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OPERATION STATUS MANAGEMENT METHOD, OPERATION STATUS MANAGEMENT SYSTEM, AND OPERATION STATUS MANAGEMENT PROGRAM

Abstract

An operation status management method includes acquiring apparatus position information indicating a position of one or more work apparatuses that include a plurality of travel modes, and perform work in a field, and travel mode information indicating a travel mode of the work apparatus. The operation status management method also includes outputting work apparatus information indicating a position of the work apparatus and a travel mode of the work apparatus, in association with each other. The work apparatus information may indicate an image indicating a position of the work apparatus on a map. Further, the plurality of travel modes may include a manual travel mode in which the work apparatus is manually controlled by a worker riding on the work apparatus. Further, the plurality of travel modes may include an automatic travel mode in which the work apparatus is controlled from a control terminal communicably connected to the work apparatus.

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Background/Summary

TECHNICAL FIELD

[0001] The present invention relates to an operation status management method, an operation status management system, and an operation status management program.

BACKGROUND ART

[0002] In recent years, there is a case where not only work is performed by manually traveling a work apparatus, but also work is performed by automatically traveling a work apparatus in a field.

[0003] Patent Document 1 discloses a technique in which, when work is performed by manually traveling a work apparatus, farm work equivalent to work by a highly skilled worker is enabled by using a work history of the highly skilled worker. Further, Patent Document 1 describes a technique in which a work apparatus automatically travels along a set work route, as work using the work apparatus.

PRIOR ART DOCUMENT

Patent Document

[0004] Patent Document 1: Japanese Patent No. 6718838

SUMMARY OF INVENTION

Technical Problem

[0005] In this way, since a work apparatus is controlled in various ways due to progress of an information communication technique, it is getting difficult to confirm whether the work apparatus is appropriately operated by a worker.

[0006] In view of the above circumstances, one of objects of the present disclosure is to easily recognize a travel mode to be controlled by a work apparatus. Another object can be understood from the following description and description on an embodiment.

Solution to Problem

[0007] In the following, means for solving the problem is described by using numerals and signs to be used in an embodiment for carrying out the invention. These numbers and signs are added with parentheses, as a reference, to indicate an example of a correspondence between description of the scope according to claims and the embodiment for carrying out the invention. Therefore, the scope according to claims should not be construed as being limited to the description with parentheses.

[0008] An operation status management method according to one embodiment to achieve the above-mentioned object includes acquiring apparatus position information indicating a position of one or more work apparatuses (100) that include a plurality of travel modes, and perform work in a field (600), and travel mode information indicating a travel mode of the work apparatus (100). The operation status management method also includes outputting work apparatus information indicating a position of the work apparatus (100) and a travel mode of the work apparatus (100), in association with each other.

[0009] An operation status management system (1000) according to one embodiment to achieve the above-mentioned object includes an information acquisition unit (350) and an output unit (370). The information acquisition unit (350) acquires apparatus position information indicating a position of one or more work apparatuses (100) that include a plurality of travel modes, and perform work in a field (600), and travel mode information indicating a travel mode of the work apparatus (100).

The output unit (370) outputs work apparatus information indicating a position of the work apparatus (100) and a travel mode of the work apparatus (100), in association with each other. [0010] An operation status management program (550) according to one embodiment to achieve the above-mentioned object causes an arithmetic device (220, 320, 420) to execute acquiring apparatus position information indicating a position of one or more work apparatuses (100) that include a plurality of travel modes, and perform work in a field (600), and travel mode information indicating a travel mode of the work apparatus (100). The operation status management program (550) also causes the arithmetic device (220, 320, 420) to execute outputting work apparatus information indicating a position of the work apparatus (100) and a travel mode of the work apparatus (100), in association with each other.

Advantageous Effects of Invention

[0011] According to the above embodiment, a user can easily recognize a travel mode of a work apparatus performing work in a field.

Description

BRIEF DESCRIPTION OF DRAWINGS

[0012] FIG. 1 is a schematic diagram of an operation status management system according to one embodiment.

[0013] FIG. 2 is a diagram illustrating an image to be displayed on a display terminal according to the embodiment.

[0014] FIG. 3 is a schematic diagram of a work apparatus according to the embodiment.

[0015] FIG. 4 is a diagram illustrating a configuration of the work apparatus according to the embodiment.

[0016] FIG. 5 is a diagram illustrating a functional block to be performed by the operation status management system according to the embodiment.

[0017] FIG. 6 is a diagram illustrating a configuration of a control terminal according to the embodiment.

[0018] FIG. 7 is a diagram illustrating a configuration of an operation status management device according to the embodiment.

[0019] FIG. 8 is a diagram illustrating a configuration of the display terminal according to the embodiment.

[0020] FIG. 9 is a flowchart illustrating processing of controlling the work apparatus by the control terminal according to the embodiment.

[0021] FIG. 10 is a flowchart illustrating processing of displaying work apparatus information by the display terminal according to the embodiment.

[0022] FIG. 11 is a diagram illustrating a configuration of the control terminal according to the embodiment.

[0023] FIG. 12 is a diagram illustrating a configuration of the operation status management device according to the embodiment.

[0024] FIG. 13 is a diagram illustrating an image to be displayed on the display terminal according to the embodiment.

DESCRIPTION OF EMBODIMENTS

Embodiment

[0025] An operation status management system 1000 according to the present embodiment of the present invention is described with reference to the drawings. In the present embodiment, as illustrated in FIG. 1, the operation status management system 1000 includes one or more work apparatuses 100, one or more control terminals 200, an operation status management device 300, and a display terminal 400. The one or more control terminals 200 are communicably connectable

to the work apparatus **100**, and control the connected work apparatus **100**. Further, the operation status management device **300** is communicably connected to the work apparatus **100**, the control terminal **200**, and the display terminal **400** via a network **20**, for example, the Internet, acquires information related to the work apparatus **100** from the work apparatus **100** and the control terminal **200**, and outputs the acquired information to the display terminal **400**.

[0026] The work apparatus **100** performs work while traveling in a field **600**. For example, as exemplified by a first work apparatus **100-1** illustrated in FIG. 2, the work apparatus **100** may perform work in a manual travel mode in which the work apparatus **100** is manually controlled by a worker in a state where the worker is riding on the work apparatus **100**. Further, as exemplified by a second work apparatus **100-2**, the work apparatus **100** may perform work in a remote travel mode in which the work apparatus **100** is automatically controlled by a worker with use of the control terminal **200** from a remote place, for example, from a position far away where the work apparatus **100** cannot be directly viewed. As exemplified by a third work apparatus **100-3**, the work apparatus **100** may perform work in a boarding travel mode in which the work apparatus **100** is automatically controlled by using the control terminal **200** in a state where a worker is riding on the work apparatus **100**. As exemplified by a fourth work apparatus **100-4**, the work apparatus **100** may perform work in a monitoring travel mode in which the work apparatus **100** is automatically controlled by using the control terminal **200** nearby the work apparatus **100**, for example, from a position where the work apparatus **100** can be directly viewed, without a worker riding on the work apparatus **100**. When the work apparatus **100** performs work in the field **600**, the work apparatus **100** outputs, to the operation status management device **300**, apparatus position information indicating a position of the work apparatus **100**, and travel mode information indicating a travel mode of the work apparatus **100**.

[0027] The operation status management device **300** determines, based on apparatus position information to be acquired from the work apparatus **100**, a position of the work apparatus **100** that performs work in the field **600**. Further, the operation status management device **300** determines, based on travel mode information to be acquired from the work apparatus **100**, a travel mode of the work apparatus **100** that performs work in the field **600**.

[0028] Information indicating a determined position and a determined travel mode of the work apparatus **100** is displayed on the display terminal **400**. Therefore, a user, for example, an owner of the field **600** can easily recognize a travel mode of the work apparatus **100** that performs work in the field **600**.

[0029] Moreover, the control terminal **200** may output, to the operation status management device **300**, terminal position information indicating a position of the control terminal **200**. The display terminal **400** may display a position of the control terminal **200** that controls the work apparatus **100** in association with the work apparatus **100**. This also allows a user to recognize a position of a worker controlling the work apparatus **100**.

[0030] Further, the control terminal **200** may output, to the operation status management device **300**, worker information indicating a worker using the control terminal **200**. The display terminal **400** may display information on a worker using the control terminal **200** that controls the work apparatus **100** in association with the work apparatus **100**. A user can also easily recognize a worker controlling the work apparatus **100**.

(Configuration of Operation Status Management System)

[0031] A configuration of the work apparatus **100** included in the operation status management system **1000** illustrated in FIG. 1 is described. For example, as illustrated in FIG. 3, the work apparatus **100** performs plowing work in the field **600** by towing a work machine **105** (e.g., a rotary tiller), and traveling while lowering the work machine **105**. The work apparatus **100** may include a device that tows the work machine **105**, for example, a tractor, and may include a device integrally formed with the work machine **105**, for example, a combine, a rice planting machine, or the like. Further, the work apparatus **100** may include a drone that sprays pesticides.

[0032] Further, as illustrated in FIG. 4, the work apparatus **100** includes an input/output device **110**, a position measuring device **115**, an arithmetic device **120**, a communication device **130**, and a storage device **140**. Information for controlling the work apparatus **100** is input to the input/output device **110**. Further, the input/output device **110** outputs information for controlling the work apparatus **100**, for example, a velocity of the work apparatus **100**, a rotation speed of an engine, and the like. Further, the input/output device **110** may include various input devices and output devices, and may include, for example, a steering wheel, a button, a lever, a display, a touch panel, and the like.

[0033] The position measuring device **115** acquires apparatus position information indicating a position of the work apparatus **100** at each time. For example, the position measuring device **115** measures a position of the work apparatus **100** at a predetermined interval (e.g., an interval of 10 seconds), and outputs apparatus position information indicating the measured position to the arithmetic device **120**. For example, the position measuring device **115** may include a receiver of a global navigation satellite system (GNSS), a quantum compass, and the like.

[0034] The communication device **130** is communicably connected to the control terminal **200**. For example, the communication device **130** is connected to the control terminal **200** by wired connection or wireless connection directly or via another device, and transfers, to the arithmetic device **120**, a signal to be acquired from the control terminal **200**. Further, the communication device **130** transfers, to the control terminal **200**, a signal generated by the arithmetic device **120**. The communication device **130** may be directly connected to the control terminal **200** by wireless connection, for example, by a wireless local area network (LAN). For example, the communication device **130** may include an access point of a wireless LAN.

[0035] Further, the communication device **130** is communicably connected to the network **20**, and performs communication with each device via the network **20**. The communication device **130** transfers, to the arithmetic device **120**, a signal to be acquired from the operation status management device **300**. Further, the communication device **130** transfers, to the operation status management device **300**, a signal generated by the arithmetic device **120**. The communication device **130** may acquire information from another device without via the network **20**. For example, the communication device **130** may acquire information from another device via any storage medium, for example, a memory card, a universal serial bus (USB) memory, or the like. Further, the communication device **130** may acquire information from directly connected another device by a USB or the like. The communication device **130** includes various interfaces, for example, a transmitter/receiver to be used in wireless communication such as a wireless local area network (LAN) and a cellular network, a network interface card (NIC), a USB, a communication terminal, and the like.

[0036] The storage device **140** stores various pieces of data for automatically traveling the work apparatus **100**, for example, a travel program **500**. The storage device **140** is used as a non-transitory tangible storage medium that stores the travel program **500**. The travel program **500** may be provided as a computer program product recorded in a computer-readable storage medium **1**, or may be provided as a computer program product that can be downloaded from a server.

[0037] The arithmetic device **120** reads the travel program **500** from the storage device **140**, executes the travel program **500**, and performs various pieces of data processing for automatically traveling the work apparatus **100**. For example, the arithmetic device **120** may include an electric control unit (ECU), a central processing unit (CPU), or the like.

[0038] As illustrated in FIG. 5, the arithmetic device **120** reads and executes the travel program **500**, thereby achieving an automatic travel unit **150** and an information output unit **160** in cooperation with the storage device **140**. The automatic travel unit **150** controls the work apparatus **100** in such a way that the work apparatus **100** automatically travels, based on control information to be acquired from the control terminal **200**. The information output unit **160** outputs, to the operation status management device **300**, apparatus position information and travel mode

information of the work apparatus **100**.

[0039] Next, a configuration of the control terminal **200** is described. As illustrated in FIG. **6**, the control terminal **200** includes an input/output device **210**, a position measuring device **215**, an arithmetic device **220**, a communication device **230**, and a storage device **240**. The control terminal **200** includes, for example, a computer, a tablet terminal, a mobile terminal, and the like.

Information for causing the arithmetic device **220** to execute processing is input to the input/output device **210**. Further, the input/output device **210** outputs a result acquired by causing the arithmetic device **220** to execute the processing. The input/output device **210** includes various input devices and output devices, and includes, for example, a keyboard, a mouse, a microphone, a display, a speaker, a touch panel, and the like.

[0040] The position measuring device **215** acquires terminal position information indicating a position of the control terminal **200** at each time. For example, the position measuring device **215** measures a position of the control terminal **200** at a predetermined interval (e.g., an interval of ten minutes), and outputs, to the arithmetic device **220**, terminal position information indicating the measured position. For example, the position measuring device **215** may include a receiver of a global navigation satellite system (GNSS), a quantum compass, and the like.

[0041] The communication device **230** is communicably connected to the work apparatus **100**. For example, the communication device **230** is connected to the work apparatus **100** by wired connection or wireless connection, and transfers, to the arithmetic device **220**, a signal to be acquired from the work apparatus **100**. Further, the communication device **230** transfers, to the work apparatus **100**, a signal generated by the arithmetic device **220**.

[0042] Further, the communication device **230** is communicably connected to the network **20**, and performs communication with each device via the network **20**. The communication device **230** transfers, to the arithmetic device **220**, a signal to be acquired from the operation status management device **300**. Further, the communication device **230** transfers, to the operation status management device **300**, a signal generated by the arithmetic device **220**. The communication device **230** may acquire information from another device without via the network **20**. For example, the communication device **230** may acquire information from another device via any storage medium, for example, a memory card, a universal serial bus (USB) memory, or the like. Further, the communication device **230** may acquire information from directly connected another device by a USB or the like. The communication device **230** includes various interfaces, for example, a transmitter/receiver to be used in wireless communication such as a wireless local area network (LAN) and a cellular network, a network interface card (NIC), a USB, a communication terminal, and the like.

[0043] The storage device **240** stores various pieces of data for controlling the work apparatus **100**, for example, worker data **510**, control data **520**, and an apparatus control program **530**. The storage device **240** is used as a non-transitory tangible storage medium that stores the apparatus control program **530**. The apparatus control program **530** may be provided as a computer program product recorded in a computer-readable storage medium **2**, or may be provided as a computer program product that can be downloaded from a server.

[0044] The worker data **510** store user information related to a worker who uses the control terminal **200**. For example, user information indicates an account name and a password to be input to the input/output device **210** for allowing a worker to use the control terminal **200**. Further, user information may indicate a name of a worker in association with an account name and a password.

[0045] The control data **520** store control information for controlling the work apparatus **100**. For example, control information indicates a route along which the work apparatus **100** travels when work is performed in each field **600**. Further, control information may indicate a height of the work machine **105** that tows the work apparatus **100** at each position on the route.

[0046] The arithmetic device **220** reads the apparatus control program **530** from the storage device **240**, executes the apparatus control program **530**, and performs various pieces of data processing

for controlling the work apparatus **100**. For example, the arithmetic device **220** includes a central processing unit (CPU), and the like.

[0047] As illustrated in FIG. 5, the arithmetic device **220** reads and executes the apparatus control program **530**, thereby achieving an apparatus control unit **250** and an information output unit **260** in cooperation with the storage device **240**. The apparatus control unit **250** outputs, to the work apparatus **100**, control information for controlling the work apparatus **100**. The information output unit **260** outputs, to the operation status management device **300**, terminal position information indicating a position of the control terminal **200**, and worker information indicating a worker using the control terminal **200**.

[0048] Next, a configuration of the operation status management device **300** is described. As illustrated in FIG. 7, the operation status management device **300** includes an input/output device **310**, an arithmetic device **320**, a communication device **330**, and a storage device **340**. The operation status management device **300** is, for example, a computer including a cloud server and the like. Information for causing the arithmetic device **320** to execute processing is input to the input/output device **310**. Further, the input/output device **310** outputs a result acquired by causing the arithmetic device **320** to execute the processing. The input/output device **310** includes various input devices and output devices, and includes, for example, a keyboard, a mouse, a microphone, a display, a speaker, a touch panel, and the like. The input/output device **310** may be omitted.

[0049] The communication device **330** is communicably connected to the network **20**, and performs communication with each device via the network **20**. For example, the communication device **330** transfers, to the arithmetic device **320**, apparatus position information and travel mode information to be acquired from the work apparatus **100**. Further, the communication device **330** transfers, to the arithmetic device **320**, terminal position information and worker information to be acquired from the control terminal **200**. The communication device **330** transfers, to the display terminal **400**, a signal generated by the arithmetic device **320**. The communication device **330** includes, for example, various interfaces, such as a network interface card (NIC), and a universal serial bus (USB).

[0050] The storage device **340** stores various pieces of data for outputting work apparatus information indicating a travel mode of the work apparatus **100**, for example, work apparatus data **540**, and an operation status management program **550**. The storage device **340** is used as a non-transitory tangible storage medium that stores the operation status management program **550**. The operation status management program **550** may be provided as a computer program product recorded in a computer-readable storage medium **3**, or may be provided as a computer program product that can be downloaded from a server.

[0051] The work apparatus data **540** store, in the work apparatus **100**, information related to an operation status. For example, the work apparatus data **540** store information indicating a travel mode of the work apparatus **100**, a position of the work apparatus **100**, and a worker of the work apparatus **100** in association with one another.

[0052] The arithmetic device **320** reads the operation status management program **550** from the storage device **340**, executes the operation status management program **550**, and performs various pieces of data processing for outputting work apparatus information. For example, the arithmetic device **320** includes a central processing unit (CPU), and the like.

[0053] As illustrated in FIG. 5, the arithmetic device **320** reads and executes the operation status management program **550**, thereby achieving an information acquisition unit **350**, a correspondence determination unit **360**, and an output unit **370** in cooperation with the storage device **340**. The information acquisition unit **350** acquires apparatus position information and travel mode information from the work apparatus **100**. Further, the information acquisition unit **350** acquires terminal position information and worker information from the control terminal **200**. The correspondence determination unit **360** determines the control terminal **200** controlling the work apparatus **100**. The output unit **370** outputs, to the display terminal **400**, work apparatus

information indicating a travel mode of the work apparatus **100**.

[0054] Next, a configuration of the display terminal **400** is described. As illustrated in FIG. 8, the display terminal **400** includes an input/output device **410**, an arithmetic device **420**, a communication device **430**, and a storage device **440**. The display terminal **400** includes, for example, a computer, a tablet terminal, a mobile terminal, and the like. Information for causing the arithmetic device **420** to execute processing is input to the input/output device **410**. Further, the input/output device **410** outputs a result acquired by causing the arithmetic device **420** to execute the processing. The input/output device **410** includes various input devices and output devices, and includes, for example, a keyboard, a mouse, a microphone, a display, a speaker, a touch panel, and the like.

[0055] The communication device **430** is communicably connected to the network **20**, and performs communication with each device via the network **20**. The communication device **430** transfers, to the arithmetic device **420**, a signal to be acquired from the operation status management device **300**. Further, the communication device **430** transfers, to the operation status management device **300**, a signal generated by the arithmetic device **420**. The communication device **430** may acquire information from another device without via the network **20**. For example, the communication device **430** may acquire information from another device via any storage medium, for example, a memory card, a universal serial bus (USB) memory, or the like. Further, the communication device **430** may acquire information from directly connected another device by a USB or the like. The communication device **430** includes various interfaces, for example, a transmitter/receiver to be used in wireless communication such as a wireless local area network (LAN) and a cellular network, a network interface card (NIC), a USB, and the like.

[0056] The storage device **440** stores various pieces of data for displaying work apparatus information indicating a travel mode of the work apparatus **100**, for example, a display program **560**. The storage device **440** is used as a non-transitory tangible storage medium that stores the display program **560**. The display program **560** may be provided as a computer program product recorded in a computer-readable storage medium **4**, or may be provided as a computer program product that can be downloaded from a server.

[0057] As illustrated in FIG. 5, the arithmetic device **420** reads and executes the display program **560**, thereby achieving a display unit **450** in cooperation with the storage device **440** and the input/output device **410**. The display unit **450** displays work apparatus information indicating a travel mode of the work apparatus **100**.

(Operation of Operation Status Management System)

[0058] An operation of the operation status management system **1000** is described. First, an operation when work is performed in the field **600** by using the work apparatus **100** is described. When performing work in the field **600**, a worker activates a driving device of the work apparatus **100**, for example, an engine, an electric motor, and the like. When the driving device of the work apparatus **100** is activated, the arithmetic device **120** of the work apparatus **100** reads the travel program **500** from the storage device **140**, and executes the travel program **500**. When the travel program **500** is read and executed, the information output unit **160** to be achieved by the arithmetic device **120** acquires position information of the work apparatus **100** from the position measuring device **115**, and outputs the acquired position information to the operation status management device **300**. The information output unit **160** continues to periodically output the position information to the operation status management device **300** until the driving device is stopped. The position information includes information indicating time at which a position of the work apparatus **100** is measured. Further, the position information may include information for identifying the work apparatus **100**.

[0059] The information acquisition unit **350** of the operation status management device **300** stores, in the work apparatus data **540**, position information acquired from the work apparatus **100**. This allows the operation status management device **300** to store position information of the work

apparatus **100** performing work in the field **600**.

[0060] When manually performing work while boarding the work apparatus **100**, a worker operates the work apparatus **100** in which the driving device is activated, and starts work in the field **600**. When the worker finishes the work in the field **600**, the worker stops the driving device of the work apparatus **100**. When the driving device is stopped, the information output unit **160** of the work apparatus **100** outputs, to the operation status management device **300**, information indicating that the work apparatus **100** is stopped. Upon acquiring the information indicating that the work apparatus **100** is stopped, the information acquisition unit **350** of the operation status management device **300** stores, in the work apparatus data **540**, that the work apparatus **100** is stopped.

[0061] A worker may automatically control the work apparatus **100** by using the control terminal **200** in a state where the worker is riding on the work apparatus **100**. For example, after activating the work apparatus **100**, a worker inputs, to the input/output device **210** of the control terminal **200**, an operation for controlling the work apparatus **100**. When the operation is input to the input/output device **210**, the arithmetic device **220** of the control terminal **200** reads the apparatus control program **530** from the storage device **240**, and executes the apparatus control program **530**. For example, when the control terminal **200** is activated, the arithmetic device **220** of the control terminal **200** may read and execute the apparatus control program **530**. When the apparatus control program **530** is read and executed, the arithmetic device **220** starts processing illustrated in FIG. **9**, which is a part of an operation status management method.

[0062] In step **S110**, the apparatus control unit **250** to be achieved by the arithmetic device **220** accepts user information of a worker who uses the control terminal **200**. The worker inputs his/her account name and password to the input/output device **210**. The apparatus control unit **250** compares with user information stored in the worker data **510**, and identifies a worker who uses the control terminal **200**.

[0063] In step **S120**, the apparatus control unit **250** accepts connected apparatus information indicating the work apparatus **100** to be controlled. The worker inputs, to the input/output device **210**, the connected apparatus information indicating the work apparatus **100** to be controlled. The apparatus control unit **250** outputs, to the work apparatus **100** indicated by the input connected apparatus information, a request signal for connection. For example, the apparatus control unit **250** outputs a request signal for connecting to an access point of the communication device **130** of the work apparatus **100**. Further, the apparatus control unit **250** may output authentication information to the work apparatus **100**, in addition to a request signal for connecting to an access point.

[0064] In step **S130**, the automatic travel unit **150** of the work apparatus **100** authenticates the control terminal **200**, based on the request signal and the authentication information to be acquired from the control terminal **200**. For example, when the request signal or the authentication information coincides with information registered in advance, the automatic travel unit **150** permits connection from the control terminal **200**, and establishes connection with the control terminal **200**.

[0065] In step **S140**, when communication with the work apparatus **100** is established, the apparatus control unit **250** of the control terminal **200** outputs, to the work apparatus **100**, control information for controlling the work apparatus **100**. For example, the apparatus control unit **250** accepts, from control information stored in the control data **520**, control information according to work in the field **600**. For example, a user selects, from among control information stored in the control data **520**, control information suitable for performing work in the field **600**. The apparatus control unit **250** outputs the selected control information to the work apparatus **100**. The control information includes information indicating the boarding travel mode in which the work apparatus **100** automatically travels by the control terminal **200** in a state where a worker is riding on the work apparatus **100**.

[0066] In step **S150**, the apparatus control unit **250** starts outputting, to the operation status management device **300**, terminal position information indicating a position measured by the position measuring device **215**. For example, the apparatus control unit **250** measures a position of

the control terminal **200** at a predetermined interval, and outputs, to the operation status management device **300**, terminal position information indicating the measured position. Further, the apparatus control unit **250** may output, to the operation status management device **300**, worker information indicating a worker using the control terminal **200**, for example, information indicating a name of a worker.

[0067] In step **S160**, the information output unit **160** of the work apparatus **100** determines a travel mode, based on the control information to be acquired from the control terminal **200**, and outputs, to the operation status management device **300**, travel mode information indicating the determined travel mode. For example, when the control information includes information indicating the boarding travel mode, the automatic travel unit **150** determines, as a travel mode, the boarding travel mode in which the worker performs work while boarding the work apparatus **100**. The automatic travel unit **150** outputs, to the operation status management device **300**, travel mode information indicating the boarding travel mode. The travel mode information may include information indicating the control terminal **200** that has output the control information to the work apparatus **100**.

[0068] In step **S170**, the automatic travel unit **150** controls the work apparatus **100** in accordance with the control information, and performs work in the field **600**. For example, the automatic travel unit **150** compares a position of the work apparatus **100** to be measured by the position measuring device **115** with a route indicated by the control information, and controls the work apparatus **100** in such a way that the work apparatus **100** travels along the route indicated by the control information. The control information may be divided according to a current position of the work apparatus **100**, and output from the control terminal **200**. In this case, the automatic travel unit **150** of the work apparatus **100** outputs, to the control terminal **200**, terminal position information indicating a position of the work apparatus **100**.

[0069] When work indicated by the control information is finished, in step **S180**, the information output unit **160** outputs, to the operation status management device **300**, finishing information indicating that work to be automatically performed, for example, work in the boarding travel mode is finished.

[0070] In step **S190**, the correspondence determination unit **360** of the operation status management device **300** changes the travel mode of the work apparatus **100** stored in the work apparatus data **540** to the manual travel mode, based on the finishing information to be acquired from the work apparatus **100**.

[0071] In this way, when the work apparatus **100** travels in the boarding travel mode, the operation status management device **300** acquires travel mode information indicating a travel mode of the work apparatus **100**, and terminal position information indicating a position of the control terminal **200**.

[0072] Further, the worker may automatically control the work apparatus **100** by using the control terminal **200** from a position at which the work apparatus **100** can be directly viewed, without boarding the work apparatus **100**. Similarly to the boarding travel mode, after activating the work apparatus **100**, the worker inputs, to the input/output device **210** of the control terminal **200**, an operation for controlling the work apparatus **100**. Upon input of the operation, the arithmetic device **220** of the control terminal **200** reads and executes the apparatus control program **530**. Herein, in step **S140**, movement in the monitoring travel mode, and movement in the boarding travel mode are different from each other in the content of control information to be output from the apparatus control unit **250** of the control terminal **200**. Specifically, in the monitoring travel mode, control information to be output from the apparatus control unit **250** includes information indicating the monitoring travel mode, in place of information indicating the boarding travel mode. Since other movements are similar to those in the boarding travel mode, detailed description thereof is omitted.

[0073] A worker may automatically control the work apparatus **100** by using the control terminal **200** from a remote place, without boarding the work apparatus **100**. Also in this case, similarly to

the boarding travel mode, after activating the work apparatus **100**, the worker input, to the input/output device **210** of the control terminal **200**, an operation for controlling the work apparatus **100**. Upon input of the operation, the arithmetic device **220** of the control terminal **200** reads and executes the apparatus control program **530**. Herein, in the remote travel mode, unlike the boarding travel mode, in step **S120**, the apparatus control unit **250** of the control terminal **200** outputs a request signal or authentication information for connecting to the work apparatus **100** via the network **20**. Further, in step **S140**, similarly to the monitoring travel mode, the content of control information to be output from the apparatus control unit **250** of the control terminal **200** is different between movement in the remote travel mode and movement in the boarding travel mode.

Specifically, in the remote travel mode, control information to be output from the apparatus control unit **250** includes information indicating the remote travel mode, in place of information indicating the boarding travel mode. Since other movements are similar to those in the boarding travel mode, detailed description thereof is omitted.

[0074] Next, an operation of displaying a travel mode of the work apparatus **100** by the operation status management system **1000** is described. Upon receiving a signal from the work apparatus **100** or the control terminal **200**, the arithmetic device **320** of the operation status management device **300** reads the operation status management program **550** from the storage device **340**, and executes the operation status management program **550**. When the operation status management program **550** is read and executed, the arithmetic device **320** starts processing illustrated in FIG. **10**, which is a part of the operation status management method.

[0075] In step **S210**, the information acquisition unit **350** to be achieved by the arithmetic device **320** acquires apparatus position information and travel mode information from the work apparatus **100**. For example, the information acquisition unit **350** acquires apparatus position information to be periodically output from the work apparatus **100**. Further, the information acquisition unit **350** acquires travel mode information to be output from the work apparatus **100**. Furthermore, the information acquisition unit **350** acquires terminal position information to be periodically output from the control terminal **200**. The information acquisition unit **350** stores, in the work apparatus data **540**, the acquired each piece of information.

[0076] For example, in the example illustrated in FIG. **2**, the information acquisition unit **350** acquires each piece of apparatus position information indicating a position of each work apparatus **100**, for example, the first work apparatus **100-1**, the second work apparatus **100-2**, the third work apparatus **100-3**, and the fourth work apparatus **100-4**. In addition, the information acquisition unit **350** acquires a position of the control terminal **200** that controls the work apparatus **100**, in other words, terminal position information indicating a position of a worker who controls the work apparatus **100**. The information acquisition unit **350** acquires, from the control terminal **200**, worker information indicating a worker using the control terminal **200**. In addition, when the information acquisition unit **350** acquires apparatus position information from each work apparatus **100**, and does not acquire travel mode information, the travel mode of each work apparatus **100** may be determined as the manual travel mode in which the worker manually controls the work apparatus **100** while boarding the work apparatus **100**.

[0077] In step **S220** illustrated in FIG. **10**, the correspondence determination unit **360** determines the control terminal **200** that controls the work apparatus **100**, based on information indicating the control terminal **200** included in the travel mode information. For example, the correspondence determination unit **360** determines the control terminal **200** indicated in the travel mode information, as the control terminal **200** that controls the work apparatus **100** from which the travel mode information is output. Further, the correspondence determination unit **360** determines a position indicated by the terminal position information of the control terminal **200**, as a worker position **60** indicating a position of a worker who controls the work apparatus **100**.

[0078] For example, in the example illustrated in FIG. **2**, travel mode information to be output from the second work apparatus **100-2** includes information indicating the control terminal **200** that

controls the second work apparatus **100-2**. The correspondence determination unit **360** determines the control terminal **200** that controls the second work apparatus **100-2**, based on the travel mode information. The correspondence determination unit **360** determines, as a position of the worker who controls the second work apparatus **100-2**, a position indicated by terminal position information of the determined control terminal **200**, for example, a second worker position **60-2**. Likewise, the correspondence determination unit **360** determines, as a position of the worker who controls the fourth work apparatus **100-4**, a fourth worker position **60-4**.

[0079] In step **S230** illustrated in FIG. **10**, the output unit **370** outputs, to the display terminal **400**, work apparatus information indicating a travel mode of the work apparatus **100**. For example, as illustrated in FIG. **2**, the work apparatus information indicates a position of one or more work apparatuses **100** on a map, and indicates a travel mode of each work apparatus **100** in association with the corresponding work apparatus **100**. In addition, the work apparatus information may indicate a position of the control terminal **200** that controls the work apparatus **100**, in other words, a position of the worker who controls the work apparatus **100** in association with the corresponding work apparatus **100**. The work apparatus information may indicate information related to a worker who uses the control terminal **200** in association with the work apparatus **100** to be controlled by the control terminal **200**.

[0080] In step **S240** illustrated in FIG. **10**, the display unit **450** of the display terminal **400** displays work apparatus information to be acquired from the operation status management device **300**. For example, as illustrated in FIG. **2**, the display unit **450** displays an image indicating a position of one or more work apparatuses **100** on a map, and indicating a travel mode of the work apparatus **100** in association with the corresponding work apparatus **100**. For example, a travel mode of each work apparatus **100** is displayed in a travel mode display area **50** displayed in association with the work apparatus **100**. In the example illustrated in FIG. **2**, a travel mode of the first work apparatus **100-1** is displayed in a first travel mode display area **50-1**, and a “manual mode” indicating that the worker is manually controlling while boarding the work apparatus is displayed in the first travel mode display area **50-1**. A travel mode of the second work apparatus **100-2** is displayed in a second travel mode display area **50-2**, and a “remote mode” indicating that the worker is automatically controlling from a remote place is displayed in the second travel mode display area **50-2**. A travel mode of the third work apparatus **100-3** is displayed in a third travel mode display area **50-3**, and an “onboard mode” indicating that the worker is automatically controlling while boarding the work apparatus is displayed in the third travel mode display area **50-3**. A travel mode of the fourth work apparatus **100-4** is displayed in a fourth travel mode display area **50-4**, and a “monitoring mode” indicating that the worker is automatically controlling from a position at which the work apparatus **100** can be directly viewed is displayed in the fourth travel mode display area **50-4**.

[0081] In addition, the display unit **450** may display the worker position **60** indicating a position of a worker controlling the work apparatus **100** on a map. For example, the display unit **450** displays the second worker position **60-2** on the map, as a position of the worker controlling the second work apparatus **100-2**. In addition, the display unit **450** may display an association line **70** that associates the second work apparatus **100-2** with the second worker position **60-2** of the worker controlling the second work apparatus **100-2**. The association line **70** is indicated, for example, by a straight line connecting a position of the second work apparatus **100-2** and the second worker position **60-2**. Likewise, regarding the fourth work apparatus **100-4**, the display unit **450** displays the association line **70** connecting the fourth worker position **60-4** and a position of the fourth work apparatus **100-4**.

[0082] The display unit **450** may display a worker controlling the work apparatus **100** in association with the work apparatus **100** being controlled. For example, the display unit **450** displays the worker controlling the work apparatus **100** in the travel mode display area **50**. In the example illustrated in FIG. **2**, a “worker A” is displayed as a worker who controls the second work apparatus **100-2** in the second travel mode display area **50-2**. Further, the second worker position

60-2 indicates a position of the “worker A”. Further, a “worker B” is displayed as a worker who controls the third work apparatus **100-3** in the third travel mode display area **50-3**. Since the “onboard mode” is displayed as the travel mode of the third work apparatus **100-3**, a position of the “worker B” is indicated by the position of the third work apparatus **100-3**. A “worker C” is displayed as a worker who controls the fourth work apparatus **100-4** in the fourth travel mode display area **50-4**. The fourth worker position **60-4** indicates a position of the “worker C”.

[0083] In this way, a user can easily recognize a travel mode of the work apparatus **100** by confirming work apparatus position displayed on the display terminal **400**. Further, the user can also easily recognize a worker controlling the work apparatus **100**, and a position of the worker. Modifications

[0084] The configuration described in the embodiment is an example, and the configuration can be modified within a range in which the functions are not inhibited. For example, as illustrated in FIG. **11**, a control terminal **200B** may be a computer installed in a room or the like without including the position measuring device **215**. In this case, as illustrated in FIG. **12**, the storage device **340** of the operation status management device **300** stores the control terminal data **570** that store information indicating a position where the control terminal **200** is installed. For example, in step **S150** illustrated in FIG. **9**, the information output unit **260** of the control terminal **200B** may output worker information without outputting terminal position information. When acquiring worker information without acquiring terminal position information from the control terminal **200**, the information acquisition unit **350** of the operation status management device **300** may acquire, from the control terminal data **570**, a position of the control terminal **200** that has output the worker information.

[0085] In step **S110** illustrated in FIG. **9**, the apparatus control unit **250** of the control terminal **200** may not accept a password, as user information. Further, the apparatus control unit **250** may accept worker information, for example, a name of a worker. Furthermore, when a person who uses the control terminal **200** is fixed, the apparatus control unit **250** does not have to accept user information. In this case, information on a worker who uses the control terminal **200** is registered in advance in the control terminal **200**, and when the control terminal **200** is activated, the apparatus control unit **250** identifies the registered worker, as a worker who uses the control terminal **200**. Further, when the operation status management system **1000** does not display worker information, processing of step **S110** may be omitted.

[0086] In step **S140** illustrated in FIG. **9**, control information to be output from the apparatus control unit **250** of the control terminal **200** indicates the monitoring travel mode and the remote travel mode in a distinguishable manner, however, the present invention is not limited thereto. In step **S160**, any method may be used, as long as the information output unit **160** of the work apparatus **100** can specify a travel mode when the work apparatus **100** is controlled by the control terminal **200**. For example, control information may indicate a non-boarding travel mode without distinguishing between the monitoring travel mode and the remote travel mode. In this case, for example, the information output unit **160** of the work apparatus **100** may distinguish between the monitoring travel mode and the remote travel mode depending on whether the control terminal **200** is directly connected to an access point or the like of the work apparatus **100**. For example, when the control terminal **200** is directly connected to the work apparatus **100**, the information output unit **160** determines the monitoring travel mode, as a travel mode of the work apparatus **100**. Further, when the control terminal **200** is connected to the work apparatus **100** via the network **20**, the information output unit **160** determines the remote travel mode, as a travel mode of the work apparatus **100**. Further, when the operation status management system **1000** does not display the monitoring travel mode and the remote travel mode in a distinguishable manner, control information to be output from the control terminal **200**, and the information output unit **160** may use the non-boarding travel mode without distinguishing between the monitoring travel mode and the remote travel mode.

[0087] Further, the operation status management system **1000** may display the boarding travel mode and the non-boarding travel mode, as an automatic travel mode without distinguishing between the boarding travel mode and the non-boarding travel mode. In this case, control information to be output from the control terminal **200**, and the information output unit **160** may use the automatic travel mode without distinguishing between the boarding travel mode and the non-boarding travel mode.

[0088] Further, in step **S210** illustrated in FIG. **10**, an example in which the information acquisition unit **350** of the operation status management device **300** determines the manual travel mode is described, however, the present invention is not limited thereto. For example, when the information output unit **160** of the work apparatus **100** does not receive control information from the control terminal **200**, the information output unit **160** may determine the travel mode of the work apparatus **100**, as the manual travel mode. In this case, for example, when the work apparatus **100** is activated, the information output unit **160** may output, to the operation status management device **300**, travel mode information indicating the manual travel mode.

[0089] Apparatus position information of the work apparatus **100**, and travel mode information may be output to the operation status management device **300** by any method. For example, the information output unit **160** of the work apparatus **100** may output, to the operation status management device **300**, apparatus position information of the work apparatus **100**, and travel mode information via the control terminal **200**. Further, in step **S140** illustrated in FIG. **9**, travel mode information may be output from the information output unit **260** of the control terminal **200** to the operation status management device **300**.

[0090] Terminal position information of the control terminal **200**, and worker information may be output to the operation status management device **300** by any method. For example, the information output unit **260** of the control terminal **200** may be output to the operation status management device **300** via the work apparatus **100**.

[0091] Further, an example in which information indicating the control terminal **200** that controls the work apparatus **100** is included in travel mode information is described, however, the present invention is not limited thereto. Information indicating the control terminal **200** that controls the work apparatus **100** may be output to the operation status management device **300** by any method. For example, information indicating the control terminal **200** that controls the work apparatus **100** may be output from the control terminal **200** to the operation status management device **300**. For example, information indicating the control terminal **200** that controls the work apparatus **100** may be included in terminal position information, and output to the operation status management device **300**.

[0092] The display unit **450** of the display terminal **400** may display various pieces of information related to the work apparatus **100**. The display unit **450** may display time related to various pieces of information, for example, apparatus position information, terminal position information, travel mode information, and the like. For example, the display unit **450** may display time at which a position of the work apparatus **100** is measured in association with the work apparatus **100**. Further, the display unit **450** may display time at which a position of the control terminal **200** is measured in association with a position of the control terminal **200**. The display unit **450** may display time at which the operation status management device **300** receives travel mode information or finishing information. In this case, the operation status management device **300** stores each time in the work apparatus data **540**.

[0093] Further, the display unit **450** may display a distance from a position of the work apparatus **100** to a position of the control terminal **200**. In this case, for example, the information acquisition unit **350** of the operation status management device **300** may compute a distance from a position of the work apparatus **100** to a position of the control terminal **200**, and store the computed distance in the work apparatus data **540**. For example, information indicating a computed distance is included in work apparatus information, and output to the display terminal **400**.

[0094] Further, the display unit **450** may not display a position of the control terminal **200**. In this case, the control terminal **200** does not include the position measuring device **215**, and does not have to output terminal position information.

[0095] The display unit **450** may display work apparatus information in any format. For example, as illustrated in FIG. **13**, the display unit **450** may display work apparatus information in a table format. The display unit **450** may display various pieces of information, for example, a position of the work apparatus **100**, a travel mode of the work apparatus **100**, a name of a worker controlling the work apparatus **100**, and the like in association with the work apparatus **100**.

[0096] The embodiment and modifications described above are each an example, and the configuration described in each embodiment and the modifications may be optionally modified and/or optionally combined to the extent that does not inhibit the functions. Furthermore, a part of the functions that have been described in the embodiment and the modifications may be omitted, as far as the necessary functions can be achieved. For example, processing of the display terminal **400** may be performed by the operation status management device **300**. Furthermore, a part or all pieces of processing of the operation status management device **300** may be performed by the control terminal **200** or the display terminal **400**. A part or all pieces of processing of the display terminal **400** may be performed by the control terminal **200**.

[0097] Further, the operation status management program **550** may include the travel program **500**, or may include the apparatus control program **530**, or may include the display program **560**.

[0098] Further, the operation status management system **1000** may not include the work apparatus **100**, and may acquire various pieces of information from an external work apparatus that is not included in the operation status management system **1000**. Further, the operation status management system **1000** may not include the control terminal **200**, and may acquire various pieces of information from an external control terminal that is not included in the operation status management system **1000**. Further, the operation status management system **1000** may not include the display terminal **400**, and may display work apparatus information on an external control terminal that is not included in the operation status management system **1000**.

Supplementary Notes

[0099] The operation status management method, the operation status management system, and the operation status management program described in each embodiment can be described as follows.

[0100] An operation status management method according to a first aspect includes: [0101] acquiring apparatus position information indicating a position of one or more work apparatuses that include a plurality of travel modes, and perform work in a field, and travel mode information indicating a travel mode of the work apparatus; and [0102] outputting work apparatus information indicating a position of the work apparatus and a travel mode of the work apparatus, in association with each other.

[0103] An operation status management method according to a second aspect is the operation status management method according to the first aspect, wherein [0104] the work apparatus information indicates an image indicating a position of the work apparatus on a map.

[0105] An operation status management method according to a third aspect is the operation status management method according to the first or second aspect, wherein [0106] the plurality of travel modes include [0107] a manual travel mode in which the work apparatus is manually controlled by a worker riding on the work apparatus, and [0108] an automatic travel mode in which the work apparatus is controlled from a control terminal that is communicably connected to the work apparatus.

[0109] An operation status management method according to a fourth aspect is the operation status management method according to the third aspect, wherein [0110] the automatic travel mode includes [0111] a boarding travel mode in which the work apparatus is controlled from the control terminal that is loaded in the work apparatus, while a worker is riding on the work apparatus, and [0112] a non-boarding travel mode in which the work apparatus is controlled from the control

terminal that is not loaded in the work apparatus, without a worker riding on the work apparatus.

[0113] An operation status management method according to a fifth aspect is the operation status management method according to the fourth aspect, wherein [0114] the work apparatus information includes control terminal information related to the control terminal that controls the work apparatus, when the work apparatus is controlled in the non-boarding travel mode.

[0115] An operation status management method according to a sixth aspect is the operation status management method according to the fifth aspect, wherein [0116] the control terminal information indicates a position of the control terminal.

[0117] An operation status management method according to a seventh aspect is the operation status management method according to the fifth or sixth aspect, wherein [0118] the control terminal information indicates a worker who operates the control terminal.

[0119] An operation status management method according to an eighth aspect is the operation status management method according to any one of the first to seventh aspects, further including:

[0120] displaying the work apparatus information.

[0121] An operation status management system according to a ninth aspect includes: [0122] an information acquisition unit that acquires position information indicating a position of one or more work apparatuses that include a plurality of travel modes, and perform work in a field, and travel mode information indicating a travel mode of the work apparatus; and [0123] an output unit that outputs work apparatus information indicating a position of the work apparatus and a travel mode of the work apparatus, in association with each other.

[0124] An operation status management program according to a tenth aspect causes an arithmetic device to execute: [0125] acquiring position information indicating a position of one or more work apparatuses that include a plurality of travel modes, and perform work in a field, and travel mode information indicating a travel mode of the work apparatus; and [0126] outputting work apparatus information indicating a position of the work apparatus and a travel mode of the work apparatus, in association with each other.

REFERENCE SIGNS LIST

[0127] **1, 2, 3, 4:** Storage medium [0128] **20:** Network [0129] **50:** Travel mode display area [0130] **60:** Worker position [0131] **70:** Association line [0132] **100:** Work apparatus [0133] **105:** Work machine [0134] **110:** Input/output device [0135] **115:** Position measuring device [0136] **120:** Arithmetic device [0137] **130:** Communication device [0138] **140:** Storage device [0139] **150:** Automatic travel unit [0140] **160:** Information output unit [0141] **200:** Control terminal [0142] **210:** Input/output device [0143] **215:** Position measuring device [0144] **220:** Arithmetic device [0145] **230:** Communication device [0146] **240:** Storage device [0147] **250:** Apparatus control unit [0148] **260:** Information output unit [0149] **300:** Operation status management device [0150] **310:** Input/output device [0151] **320:** Arithmetic device [0152] **330:** Communication device [0153] **340:** Storage device [0154] **350:** Information acquisition unit [0155] **360:** Correspondence determination unit [0156] **370:** Output unit [0157] **400:** Display terminal [0158] **410:** Input/output device [0159] **420:** Arithmetic device [0160] **430:** Communication device [0161] **440:** Storage device [0162] **450:** Display unit [0163] **500:** Travel program [0164] **510:** Worker data [0165] **520:** Control data [0166] **530:** Apparatus control program [0167] **540:** Work apparatus data [0168] **550:** Operation status management program [0169] **560:** Display program [0170] **570:** Control terminal data [0171] **600:** Field [0172] **1000:** Operation status management system

Claims

1. An operation status management method comprising: acquiring apparatus position information and travel mode information, wherein the apparatus position information indicates a position of a work apparatus that includes a plurality of travel modes and performs work in a field, and wherein the travel mode information indicates a travel mode of the work apparatus; and outputting work

apparatus information indicating a position of the work apparatus and a travel mode of the work apparatus, in association with each other.

2. The operation status management method according to claim 1, wherein the work apparatus information indicates an image indicating a position of the work apparatus on a map.

3. The operation status management method according to claim 1, wherein: the plurality of travel modes include: a manual travel mode in which the work apparatus is manually controlled by a worker riding on the work apparatus, and an automatic travel mode in which the work apparatus is controlled from a control terminal that is communicably connected to the work apparatus.

4. The operation status management method according to claim 3, wherein the automatic travel mode includes: a boarding travel mode in which the work apparatus is controlled from the control terminal that is loaded in the work apparatus, while a worker is riding on the work apparatus, and a non-boarding travel mode in which the work apparatus is controlled from the control terminal that is not loaded in the work apparatus, without a worker riding on the work apparatus.

5. The operation status management method according to claim 4, wherein the work apparatus information includes control terminal information related to the control terminal that controls the work apparatus, when the work apparatus is controlled in the non-boarding travel mode.

6. The operation status management method according to claim 5, wherein the control terminal information indicates a position of the control terminal.

7. The operation status management method according to claim 5, wherein the control terminal information indicates a worker who operates the control terminal.

8. The operation status management method according to claim 1, further comprising: displaying the work apparatus information.

9. An operation status management system comprising: an information acquisition unit that acquires position information and travel mode information, wherein the position information indicates a position of a work apparatus that includes a plurality of travel modes and performs work in a field, and wherein the travel mode information indicates a travel mode of the work apparatus; and an output unit that outputs work apparatus information indicating a position of the work apparatus and a travel mode of the work apparatus, in association with each other.

10. An operation status management program comprising instructions, which when executed by a processor, cause the processor to perform operations including: acquiring position information and travel mode information, wherein the apparatus position information indicates a position of a work apparatus that includes a plurality of travel modes and performs work in a field, and wherein the travel mode information indicates a travel mode of the work apparatus; and outputting work apparatus information indicating a position of the work apparatus and a travel mode of the work apparatus, in association with each other.
