

MONITOR-AND-CONTROL SYSTEM

Background

5 The present invention relates to a monitor-and-control system configured to monitor and control facilities of a building, a plant, or the like.

For example, a control system and an apparatus management apparatus monitor and control facilities of a building, control a plant, and the like. Such a monitor-and-control system connects to field apparatuses such as process apparatuses and various sensors installed in a site via a network. The monitor-and-control system sends/receives signals to/from the field apparatuses, controls behaviors of the field apparatuses, for example confirms behaviors of the field apparatuses, displays results of diagnoses, and sets parameters.

The monitor-and-control system controls and monitors various kinds of apparatuses. The monitor-and-control system handles various kinds of information on control and monitoring. The examples of the information include information on production operation, production management, a manufacturing method, and apparatus management. Moreover, it is important to set use/reference authority for each kind of information and for a display mode of the information from viewpoints of efficiency of the system and various kinds of security.

For example, Japanese Patent No. 3048147 discloses a system configured to classify information for each apparatus to be monitored, and to display a window for each piece of classified information. A person in charge of establishing the system generates classified

information on apparatuses to be monitored, and establishes the system and application software. A user of the system uses the established system and application software.

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Summary

However, in recent years, when a complicated process or the like is controlled, many apparatuses are controlled and monitored. In addition, there are many pieces of information on the controlled and monitored apparatuses. As a result, many pieces of information are to be displayed. For example, there are many pieces of information on one controlled and monitored apparatus. Examples of such information include information necessary to control the apparatus, and information necessary for maintenance management. Because of this, if there are many controlled and monitored apparatuses, a huge number of pieces of information are to be displayed. Because of this, one monitor window of the monitor-and-control system is not capable of displaying all the information at once. In view of this, for example, a monitor window is changed and displayed for each controlled and monitored apparatus or for each piece of information.

In this situation, a user of the system takes a lot of trouble to obtain information necessary for him. Moreover, if the user does not get a complete view of the system, he may not obtain (refer to) necessary information sometimes. As described above, in the past, it is difficult for a user of the system to obtain information necessary for him from the monitor-and-control system, which is problematic.

In view of the above-mentioned circumstances, it is desirable to provide a monitor-and-control system, from which a user of the system is capable of obtaining information necessary for him easily.

According to an aspect of the present invention, there is provided a monitor-and-control system, including: user information storage configured to store user information identifying a user and a role corresponding to the user; role-to-information storage configured to store an apparatus name showing an apparatus-to-be-controlled and information on the apparatus in relation to the role; an apparatus information obtaining unit configured to retrieve a role corresponding to an input user information from the user information storage, and to retrieve an apparatus name corresponding to the retrieved role and corresponding information from the role-to-information storage; and a display controller configured to display the information retrieved by the apparatus information obtaining unit and the apparatus name retrieved by the apparatus information obtaining unit together on a display unit, wherein the role-to-information storage may store a management/monitoring target in relation to the role, the management/monitoring target being the information on the apparatus, the management/monitoring target identifying a management and monitoring target of the apparatus, the monitor-and-control system may further include management/monitoring target and attribute storage configured to store an attribute of the management/monitoring target of the apparatus in relation to the apparatus name, the apparatus information obtaining unit may be configured to retrieve an

apparatus name and a management/monitoring target corresponding to the retrieved role from the role-to-information storage, and the display controller may be configured to display the management/monitoring target attribute retrieved by the apparatus information obtaining unit and the apparatus name retrieved by the apparatus information obtaining unit together on the display unit.

The monitor-and-control system may further include apparatus-to-display definition storage configured to store a display definition-corresponding-to-apparatus in relation to the management/monitoring target, the display definition-corresponding-to-apparatus being used to display the management/monitoring target attribute, in which the display controller may be configured to display the management/monitoring target attribute and the apparatus name together on the display unit based on a display definition-corresponding-to-apparatus, the display definition-corresponding-to-apparatus corresponding to the management/monitoring target, the display definition-corresponding-to-apparatus being stored in the apparatus-to-display definition storage.

The monitor-and-control system may further include display definition-corresponding-to-role storage configured to store a display definition-corresponding-to-role in relation to the role, the display definition-corresponding-to-role being used to display the management/monitoring target attribute, in which the display controller may be configured to display the management/monitoring target attribute and the apparatus name together on the display unit based on a display

definition-corresponding-to-role corresponding to the role stored in the display definition-corresponding-to-role storage.

The monitor-and-control system may further include: authority information storage configured to store an access authority for the information on the apparatus in relation to the role; and an access controller configured to validate and invalidate access to information based on an access authority, the information being displayed by the display controller on the display unit, the access authority being stored in the authority information storage in relation to a role corresponding to input user information, in which the display controller may be configured to change a symbol of information displayed on the display unit corresponding to validation and invalidation controlled by the access controller.

In the monitor-and-control system, the management/monitoring target includes an operation status of the apparatus, a maintenance status of the apparatus, and a working status of the apparatus.

As described above, according to embodiments of the present invention, a user of the system is capable of obtaining information necessary for him from a monitor-and-control system easily.

Brief Description of Drawings

Fig. 1 is a configuration diagram showing the configuration of a monitor-and-control system of Embodiment 1 of the present invention;

Fig. 2 is a configuration diagram showing the configuration of the user information storage 101;

Fig. 3 is a configuration diagram showing the configuration of the role-to-information storage 102;

Fig. 4 is a configuration diagram showing the configuration of a monitor-and-control system of Embodiment 2 of the present invention;

Fig. 5 is a configuration diagram showing the configuration of the role-to-information storage 202;

Fig. 6 is a configuration diagram showing the configuration of the management/monitoring target and attribute storage 203;

Fig. 7 is a configuration diagram showing the configuration of the apparatus-to-display definition storage 204;

Fig. 8 is a a configuration diagram showing the configuration of a monitor-and-control system of Embodiment 3 of the present invention;

Fig. 9 is a configuration diagram showing the configuration of the role-to-information storage 302;

Fig. 10 is a diagram illustrating a display example of the display unit 207 of Embodiment 3;

Fig. 11 is a configuration diagram showing the configuration of a monitor-and-control system of Embodiment 4 of the present invention;

Fig. 12 is a configuration diagram showing the configuration of the authority information storage 402;

Fig. 13 is a configuration diagram showing the configuration of the management/monitoring target authority definition storage 403; and

Fig. 14 is a diagram illustrating a display example of the display unit 105 of Embodiment 4.

Detailed Description of Embodiments

Hereinafter, embodiments of the present invention will be described with reference to the drawings.

[Embodiment 1]

5 Firstly, Embodiment 1 of the present invention will be described with reference to Fig. 1. Fig. 1 is a configuration diagram showing the configuration of a monitor-and-control system of Embodiment 1 of the present invention. The monitor-and-control system includes the
10 user information storage 101, the role-to-information storage 102, the apparatus information obtaining unit 103, the display controller 104, the display unit 105, and the input unit 106.

 The user information storage 101 stores user
15 information and a role corresponding to the user together.

 The user information identifies a user (user of the system). For example, as shown in Fig. 2, the roles "operation management" and "maintenance management" are in relation to a user A (user information). Moreover,
20 the role "maintenance management" is in relation to a user B. Moreover, the role "working plan" is in relation to a user C.

 The role-to-information storage 102 stores an apparatus name and information on the apparatus in
25 relation to each role. The apparatus name shows an apparatus-to-be-controlled,

 For example, as shown in Fig. 3, the apparatus names "compressor" and "dryer" show apparatuses-to-be-
30 controlled. Information on those apparatuses includes target values and status values of pressure, temperature, air volume, and the like. Information on those

apparatuses further includes operating time, number of start and stop, consumption rate, and the like. Each of those pieces of information is in relation to a role such as "operation management", "maintenance management", or
5 "working plan".

A user operates the input unit 106 and inputs user information. Firstly, the apparatus information obtaining unit 103 retrieves a role from the user information storage 101 corresponding to the input user
10 information. Moreover, the apparatus information obtaining unit 103 retrieves an apparatus name corresponding to the retrieved role and corresponding information from the role-to-information storage 102.

The display controller 104 displays the above-mentioned information retrieved by the apparatus
15 information obtaining unit 103 and the apparatus name retrieved by the apparatus information obtaining unit 103 on the display unit 105 together.

For example, a user A inputs his ID and password to
20 log in to the monitor-and-control system. A controller (not shown) performs a certification operation to thereby certify those input values. Then the apparatus information obtaining unit 103 performs the above-mentioned operation. As a result, the display unit 105
25 displays information such as attributes and the like of the apparatus-to-be-controlled "compressor". The "compressor" is in relation to the role "operation management" in relation to the user A.

As described above, Embodiment 1 is characterized in
30 that a role is in relation to user information identifying a user. Embodiment 1 is further

characterized in that an apparatus name showing an apparatus-to-be-controlled and information on the apparatus are in relation to each role. As a result, if user information is input, an apparatus name and corresponding information can be selected in relation to the role set as the input user information, and can be displayed. As a result, a user of the system can obtain information necessary for him from the monitor-and-control system easily.

[Embodiment 2]

Next, Embodiment 2 of the present invention will be described with reference to Fig. 4. Fig. 4 is a configuration diagram showing the configuration of a monitor-and-control system of Embodiment 2 of the present invention. The monitor-and-control system includes the user information storage 101, the role-to-information storage 202, the management/monitoring target and attribute storage 203, the apparatus-to-display definition storage 204, the apparatus information obtaining unit 205, the display controller 206, the display unit 207, and the input unit 208.

The user information storage 101 is similar to the above-mentioned Embodiment 1. The user information storage 101 stores user information and a role corresponding to the user together. The user information identifies a user.

The role-to-information storage 202 stores an apparatus name and information on the apparatus in relation to each role. The apparatus name shows an apparatus-to-be-controlled. In Embodiment 2, the role-to-information storage 202 stores a management/monitoring

target in relation to each role. The management/monitoring target is information on an apparatus. The management/monitoring target identifies management and monitoring of the apparatus.

5 For example, as shown in Fig. 5, the role-to-information storage 202 stores the apparatus names "compressor" and "dryer" and the management/monitoring targets "operation", "maintenance", "energy", and the like in relation to roles. The apparatus name shows an
10 apparatus-to-be-controlled. The management/monitoring targets are information on those apparatuses. The "operation", "maintenance", "energy", and the like are reference classification. Moreover, in the example of Fig. 5, the role-to-information storage 202 stores
15 information to be shared such as "alarm confirmation" or "handover" in relation to each role. Moreover, "operation management", "maintenance management", and "working plan" are set as roles.

 The management/monitoring target and attribute
20 storage 203 stores the attribute of a management/monitoring target of an apparatus in relation to the apparatus name.

 For example, as shown in Fig. 6, the management/monitoring target and attribute storage 203
25 stores attributes such as "pressure target value" and "pressure status value" in relation to a management/monitoring target "operation" of "compressor". Moreover, the management/monitoring target and attribute storage 203 stores attributes such as "operating time"
30 and "number of start and stop" in relation to a management/monitoring target "maintenance" of

"compressor". Moreover, the management/monitoring target and attribute storage 203 stores attributes such as "consumption rate" in relation to a management/monitoring target "energy" of "compressor". Moreover, for example,
5 information such as input sources and output targets are set. Attributes are obtained from the input sources. The attributes are supplied to the output targets.

The apparatus-to-display definition storage 204 stores a display definition-corresponding-to-apparatus in
10 relation to a management/monitoring target. The display definition-corresponding-to-apparatus is used to display a management/monitoring target attribute.

For example, as shown in Fig. 7, the apparatus-to-display definition storage 204 stores the definition
15 information "compressor operation information window" in relation to the management/monitoring target "operation" of "compressor". Moreover, the apparatus-to-display definition storage 204 stores the definition information "compressor maintenance information window" in relation
20 to the management/monitoring target "maintenance" of "compressor". Moreover, the apparatus-to-display definition storage 204 stores the definition information "compressor energy information window" in relation to the management/monitoring target "energy" of "compressor".

25 A user operates the input unit 208 and inputs user information. Firstly, the apparatus information obtaining unit 205 retrieves a role corresponding to the user information from the user information storage 101. Moreover, the apparatus information obtaining unit 205
30 retrieves the apparatus name corresponding to the retrieved role from the role-to-information storage 202.

The apparatus information obtaining unit 205 further retrieves a management/monitoring target, which is information corresponding to the apparatus name, from the role-to-information storage 202. The

5 management/monitoring target identifies a management and monitoring target of the apparatus.

The display controller 206 displays the above-mentioned information (management/monitoring target attribute) retrieved by the apparatus information
10 obtaining unit 205 and the apparatus name retrieved by the apparatus information obtaining unit 205 together on the display unit 207. Moreover, the display controller 206 displays a management/monitoring target attribute and the apparatus name together on the display unit 207 based
15 on a display definition-corresponding-to-apparatus corresponding to the management/monitoring target, which is stored in the apparatus-to-display definition storage 204. As described above, the apparatus-to-display definition storage 204 stores the display definition-
20 corresponding-to-apparatus.

For example, a user A inputs his ID and password to log in to the monitor-and-control system. A controller (not shown) performs a certification operation to thereby certify those input values. Then the apparatus
25 information obtaining unit 205 performs the above-mentioned operation. As a result, the display unit 207 displays information such as attributes and the like of the apparatus-to-be-controlled "compressor". The "compressor" is in relation to the role "operation
30 management" in relation to the user A. Moreover, the information is displayed based on the definition

"compressor operation information window" stored in the apparatus-to-display definition storage 204. Note that a display window definition may be set as each role and each reference classification such as "operation" in relation to the role. For example, the dedicated definition "compressor energy window" may be set as "compressor" of "working plan". In this case, the window is displayed without reference to the apparatus-to-display definition storage 204.

As described above, also according to Embodiment 2, if user information is input, an apparatus name and corresponding information can be selected in relation to the role set as the input user information, and can be displayed. As a result, a user of the system can obtain information necessary for him from the monitor-and-control system easily.

[Embodiment 3]

Next, Embodiment 3 of the present invention will be described with reference to Fig. 8. Fig. 8 is a configuration diagram showing the configuration of a monitor-and-control system of Embodiment 3 of the present invention. The monitor-and-control system includes the user information storage 101, the role-to-information storage 302, the management/monitoring target and attribute storage 203, the apparatus-to-display definition storage 204, the apparatus information obtaining unit 205, the display controller 306, the display unit 207, and the input unit 208. Moreover, the role-to-information storage 302 stores a display definition-corresponding-to-role 304.

Note that the user information storage 101, the

management/monitoring target and attribute storage 203,
the apparatus-to-display definition storage 204, the
apparatus information obtaining unit 205, the display
unit 207, and the input unit 208 are similar to those of
5 the above-mentioned Embodiment 2. Description thereof
will be omitted.

The role-to-information storage 302 stores an
apparatus name showing an apparatus-to-be-controlled and
information on the apparatus in relation to each role.
10 For example, the role-to-information storage 302 stores a
management/monitoring target, i.e., information on an
apparatus, in relation to each role. The
management/monitoring target identifies a management and
monitoring target of an apparatus. Moreover, the display
15 definition-corresponding-to-role 304 stored in the role-
to-information storage 302 is a definition, which is used
to display a management/monitoring target attribute in
relation to the above-mentioned role.

For example, as shown in Fig. 9, the role-to-
20 information storage 302 stores the apparatus names
"compressor" and "dryer" and the management/monitoring
targets "operation", "maintenance", "energy", and the
like in relation to roles. The apparatus name shows an
apparatus-to-be-controlled. The management/monitoring
25 targets are information on those apparatuses. Moreover,
in the example of Fig. 9, the role-to-information storage
302 stores information to be shared such as "alarm
confirmation" or "handover" in relation to each role.
Moreover, "operation management", "maintenance
30 management", and "working plan" are set as roles. In
addition, the role-to-information storage 302 stores a

display definition in relation to each role. For example, the role-to-information storage 302 stores the display definition "display definition-corresponding-to-apparatus" in relation to the role "operation management".

5 The display controller 306 displays the above-mentioned information (management/monitoring target attribute) retrieved by the apparatus information obtaining unit 205 and the apparatus name retrieved by the apparatus information obtaining unit 205 together on
10 the display unit 207. Moreover, the display controller 306 displays the management/monitoring target attribute and the apparatus name together on the display unit 207 based on the display definition-corresponding-to-role 304 corresponding to a role, which is stored in the role-to-
15 information storage 302.

 For example, a user A inputs his ID and password to log in to the monitor-and-control system. A controller (not shown) performs a certification operation to thereby certify those input values. Then the apparatus
20 information obtaining unit 205 performs the above-mentioned operation. As a result, the display unit 207 displays information such as attributes and the like of the apparatus-to-be-controlled "compressor". The "compressor" is in relation to the role "operation
25 management" in relation to the user A. Moreover, the information is displayed based on "display definition-corresponding-to-apparatus" of the display definition-corresponding-to-role 304 corresponding to the role. The display definition-corresponding-to-role 304 is stored in
30 the role-to-information storage 302.

 As described above, also according to Embodiment 3,

if user information is input, an apparatus name and corresponding information can be selected in relation to the role set as the input user information, and can be displayed. As a result, a user of the system can obtain information necessary for him from the monitor-and-control system easily.

Moreover, as shown in Fig. 10, the above-mentioned monitor-and-control system of Embodiment 3 displays information on the display unit 207. For example, the display unit 207 displays information on operation of a compressor. Moreover, attribute values of the target compressor are displayed in the area 271. Moreover, icons such as buttons are displayed in the area 272. The buttons are used to select other classification of the compressor to be displayed. Information common to all the roles are displayed in the area 273. For example, if a user operates the arrow key 272a or 272d in the area 272, an information window of an apparatus having the same level such as a dryer is displayed. Moreover, for example, if a user operates the arrow key 272b, an information window of an apparatus, whose level is upper than that of the compressor, such as an air-supply facility is displayed. If a user operates the arrow key 272c, a lower-level information window showing a pressure schedule or the like is displayed. In this display, the icons displayed in the area 272 are changed depending on a display definition corresponding to a role.

[Embodiment 4]

Next, Embodiment 4 of the present invention will be described with reference to Fig. 11. Fig. 11 is a configuration diagram showing the configuration of a

monitor-and-control system of Embodiment 4 of the present invention. The monitor-and-control system includes the user information storage 101, the role-to-information storage 102, the apparatus information obtaining unit 103, the display unit 105, and the input unit 106. The configurations thereof are similar to those of the above-mentioned Embodiment 1.

In Embodiment 4, the monitor-and-control system further includes the authority information storage 402, the management/monitoring target authority definition storage 403, the access controller 404, and the display controller 405 in addition to the above-mentioned blocks.

The authority information storage 402 stores access authority for information on an apparatus in relation to each role. For example, as shown in Fig. 12, firstly, the authority information storage 402 stores the management/monitoring targets "operation", "maintenance", "energy", and the like in relation to each role such as "operation management", "maintenance management", or "working plan". The "operation", "maintenance", "energy", and the like are reference classification. The authority information storage 402 stores "entire operation", "partial operation", "monitoring", or "no" in relation to each reference classification. For example, the authority "entire operation" is set as the management/monitoring target "operation" of the role "operation management". The "entire operation" means that the entire operation is allowed.

The management/monitoring target authority definition storage 403 classifies and defines access authority, which can be accepted by information on an

apparatus-to-be-controlled, for each management/monitoring target. For example, as shown in Fig. 13, acceptable access authority (readout minimum authority, change minimum authority, etc.) of information on an apparatus-to-be-controlled ("compressor", "dryer", etc.) is defined for each management/monitoring target ("operation", "maintenance", "energy", etc.).

The access controller 404 validates or invalidates access to information displayed on the display unit 207, which is controlled by the display controller 405, based on access authority. The access authority is stored in the authority information storage 402 in relation to each role corresponding to input user information.

Here, similar to the display controller 104 of the above-mentioned Embodiment 1, the display controller 405 displays the information retrieved by the apparatus information obtaining unit 103 and the apparatus name retrieved by the apparatus information obtaining unit 103 together on the display unit 105. In addition, the display controller 405 changes a symbol of information displayed on the display unit 105 corresponding to validation or invalidation controlled by the access controller 404.

For example, a user A inputs his ID and password to log in to the monitor-and-control system. A controller (not shown) performs a certification operation to thereby certify those input values. Then the apparatus information obtaining unit 103 performs the above-mentioned operation. As a result, firstly, the display unit 105 displays information such as attributes and the like of the apparatus-to-be-controlled "compressor". The

"compressor" is in relation to the role "operation management" in relation to the user A.

Moreover, the access controller 404 validates or invalidates access. The display controller 405 controls the display unit 105 based on the validation or invalidation. In this display, a user is not capable of selecting information on invalidated access authority of a role in relation to the user A. Moreover, the displayed symbol on this information is different from a symbol showing validated access authority.

As described above, also according to Embodiment 4, if user information is input, an apparatus name and corresponding information can be selected in relation to the role set as the input user information, and can be displayed. Moreover, access to information can be controlled corresponding to a role. As a result, a user of the system can obtain information necessary for him from the monitor-and-control system easily while confidentiality is preserved.

As shown in Fig. 10, the above-mentioned monitor-and-control system of Embodiment 4 displays information on the display unit 105. For example, the display unit 105 displays information on operation of a compressor. Moreover, attribute values of the target compressor are displayed in the area 151. Moreover, icons such as buttons are displayed in the area 152. The buttons are used to select other classification of the compressor to be displayed. Information common to all the roles are displayed in the area 153. In this display, the icons displayed in the area 152 are changed depending on a display definition corresponding to a role. Moreover, in

the area 151, the "operate" buttons and the "stop" button are used to control start and stop, and correspond to the access authority of the role of a user, who logged in to the monitor-and-control system. If the user does not
5 have access authority, operation is invalidated. In addition, if the user does not have access authority, the symbol is displayed in a different manner. For example, the displayed button is darker than the background.

Note that the present invention is not limited to
10 the above-mentioned embodiments. It is obvious that people skilled in the art may variously modify and combine techniques within the technical scope of the present invention. For example, in the above-mentioned embodiments, the role-to-information storage 302 stores
15 the display definition-corresponding-to-role 304.

Alternatively, another database different from the role-to-information storage 302 may store the display definition-corresponding-to-role 304.

What is claimed is:

1. A monitor-and-control system, comprising:

user information storage configured to store user information identifying a user and a role corresponding to the user;

role-to-information storage configured to store an apparatus name showing an apparatus-to-be-controlled and information on the apparatus in relation to the role;

an apparatus information obtaining unit configured to retrieve a role corresponding to an input user information from the user information storage, and

to retrieve an apparatus name corresponding to the retrieved role and corresponding information from the role-to-information storage; and

a display controller configured to display the information retrieved by the apparatus information obtaining unit and the apparatus name retrieved by the apparatus information obtaining unit together on a display unit, wherein

the role-to-information storage stores a management/monitoring target in relation to the role, the management/monitoring target being the information on the apparatus, the management/monitoring target identifying a management and monitoring target of the apparatus,

the monitor-and-control system further comprises management/monitoring target and attribute storage configured to store an attribute of the management/monitoring target of the apparatus in relation to the apparatus name,

the apparatus information obtaining unit is configured to retrieve an apparatus name and a management/monitoring target corresponding to the retrieved role from the role-to-information storage, and

the display controller is configured to display the management/monitoring target attribute retrieved by the

apparatus information obtaining unit and the apparatus name retrieved by the apparatus information obtaining unit together on the display unit.

2. The monitor-and-control system according to claim 1, further comprising:

apparatus-to-display definition storage configured to store a display definition-corresponding-to-apparatus in relation to the management/monitoring target, the display definition-corresponding-to-apparatus being used to display the management/monitoring target attribute, wherein

the display controller is configured to display the management/monitoring target attribute and the apparatus name together on the display unit based on a display definition-corresponding-to-apparatus, the display definition-corresponding-to-apparatus corresponding to the management/monitoring target, the display definition-corresponding-to-apparatus being stored in the apparatus-to-display definition storage.

3. The monitor-and-control system according to claim 1 or 2, further comprising:

display definition-corresponding-to-role storage configured to store a display definition-corresponding-to-role in relation to the role, the display definition-corresponding-to-role being used to display the management/monitoring target attribute, wherein

the display controller is configured to display the management/monitoring target attribute and the apparatus name together on the display unit based on a display definition-corresponding-to-role corresponding to the role stored in the display definition-corresponding-to-role storage.

4. The monitor-and-control system according to any one of claims 1 to 3, further comprising:

authority information storage configured to store an access authority for the information on the apparatus in relation to the role; and

an access controller configured to validate and invalidate access to information based on an access authority, the information being displayed by the display controller on the display unit, the access authority being stored in the authority information storage in relation to a role corresponding to input user information, wherein

the display controller is configured to change a symbol of information displayed on the display unit corresponding to validation and invalidation controlled by the access controller.

5. The monitor-and-control system according to any one of claims 1 to 4, wherein

the management/monitoring target includes an operation status of the apparatus, a maintenance status of the apparatus, and a working status of the apparatus.