosure may be realized by aspects described below.

[0082] (1) In accordance with one aspect of the present disclosure, there is provided an updating device for updating software stored in a moving object. The control device includes a memory storing program instructions and a processor configured to execute the program instructions to determine whether or not an updating of the software is possible. In a first case that update target information satisfies a predetermined condition; the processor executes the program instructions to determine whether or not the updating of the software is possible by a first method. In a second case that the update target information does not satisfy the predetermined condition, the processor executes the program instructions to determine whether or not the updating of the software is possible by a second method that has a higher security level than the first method.

[0083] According to the control the device of this aspect, in a first case where the update target information satisfies a predetermined condition, the update availability is determined by the first method, and in a second case where the update target information does not satisfy the predetermined condition, the update availability is determined by the second method with a higher security level than first method. Therefore, in the first case, it is possible to easily determine the update availability by the first method having a lower security level compared to the second method, it is possible to suppress an increase in time for updating the software. Further, in the second case, the update availability can be determined by the second method having a higher security level compared to the first method, and the deterioration of the security level can be suppressed compared to the form in which the update availability is always determined by the first method.

[0084] (2) In the above aspect, the predetermined condition may include that the moving object is located in a predetermined area.

[0085] According to the control the device of this aspect, since the predetermined condition includes that the moving object is located within the predetermined region, the first method and the second method can be appropriately used depending on whether the moving object is located within the predetermined region or not.

[0086] (3) In the above aspect, the predetermined condition may include that the software is software used when the moving object is present in a predetermined area.

[0087] According to the control the device of this aspect, since the software includes the software used when the moving object is present in a predetermined area first method and the second method can be appropriately used depending on whether the software is the software used when the moving object is present in a predetermined area.

[0088] (4) In the above aspect, the predetermined condition may include that the software is stored in a predetermined device.

[0089] According to the control the device of this aspect, since the predetermined condition includes that the software is stored in the predetermined the device, the first method and the second method can be easily used separately depending on whether the software is stored in the predetermined the device.

Claims

1. An updating device for updating software stored in a moving object, comprising: a memory storing program instructions; and a processor configured to execute the program instructions to determine whether or not an updating of the software is possible, wherein in a first case that update target information satisfies a predetermined condition, the processor executes the program instructions to determine whether or not the updating of the software is possible by a first method, in a second case that the update target information does not satisfy the predetermined condition, the processor executes the program instructions to determine whether or not the updating of the software is possible by a second method that has a higher security level than the first method.
 2. The updating device according to claim 1, wherein the predetermined condition includes that the moving object is located within a predetermined area.
 3. The updating device according to claim 1, wherein the predetermined condition includes that the software is software to be used when the moving object is within a predetermined area.
 4. The updating device according to claim 1, wherein the predetermined condition includes that the software is stored in a predetermined device.
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