

DESCRIPTION

Title of Invention: INFORMATION PROVISION SYSTEM,
INFORMATION PROVISION DEVICE, AND INFORMATION
PROVISION PROGRAM

5 TECHNICAL FIELD

[0001] The present disclosure relates to a technology
that provides information regarding a plant.

BACKGROUND ART

[0002] A large number of plants of various types and
10 scales, such as petroleum plants and chemical plants, are
operated. The number of years of operation varies for each
plant, and there are many plants for which a considerable
number of years have elapsed since the start of operation.

PRIOR ART LITERATURE

15 Non Patent Literature

[0003] Non Patent Literature 1: "Society 5.0", the
Cabinet Office, https://www8.cao.go.jp/cstp/society5_0

SUMMARY OF INVENTION

TECHNICAL PROBLEM

20 **[0004]** In a plant with a great number of years of
operation, the cost for safely operating the plant has been
increasing year by year due to aging and the like of
facilities. In addition, difficulties such as shortage of
staff caused by a decline in the number of children or the
25 like and a decrease in the number of experienced workers have
also become apparent.

[0005] In order to solve such problems, it is desirable to incorporate, into a plant, the mechanism of the Society 5.0 aimed at achieving both of economic development and solving social problems by a system in which a cyberspace (virtual space) and a physical space (real space) are highly integrated (see, for example, Non Patent Literature 1).

[0006] However, the present inventors have recognized, as problems, that there is a high threshold from the viewpoint of security and investment effects in order to incorporate the mechanism of Society 5.0 into a plant in which safe running has been supported for many years by an operational technology (OT) that ensures high safety and real-time performance by a closed system constructed with unique architecture and specifications.

[0007] An object of the present disclosure is to improve a technology for detecting a state of a plant.

SOLUTION TO PROBLEM

[0008] In order to solve the above problems, an information providing system according to a certain mode of the present disclosure includes: a sensor installed in a plant to detect information necessary for analyzing a state of the plant; a transfer device structured to transfer detection information detected by the sensor to a storage area; the storage area of a cloud accessible via a network for which an owner or a manager of the plant is allowed to manage an access right; an analyzer structured to analyze, in

the cloud, the detection information retained in the storage area; and a presenter structured to present an analysis result by the analyzer from the cloud.

[0009] Another mode of the present disclosure is an information providing device. This device includes: a detection information acquirer structured to acquire detection information detected by a sensor installed in a plant to detect information necessary for analyzing a state of the plant, the detection information being retained in a storage area accessible via a network for which an owner or a manager of the plant is allowed to manage an access right; an analyzer structured to analyze the detection information acquired by the detection information acquirer; and a presenter structured to present an analysis result by the analyzer.

[0010] Still another mode of the present disclosure is an information providing program. This program causes a computer to function as: a detection information acquirer structured to acquire detection information detected by a sensor installed in a plant to detect information necessary for analyzing a state of the plant, the detection information being retained in a storage area accessible via a network for which an owner or a manager of the plant is allowed to manage an access right; an analyzer structured to analyze the detection information acquired by the detection information acquirer; and a presenter structured to present an analysis

result by the analyzer.

[0011] Note that any combinations of the above constituent elements and the converted expressions of the present invention between methods, devices, systems, recording media, computer programs, and the like are also effective as modes of the present invention.

ADVANTAGEOUS EFFECTS OF INVENTION

[0012] According to the present disclosure, a technology for detecting a state of a plant can be improved.

10 BRIEF DESCRIPTION OF DRAWINGS

[0013] [Fig. 1] Fig. 1 is a diagram illustrating an overall configuration of an information providing system according to an embodiment.

[Fig. 2] Fig. 2 is a sequence diagram illustrating a procedure of an information providing method according to the embodiment.

[Fig. 3] Fig. 3 is a diagram illustrating an example of a presentation screen for an analysis result provided to an owner terminal from the information providing device.

20 [Fig. 4] Fig. 4 is a diagram illustrating a configuration of an information providing device according to the embodiment.

[Fig. 5] Fig. 5 is a diagram illustrating a configuration of the owner terminal according to the embodiment.

25 DESCRIPTION OF EMBODIMENTS

[0014] In the present disclosure, a technology that analyzes a state of a plant and provides an analysis result to a manager, an owner, or the like of the plant will be described. An information providing device according to an embodiment of the present disclosure acquires detection information necessary for analyzing a state of a plant from a sensor installed in the plant and provides an analysis result obtained by analyzing the acquired detection information to the owner or the like of the plant. This allows the plant owner to accurately grasp the state of the plant and to, for example, maintain a decrepit part, or predict the occurrence of a failure or the like to reflect the predicted occurrence in a repair plan. Therefore, the occurrence of an accident can be avoided in advance, and the cost for safely operating the plant can be reduced.

[0015] In order to operate such an information providing service at low cost, it is conceivable to use information technology (IT) such as cloud computing or Internet of things (IoT). Cloud computing services and IoT equipment have been explosively spread in a short period of time due to overwhelming technological innovation and standardization and enable operation at a lower cost than a case where a dedicated storage or sensor is provided. In addition, by accumulating and preserving the detection information detected by the IoT equipment in the cloud, the detection information can be used not only to grasp the state of the

plant but also to, for example, predict a future state of the plant, optimize the working, and detect an anomaly.

[0016] However, as described above, there is a high threshold for plant owners to integrate IT with OT from the aspect of security and from the viewpoint of investment effects. Therefore, there is a demand for a technology intended to remove concerns of plant owners in the aspect of security or regarding investment effects.

[0017] For example, since general consumer IoT equipment uses central processing units (CPUs) of various manufacturing entities, operating systems (OSs) whose specifications are open to public, and the like, a risk of being subjected to a cyber-attack from the outside is involved. In plants such as energy plants and chemical plants in which damage in the event of an accident can be serious, a very high level of security and safety performance is required, and thus it cannot be said that the level of general consumer IoT equipment is sufficient.

[0018] For this reason, it is necessary to install an IoT sensor having high security performance and safety performance such as explosion resistance in the plant, but since such a sensor is expensive, initial cost for installing the sensor in the plant and visualizing the state of the plant can be high. Therefore, the cost effectiveness is poor for the plant owner, and it is difficult to obtain a sense of satisfaction with the introduction of the IoT sensor.

[0019] In order to solve such problems, in the embodiment of the present disclosure, a sensor having high security and safety performance provided by a service provider or the like of the service according to the present disclosure is installed in a plant. This makes it possible to visualize the state of the plant while keeping the security and safety performance of the plant at a high level. In addition, not only the detection information detected by the sensor is simply provided to the plant owner, but also the analysis result obtained by analyzing the detection information is provided. This can enhance the added value of the introduction of the IoT sensor and thus makes it possible to obtain a sense of satisfaction of the plant owner in the investment necessary for the introduction of the IoT sensor. In addition, since accurate information by experts can be provided, the plant can be appropriately operated regardless of the experience, level, or the like of the worker, and labor-saving in daily tasks also can be achieved. Moreover, the information can be used to train an unskilled worker. Furthermore, as the compensation for the information providing service, the plant owner is charged by a subscription scheme for the compensation including not only the compensation for the analysis result but also the compensation for the IoT sensor, the communication device main body and its installation, use, maintenance, and the like. This makes it possible to greatly suppress the initial

cost and thus can lower the threshold for the introduction of the IoT sensor to promote the introduction of the IoT sensor.

[0020] In addition, in an IoT platform or a data platform using a conventional cloud computing service, since
5 data is directly saved in a storage constructed by a service provider in a tenant of a cloud, it has been difficult for an end user such as a plant owner to, for example, manage confidentiality and health of data by, for example, managing access rights to the saved data or checking an access
10 history, or to analyze data or use data secondarily using another service provider in a personal manner of the end user.

[0021] In order to solve such problems, in the embodiment of the present disclosure, the detection
15 information detected by the IoT sensor is saved in an own tenant of the plant owner in a cloud in which a storage device is installed at a location designated by the plant owner. The plant owner uses the function provided in a cloud computing service to pay the provider of the information
20 providing service for the access rights to the detection information necessary for the information providing service. The provider of the information providing service constructs an information providing device in its own tenant in the same cloud. The information providing device uses a data
25 acquisition function provided in the cloud computing service to acquire necessary detection information from the tenant of

the plant owner in a necessary unit. This allows the plant owner to personally manage the detection information detected by the IoT sensor and thus can assure security performance and health of the information. In addition, data obtained by analysis and processed data are also fed back to the tenant of the owner, as necessary. This allows the plant owner to reliably manage all the data and thus makes it possible to obtain a sense of trust. In addition, since the detection information can also be disclosed to another service provider and reused, the value of introducing the IoT sensor can be enhanced. Moreover, since information such as the detection information is saved at a location designated by the plant owner, such as a data center installed in the own country or in an area to which the own country belongs, and the detection information and the like are analyzed by the information providing device constructed in the same data center, important information can be avoided from leaking to the outside of the country or the outside of the area.

[0022] Fig. 1 illustrates an overall configuration of an information providing system according to the embodiment. An information providing system 1 includes a plant 10, a cloud 20, and an owner terminal 12.

[0023] In the plant 10, a sensor 11 for detecting information necessary for analyzing the state of the plant 10 is installed. The sensor 11 has specifications designed by a service provider 2 that is a vendor of the plant 10 so as to

ensure the security and safety performance required in the plant 10 and satisfying necessary security and functional requirements. The detection information detected by the sensor 11 is transferred to the cloud 20 by a transfer device 15 via a communication network 3. The transfer device 15 may be built in the sensor 11. The transfer device 15 may acquire the detection information from a plurality of sensors 11 to transfer the acquired detection information to the cloud 20.

10 **[0024]** The cloud 20 is provided by a cloud computing service provider. Storage devices constituting the cloud 20 are provided with an owner tenant 21 that is a storage area allocated to an owner of the plant 10 and a vendor tenant 22 that is a storage area allocated to the service provider 2.

15 The owner tenant 21 is provided for each of owners of a plurality of plants 10. The plant owner can designate, in any way, the installation location of the storage device in which the owner tenant 21 is constructed.

20 **[0025]** The service provider 2 retains data, programs, and the like for implementing an information providing device 100 of the present embodiment in the vendor tenant 22 and constructs the information providing device 100.

25 **[0026]** The owner terminal 12 is used by the owner of the plant 10 to, for example, manage the access right to the detection information retained in the owner tenant 21 and display the analysis result provided from the information

providing device 100.

[0027] Fig. 2 is a sequence diagram illustrating a procedure of an information providing method according to the embodiment. The owner of the plant 10 applies to the service provider 2 for the information providing service. The service provider 2 discusses the contents of the service to be provided to the owner of the plant 10 with the owner of the plant 10. Specifically, the contents of the analysis relating to the plant 10, the type of detection information necessary for that analysis, the type, number, and specifications of the sensors 11 necessary for acquiring that detection information, the type, number, and specifications of the transfer devices 15, the capacity and specifications of the owner tenant 21, the installation location of the storage device, the charge amount and the charging method for the owner of the plant 10, and the like are discussed. When an agreement of the discussion has been reached, a contract is concluded between the service provider 2 and the owner of the plant 10 (S10).

[0028] The service provider 2 installs, in the plant 10, the sensor 11 and the transfer device 15 for detecting information necessary for analyzing the state of the plant 10 on the basis of the contract (S12).

[0029] Using an access right management function provided in the cloud 20, the owner of the plant 10 grants the right for the service provider 2 to access, from the

vendor tenant 22, the detection information uploaded from the sensor 11 to the owner tenant 21 (S14).

[0030] The sensor 11 detects the detection information and transmits the detected detection information to the owner tenant 21 via the transfer device 15 (S20). The transfer device 15 may transmit the detection information to the owner tenant 21 of the cloud 20 via the communication network 3 by a communication scheme designed on the basis of the zero trust policy. Programs used by the sensor 11 and the transfer device 15 to execute functions such as detection and communication may be provided to the sensor 11 and the transfer device 15 from the information providing device 100 and updated as needed. This makes it possible to appropriately take measures against a new threat and thus can keep high security performance.

[0031] The information providing device 100 requests the detection information retained in the owner tenant 21, using a cloud cooperation data acquisition function provided in the cloud 20 (S22). The data acquisition function responds to the information providing device 100 with the requested detection information (S24).

[0032] The information providing device 100 analyzes the acquired detection information (S26). The information providing device 100 analyzes the state of the plant 10 on the basis of the detection information and generates a display screen for visualizing the state of the plant 10.

[0033] The owner terminal 12 accesses the information providing device 100 and requests an analysis result (S28). The information providing device 100 presents the analysis result to the owner terminal 12 (S30).

5 **[0034]** The information providing device 100 charges the owner of the plant 10 for the compensation for the service on the basis of the contract (S32). This compensation includes not only the compensation for providing the analysis result but also the compensation for installation, use, maintenance,
10 and the like of the sensor 11. The information providing device 100 charges the owner of the plant 10 for the compensation for the service by a subscription scheme. The information providing device 100 may charge the owner of the plant 10 for the compensation every predetermined period of
15 time such as one month, two months, three months, half a year, or one year. The owner of the plant 10 pays the compensation to the service provider 2 (S34).

[0035] Fig. 3 illustrates an example of a presentation screen for an analysis result provided to the owner terminal
20 12 from the information providing device 100. The information providing device 100 not only presents the detection information simply but also presents an advanced analysis result in consideration of knowledge as a vendor of the plant 10.

25 **[0036]** Fig. 4 illustrates a configuration of the information providing device 100 according to the embodiment.

The information providing device 100 is constructed in the vendor tenant 22 of the cloud 20.

[0037] The information providing device 100 includes an application acceptor 121, a detection information acquirer 122, a detection information analyzer 123, an analysis result presenter 124, and a charging manager 125. In terms of hardware components, these constituents are implemented by a CPU, a memory, a program loaded into the memory, and the like of any computer, but here, functional blocks implemented by cooperation of these constituents are depicted. Therefore, it is understood by those skilled in the art that these functional blocks can be implemented in a variety of forms by only hardware, only software, or a combination of hardware and software.

[0038] The application acceptor 121 accepts application for the service from the owner of the plant 10. The application acceptor 121 accepts, from the owner terminal 12, the contents of the analysis relating to the plant 10, the type of detection information necessary for that analysis, the type, number, and specifications of the sensors 11 necessary for acquiring that detection information, the capacity and specifications of the owner tenant 21, the charge amount and the charging method for the owner of the plant 10, and the like.

[0039] The detection information acquirer 122 acquires the detection information retained in the owner tenant 21.

The detection information analyzer 123 analyzes the detection information acquired by the detection information acquirer 122. The analysis result presenter 124 presents the result obtained by analysis by the detection information analyzer 123 to the owner terminal 12. The charging manager 125 charges the owner of the plant 10 for the compensation for the service.

[0040] Fig. 5 illustrates a configuration of the owner terminal 12 according to the embodiment. The owner terminal 12 includes a communication device 31, a display device 32, an input device 33, a processing device 40, and a storage device 34.

[0041] The communication device 31 controls communication in a wireless or wired manner. The communication device 31 transmits and receives data to and from other devices via the communication network 3. The display device 32 displays a display image generated by the processing device 40. The input device 33 inputs an instruction to the processing device 40. The storage device 34 retains data and a computer program used by the processing device 40.

[0042] The processing device 40 includes a service applicator 41, an access right manager 42, an analysis result acquirer 43, an analysis result display 44, and a payment manager 45. These constituents can also be implemented in a variety of forms by only hardware, only software, or a

combination of hardware and software.

[0043] The service applicator 41 applies to the information providing device 100 for service provision. The service applicator 41 accepts desired conditions of the owner
5 of the plant 10 regarding the contents of the service and transmits the accepted desired conditions to the information providing device 100.

[0044] The access right manager 42 accesses the cloud 20 and manages the access right to the data retained in the
10 owner tenant 21. The access right manager 42 may acquire and present information such as an access history for the detection information retained in the owner tenant 21 from the cloud service. The analysis result acquirer 43 accesses the information providing device 100 and acquires the
15 analysis result. The analysis result display 44 displays the analysis result acquired by the analysis result acquirer 43 on the display device 32. The payment manager 45 executes processing for paying the charge amount notified by the information providing device 100 to the service provider 2.

20 **[0045]** In the cloud computing service, in a case where a function for managing the access right to the data retained in the owner tenant 21 of the cloud 20 is provided so as to be accessible by a web browser, the access right manager 42 may be implemented by the web browser. The access right
25 manager 42 may be implemented by a dedicated application or the like provided by the cloud computing service.

[0046] In a case where a display function for the analysis result by the information providing device 100 is provided to be accessible by a web browser, the analysis result acquirer 43 and the analysis result display 44 may be implemented by the web browser. The analysis result acquirer 43 and the analysis result display 44 may be implemented by a dedicated application or the like provided by the service provider.

[0047] The present disclosure has been described above based on the working examples. It is understood by those skilled in the art that these working examples are exemplary, a variety of modifications can be made to combinations of respective constituent elements and respective processing processes, and such modifications are also within the scope of the present invention.

[0048] In the embodiment, the technology that provides the information regarding the plant has been described, but the technology of the present embodiment is also applicable to fields other than the plant managed by the OT, including, for example, fields such as an electric power generating station and a railway.

INDUSTRIAL APPLICABILITY

[0049] The present disclosure can be used for a technology that provides information regarding a plant.

REFERENCE SIGNS LIST

[0050] 1 information providing system, 2 service

provider, 3 communication network, 10 plant, 11 sensor, 12
owner terminal, 15 transfer device, 20 cloud, 21 owner
tenant, 22 vendor tenant, 31 communication device, 32 display
device, 33 input device, 34 storage device, 40 processing
5 device, 41 service applicator, 42 access right manager, 43
analysis result acquirer, 44 analysis result display, 45
payment manager, 100 information providing device, 121
application acceptor, 122 detection information acquirer, 123
detection information analyzer, 124 analysis result
10 presenter, 125 charging manager

CLAIMS

[Claim 1]

An information providing system comprising:

a sensor installed in a plant to detect information necessary for analyzing a state of the plant;

a transfer device structured to transfer detection information detected by the sensor to a storage area of a cloud;

the storage area of the cloud accessible via a network for which an owner or a manager of the plant is allowed to manage an access right;

an analyzer structured to analyze, in the cloud, the detection information retained in the storage area; and

a presenter structured to present an analysis result by the analyzer from the cloud.

[Claim 2]

The information providing system according to claim 1, wherein

the detection information is retained in the storage area of the cloud installed at a location designated by the owner or the manager of the plant.

[Claim 3]

An information providing device comprising:

a detection information acquirer structured to acquire

detection information detected by a sensor installed in a plant to detect information necessary for analyzing a state of the plant, the detection information being retained in a storage area accessible via a network for which an owner or a manager of the plant is allowed to manage an access right;

an analyzer structured to analyze the detection information acquired by the detection information acquirer; and

a presenter structured to present an analysis result by the analyzer.

[Claim 4]

The information providing device according to claim 3, wherein

the information providing device is provided in another storage area in the cloud provided with the storage area in which the detection information is retained.

[Claim 5]

The information providing device according to claim 4, wherein

the access right of the information providing device to the detection information is managed by the owner or the manager of the plant, using a function provided in the cloud.

[Claim 6]

The information providing device according to claim 4 or 5, wherein

the detection information acquirer acquires the detection information retained in the storage area, using a function provided in the cloud.

[Claim 7]

The information providing device according to any one of claims 3 to 6, the information providing device further comprising

a charging manager structured to manage charging for compensation for providing the analysis result.

[Claim 8]

The information providing device according to claim 7, wherein

the compensation includes a cost for installation, use, or maintenance of the sensor.

[Claim 9]

The information providing device according to claim 7 or 8, wherein

the charging manager charges for the compensation by a subscription scheme.

[Claim 10]

An information providing program

for causing a computer to function as:

a detection information acquirer structured to acquire detection information detected by a sensor installed in a plant to detect information necessary for analyzing a state of the plant, the detection information being retained in a storage area accessible via a network for which an owner or a manager of the plant is allowed to manage an access right;

an analyzer structured to analyze the detection information acquired by the detection information acquirer;
and

a presenter structured to present an analysis result by the analyzer.