

DESCRIPTION

CONTROL DEVICE FOR ENERGY-CONSUMING DEVICE,
CONTROL METHOD FOR ENERGY-CONSUMING DEVICE, AND
CONTROL SYSTEM FOR ENERGY-CONSUMING DEVICE

Technical Field

[0001]

The present invention relates to a control device for an energy-consuming device, a control method for the energy-consuming device, and a control system for the energy-consuming device, particularly to a control device for an energy-consuming device, a control method for the energy-consuming device and a control system for the energy-consuming device, all of which control the energy-consuming device in accordance with an operation pattern corresponding to an operation mode set for the energy-consuming device.

Background Art

[0002]

As a control system for energy-consuming devices, a system in which by installing a home server is installed in a house, an electrical device in the house is controlled and also to monitor the situation of power consumption situation in the house, namely the so-called HEMS (Home Energy Management System) is attracting attention in recent years. In the HEMS, by communicating with each electrical device and a power sensor through a network built in the home, the home server outputs

a control signal to the electrical device and gathers information on power usage from the electric sensor.

[0003]

On the other hand, control systems for energy-consuming devices include those which have, with respect to each energy-consuming device, an operation pattern stored in advance and defining in what period of time and under what operation condition the energy-consuming device is operated, and controls the energy-consuming device in accordance with the pattern (for example, see Patent Documents 1 and 2).

[0004]

The technique described in the Patent Document 1 transmits control signals to each of a plurality of air conditioners in accordance with the operation pattern of time series stored in an operation schedule database. Furthermore, in the technique described in Patent Document 1, when an operation schedule of multiple air conditioners is set, it is possible to select and set a typical operation pattern stored in an operation setting database as an operation pattern in a prescribed time period. With the above configuration, an operation schedule may be set easily without setting of an operation schedule for each of the air conditioners individually.

[0005]

The technique described in the Patent Document 2 provides that as an energy-saving schedule to be provided to a controller for controlling an air conditioner, a plurality of energy-saving schedules of different degrees of saving are

provided. With this configuration, the energy saving schedule to be referred by the controller may be switched depending on the situation, and as a result, an operation control of the air conditioner at energy saving degrees loosened stepwise becomes possible without discontinuation of the energy-saving control of the air conditioner.

[0006]

Normally, a control system for an energy-consuming device is provided with a plurality of operation patterns have been prepared, and the operation pattern to be employed among them is determined through a predetermined selecting operation by the user. To facilitate the selection of the operation pattern by the user, an operation mode corresponding to each operation pattern has been also set. Described specifically, the user selects one of such a plurality of operation modes set for the energy-consuming device, and by receiving the user selection result, the control of the energy-consuming device is executed in accordance with the operation pattern corresponding to the selected operation mode.

Citation List

Patent Documents

[0007]

Patent Document 1: JP 2007-183035 A

Patent Document 2: JP 2011-242045 A

DISCLOSURE OF THE INVENTION

Problem to be Solved by the Invention

[0008]

With the conventional systems, however, a situation may arise that a control signal is transmitted to the energy-consuming device in accordance with the above-mentioned operation patterns but it is not certain if the operation state of the energy-consuming device has changed to a state corresponding to the control signals. In this case, the confirmation of the operation of the energy-consuming device in accordance with the above-mentioned operation pattern needs to visit the place of installation of the energy-consuming device or the place of use of the function of the energy-consuming device and to visually recognize the operation state of the device.

[0009]

With regard to the energy-consuming device to be controlled in the system, their types are determined by the preference of the user, leading, for example, to a situation that their communication protocols (communication standards) to be used when communicating with a home server are not the same among the energy-consuming devices. It is difficult for the user to recognize such differences in communication protocol and to reflect them to the control of the devices. Described specifically, it is difficult for the user, especially for those who are not accustomed to create programs to create programs (electronic messages) used at the time of requesting a control device for an energy-consuming device such as the home server to control the energy-consuming device, in consideration of the differences in the communication protocols of the respective devices.

[0010]

The present invention has been made in view of the above problems, and has as an object thereof the provision of a control device for an energy-consuming device, which in a configuration of controlling the energy-consuming device in accordance with an operation pattern corresponding to an operation mode selected by the user, may confirm reliable control of the energy-consuming device.

Another object of the present invention is to provide a control device for energy-consuming device, which, even if there is an energy-consuming device whose communication protocol is different from the others among the devices to be controlled, may request the control of each energy-consuming device without taking the differences in communication protocol into consideration on the side of the user.

A further object of the present invention is to provide, as a method for controlling an energy-consuming device in accordance with an operation pattern corresponding to an operation mode selected by the user, to provide a control method for the energy-consuming device, which may confirm that the energy-consuming device is reliably controlled. A still further object of the present invention is to provide, as a system for controlling an energy-consuming device in accordance with the operation pattern corresponding to an operation mode selected by the user, a control system for the energy-consuming device, which may confirm that the energy-consuming device is reliably controlled.

MEANS FOR SOLVING THE PROBLEMS

[0011]

According to a control device of the present invention for an energy-consuming device, the above-mentioned problems are solved. The control device according to the present invention is communicably connected to the energy-consuming device, and is provided with: a selected mode identification unit which among a plurality of operation modes which have been set for the energy-consuming device, identifies one selected by a user; a storage unit that stores operation patterns corresponding to the operation modes, each operation pattern defining in what period of time and under what operation condition the energy-consuming device is operated; an operation pattern reading unit which, among the operation patterns stored in the storage unit, reads an operation pattern corresponding to the selected mode identified by the selected mode identification unit; an operation condition identification unit which, based on the operation pattern read by the operation pattern reading unit, identifies the operation condition corresponding to a time point of control of the energy-consuming device; a control signal transmission unit which transmits, to the energy-consuming device, a control signal for controlling the energy-consuming device under the operation condition identified by the operation condition identification unit; and a response signal reception unit which receives a response signal transmitted from the energy-consuming device when the control signal transmitted from the control signal transmission unit is received by the energy-consuming device.

[0012]

According to the above-mentioned control device, it is possible to control the operation state of the energy-consuming device in accordance with the operation pattern that corresponds to the operation mode selected by the user. Furthermore, with the above-mentioned control device, the reception of a response signal transmitted from the energy-consuming device, which has received a control signal, makes it possible to determine whether the control of the energy-consuming device has been properly executed. In other words, with the configuration described above has realized a control device for an energy-consuming device, which may confirm that the energy-consuming device is reliably controlled.

[0013]

Further, the control device may communicate with a plurality of energy-consuming devices to control each of the plurality of energy-consuming devices and the storage unit may store the operation patterns, which are set individually for each of the plurality of energy-consuming devices, corresponding to each of the respective operation modes. The operation pattern reading unit may read, among the operation patterns stored in the storage unit, the operation pattern, which corresponds to the selected mode identified by the selected mode identification, for each of the energy-consuming devices, and the operation condition identification unit identifies, based on the operation pattern read by the operation pattern reading unit, the operation condition, which

corresponds to the time point of control of the energy-consuming device, for each of the energy-consuming devices. The control signal transmission unit may transmit, to each of the plurality of energy-consuming devices, the control signal for controlling the corresponding energy-consuming device in accordance with the operation condition identified by the operation condition identification for the corresponding energy-consuming device, and the response signal reception unit receives the response signal transmitted from each of the plurality of energy-consuming devices.

With the configuration described above, it becomes possible to control each of a plurality of energy-consuming devices in accordance with the operation pattern corresponding to the operation mode selected by the user. Furthermore, it becomes possible to verify whether the control of the energy-consuming devices has been executed properly for each energy-consuming device separately.

[0014]

Further, when the plurality of energy-consuming devices communicate using communication protocols different from each other, the control signal transmission unit changes a communication protocol, which is to be used when transmitting the control signal to the energy-consuming device, in accordance with the communication protocol used by the energy-consuming device as a destination. With the configuration described above, the switching of the communication protocol by the control device in accordance with the communication counterpart makes it possible to request the

control device to control the energy-consuming device without taking the difference in communication protocols on the side of the user.

[0015]

The selected mode identification unit may communicate with a user terminal which accepts a selection operation of the operation mode as conducted by the user to receive from the user terminal selection result data indicating a result of selection by the selection operation. The selected mode identification unit may then identify the selected mode based on the selection result data, and the selection result data may be an HTTP request.

With the configuration described above, the data that indicates the operation mode selected by the user is transmitted in the form of an HTTP request when it is transmitted from the user terminal to the control device. It is, therefore, not necessary on the side of the user to take into consideration the difference in communication protocol.

[0016]

In addition, the control device may select, as a control type upon controlling the energy-consuming device, a schedule control type or an individual control type. In the schedule control type, the energy-consuming device is controlled in accordance with the operation condition identified by the operation condition identification unit based on the operation pattern. In the individual control type, the energy-consuming device is individually controlled in accordance with an instructed condition indicated from the user terminal. When

the individual control type is selected, data indicating the instructed condition may be received from the user terminal in a form corresponding to a communication protocol used by the energy-consuming device to be controlled.

With the configuration described above, a control type may be selected from either the schedule control type as a control that does not need to take the communication protocol of the device, which is to be controlled, into consideration on the side of the user; or the individual control type as a control to be performed after the grasp of the communication protocol of the device, which is to be controlled, on the side of the user. When individual control type is selected, data indicating an instructed condition as the control condition is transmitted from the user terminal in the format corresponding to the communication protocol of the device to be controlled. As a result, there is no need to make a change or the like to the communication protocol on the side of the control device, thereby making it possible to simplify the processing.

[0017]

An update unit may also be provided for updating the operation patterns stored in the storage unit, and the update unit communicates with the user terminal which receives a modification operation by the user to the operation patterns stored in the storage unit, and receives modification result data indicating a modification result of the modification operation from the user terminal. On the basis of the modification result data, the update unit may then update the operation patterns stored in the storage unit.

With the configuration described above, it becomes possible to modify the operation pattern according to a desire of the user. It is hence possible to realize more effective control of the energy-consuming device.

[0018]

Further, the control device may control the energy-consuming device which is to be used in a building, and in the storage unit, installation location information, which indicates an installation location of the energy-consuming device in the building, and the operation patterns may be stored in a mutually-associated state.

With the configuration described above, the installation location of the energy-consuming device is managed on the side of the control device, and the installation location and the operation patterns are associated with each other. After grasping at what location and in which operation pattern the energy-consuming device is to be controlled, it is thus possible to appropriately control the energy-consuming device.

[0019]

According to a control method of the present invention for an energy-consuming device, the above-mentioned problems are also solved. The control method controls the energy-consuming device by communicating with the energy-consuming device. The control method includes: identifying among a plurality of operation modes set for the energy-consuming device, one selected by a user; reading, from a storage unit that stores operation patterns corresponding to the operation modes, each operation pattern defining in what

period of time and under what operation condition the energy-consuming device is operated, the operation pattern corresponding to the identified selected mode; identifying, based on the operation pattern so read, the operation condition corresponding to a time point of control of the energy-consuming device; transmitting, to the energy-consuming device, a control signal for controlling the energy-consuming device under which the operation condition so identified; and receiving a response signal transmitted from the energy-consuming device when the control signal so transmitted is received by the energy-consuming device.

By using the above method, it becomes possible to control the energy-consuming device in accordance with the operation pattern corresponding to the operation mode selected by the user, and further, it becomes possible to verify whether the control of the energy-consuming device has been executed properly.

[0020]

According to a control system of the present invention for an energy-consuming device, the aforementioned problems are solved. The control system has the energy-consuming device and a control device for the energy-consuming device. The control device and energy-consuming device are communicably connected to each other. The control device is provided with a selected mode identification unit which among a plurality of operation modes which have been set for the energy-consuming device, identifies one selected by a user, a storage unit that stores operation patterns corresponding to the operation modes, each operation pattern defining in what period of time and under what

operation condition the energy-consuming device is operated, an operation pattern reading unit which, among the operation patterns stored in the storage unit, reads an operation pattern corresponding to the selected mode identified by the selected mode identification unit, an operation condition identification unit which, based on the operation pattern read by the operation pattern reading unit, identifies the operation condition corresponding to a time point of control of the energy-consuming device, a control signal transmission unit which transmits, to the energy-consuming device, a control signal for controlling the energy-consuming device under the operation condition identified by the operation condition identification unit, and a response signal reception unit which receives a response signal transmitted from the energy-consuming device when the control signal transmitted from the control signal transmission unit is received by the energy-consuming device.

According to the above system, it becomes possible to control the energy-consuming device in accordance with the operation pattern corresponding to the operation mode selected by the user, and further, it becomes possible to verify whether the control of the energy-consuming devices has been executed properly.

Advantageous Effects of the Invention

[0021]

According to the control device, control method, and control system of the present invention for the energy-consuming device, it is possible to control the

energy-consuming device in accordance with the operation pattern corresponding to the operation mode selected by the user, and further, it becomes possible to verify whether the control of the energy-consuming device has been executed properly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

Fig. 1 is a diagram showing a schematic configuration example of the control system according to the present invention for the energy-consuming device;

Fig. 2 is a diagram showing a hardware configuration of the control device according to the present invention;

Fig. 3 is an explanatory diagram of a memory of the control device according to the present invention;

Fig. 4 is a diagram showing a software configuration of the control device according to the present invention;

Fig. 5 is an explanatory diagram of data transmission between a user terminal, the control device and the energy consuming device in the control system according to the present invention for the energy-consuming device;

Fig. 6 is a diagram showing an example of an operation pattern set for the energy-consuming device;

Fig. 7 is a diagram showing a correspondence relationship between installation locations and operation patterns of energy-consuming devices;

Fig. 8 is a diagram showing preset patterns of operation modes;

Fig. 9 is a block diagram showing configuration examples of respective units of the control system according to the present invention;

Fig. 10 is a diagram showing a procedure example of the control method according to the present invention;

Fig. 11 is a diagram showing an example of a procedure for steps of schedule control;

Fig. 12 is a diagram showing an example of an operation mode selection screen;

Fig. 13 is a diagram showing an example of an operation pattern modification screen; and

Fig. 14 is a diagram showing an example of a verification screen of control situations.

DETAILED DESCRIPTION OF THE INVENTION

[0023]

With regard to the control device, control method, and control system according to the present invention for the energy-consuming device, their examples will hereinafter be described with reference to Figs. 1 to 14.

[0024]

Taking a house H as an example of a building where energy-consuming devices are used, a description will hereinafter be made about a control device, control method and control system for controlling electrical devices used in the house H will be described. However, the present invention may be also applied to energy-consuming devices other than the electrical devices, for example, when controlling one or more

devices that consume gas, water and/or the like. Similarly the house H is merely an example of a building where energy-consuming devices are used, so that the present invention is also applicable when controlling energy-consuming devices used in a building other than the house H, such as a commercial building, a building in a factory or a shop. It is to be noted that the term "the house H" is a concept that also embraces a single room in an apartment complex, such as a condominium, in addition to a single-family house.

[0025]

<<Overall configuration of the control system for energy-consuming devices>>

Referring first to Fig. 1, the overall configuration of a control system S according to an embodiment of the present invention (hereinafter, the system) for energy-consuming devices will be described.

The system S is a system that a home server 1 installed in a house H controls the electrical devices in the house H by communicating with the electrical devices, that is, the so-called "HEMS". Described specifically, in the house H equipped with this system S, the home server 1 is disposed as a control device for energy-consuming devices, and the home server 1 communicates with each electrical device in the house H through a home network 5. In addition, the home server 1 is communicably connected to a power data logger 7 through the home network 5.

[0026]

With the configuration described above, a resident in the house H (hereinafter, the user), may remotely operate the electrical devices through the home server 1, and based on the data collected from the power data logger 7, may view and confirm the power consumption of the house H.

[0027]

It is to be noted that the user employs a user terminal 3 as an interface upon using the function of the home server 1 described above. Described specifically, the user may request the home server 1 to transmit data or to control each electrical device by performing a predetermined input operation through the user terminal 3. Here, the user terminal 3 is a communication terminal composed of a PDA, a smart phone, a PC, an operation panel or the like, and executes a predetermined processing by receiving an input operation from the user.

[0028]

In the following description, a case where the user terminal 3 is a PDA used in the house H will be described. More specifically, a description will hereinafter be made about the user terminal 3 which communicates with the home server 1 via a router (not shown). However, the invention shall not be limited to this configuration, and the user terminal 3 may be one which communicates with the home server 1 through the external network such as the Internet.

[0029]

In the system S, the home server 1, in response to control requests made by the user via the user terminal 3, may individually control the corresponding electrical devices in

the house H. In the system S, the home server 1 may also perform schedule control that controls a plurality of electrical devices of the same type installed in the house H, for example, each of a plurality of air conditioners in accordance with a preset schedule. In other words, the home server 1 controls each of the plurality of air conditioners by communicating simultaneously with the plurality of air conditioners in the schedule control.

[0030]

A description will be made in brief about the schedule control. For each of the plurality of air conditioners installed in the house H, an operation pattern defining in what periods of time (more specifically, what time periods of a day) and under what operation conditions the air conditioner is operated are set and stored in the home server 1 in advance. When the user requests the execution of the schedule control, the home server 1 reads out the operation pattern set for each air conditioner, and for each air conditioner, identifies the operation condition corresponding to the execution time of the schedule control based on the operation pattern. Then, the home server 1 controls the respective air conditioners under the corresponding operation conditions identified for the respective air conditioners.

[0031]

It should be noted that, although the operation pattern will be described in detail in a subsequent item, the contents of "in what periods of time and under what operation conditions the air conditioner is operated" which is defined by the

operation pattern are intended to include the contents that "during what period of time the air conditioner is kept off".

Although the installation of the four air conditioners is illustrated by way of example in Fig. 1, the number of such air conditioners is not particularly limited, and may be set to any number. Although the four air conditioners installed in the house H are to be subject to the schedule control in the system S, those to be subjected to the schedule control are not intended to be limited to them either, and a plurality of other electrical devices installed in the house H, for example, lighting devices may also be subject to the schedule control.

[0032]

<<Configuration of the home server>>

Next, the configuration of the home server 1 will be described with reference to Figs. 2 to 4.

As described above, the home server 1 corresponds to the control device of the present invention, and is communicably connected to the electrical devices in the house H. In the system S, the home server 1 is composed of a so-called home gateway, and as shown in Fig. 2, has a CPU 1a, a memory 1b and a communication interface 1c. In the memory 1b which the home server 1 is provided with, the operation patterns described above are stored corresponding to the air conditioners in an operation pattern storage area 1s illustrated in Fig. 3.

[0033]

In an installation location storage area 1t illustrated in Fig. 3 and included in the above memory 1b, installation location information - which indicates the locations of

installation in the house H of the electrical devices used in the house H, led by the air conditioners - is stored. When inspecting the state of connection between the home server 1 and each electrical device during the construction stage of the house H, the installation location information is written into the memory 1b through a predetermined input device by an inspector. However, the manner of acquisition of the installation location information shall not be limited to the above case, and the installation location information may be acquired by determining the installation locations of the individual electrical devices from data representing construction drawings of the house H.

[0034]

In a bundle storage area 1u illustrated in Fig. 3, application programs (hereinafter, the bundles) are stored. The bundles are to be executed by CPU 1a in order to allow the home server 1 to perform its function. The bundles stored in the bundle storage area 1u include a communication bundle that is to be executed when the home server 1 communicates with the respective electrical devices.

[0035]

Now, in the house H equipped with the HEMS, it is generally recommended to use electrical devices that employ a common communication protocol (synonymous with a communication mode and a communication standard). For example, it is desired that such devices are unified into those which adopt a communication protocol proposed by the ECHONET consortium. As the protocol proposed by the ECHONET consortium, however, there are

different versions, one being the ECHONET (registered trademark) and the other the ECHONETLite (registered trademark) which is a succession standard of the former, and there is a case where both the protocols are used together among the electrical devices in the house H. Further, electrical devices which a user purchases may use a communication protocol other than the ECHONET or the ECHONETLite.

[0036]

In the system S, the plurality of electrical devices used in the house H, described more specifically, the four air conditioners include at least one air conditioner which communicates in a communication protocol different from the remaining air conditioners. Therefore, in the bundle storage area 1u of the memory 1b, communication bundles to be used by the home server 1 for communications with communication counterparts in the house H are stored corresponding to communication protocols. In other words, the communication bundles as many as the number of the types of the communication protocols employed by the electrical devices in the house H are stored in the memory 1b of the system S.

[0037]

Described specifically, a bundle for communication using a first communication protocol (e.g., ECHONET), a bundle for communication using a second communication protocol (e.g., ECHONETLite), and a bundle for communication using a third communication protocol (for example, a communication protocol other than ECHONET and ECHONETLite) are stored in the bundle storage area 1u.

[0038]

Then, in the system S, among the communication bundles stored in the bundle storage area 1u, those to be read and executed are switched in accordance with the communication counterpart. The home server 1 may thus switch the communication protocol, which is to be employed when communicating with each air conditioner, in accordance with the communication protocol employed by the air conditioner as a communication counterpart. It is to be noted that the expression "to switch the communication protocol" is synonymous with rewriting an electronic message (command), which is to be transmitted by using a certain communication protocol, in accordance with another communication protocol upon transmitting the message to a communication device which uses the another communication protocol.

[0039]

Here, a description is made about the program execution environment in the home server 1. As shown in Fig. 4, the home server 1 includes an OS 101, a JAVA (registered trademark) virtual machine (hereinafter, JVM) 102, an OSGi (Open Services Gateway initiative) framework 103, and a variety of bundles that run on the OSGi framework 103.

[0040]

The OSGi framework 103 is built on the JVM 102, and manages a life cycle of the bundle that runs on the OSGi framework 103 such as a download, installation, a start-up, and a stop thereof. The bundle that runs on the OSGi framework 103 may be dynamically replaced, and as an alternative, it is possible to run a plurality of bundles in parallel.

[0041]

Bundles that run on the OSGi framework 103 include a bundle for communication using the first communication protocol (hereinafter, the first communication bundle) 104, a bundle for communication using the second communication protocol (hereinafter, the second communication bundle) 105, and a bundle for communication using the third communication protocol (hereinafter, the third communication bundle) 106, as described above.

[0042]

Among functions which the OSGi framework 103, the function of switching the bundle dynamically enables to replace the communication bundle, which is to be executed, in accordance with the communication protocol of the electrical device as a communication counterpart upon communication by the home server 1. Because of such replacement of the communication bundle, the communication protocol employed by the home server 1 is switched. As a result, despite the difference or differences in communication protocol, the home server 1 may communicate with the electrical device in the house H.

[0043]

When each communication bundle 104, 105 or 106 is registered in the OSGi framework 103, an interface for using the function of the communication bundle 104, 105 or 106 is registered in a service registry. The OSGi framework 103 provides a synthesis of these interfaces as an API (Application Program Interface). The use of this API obviates, on the user side, the need of considering differences in communication

bundle, that is, the differences in communication protocol among electrical devices. This means that, when developing a program that requests the home server 1 to control electrical devices, its developer may apply the common development method of Web communication programs once only object rules on the respective electrical devices are grasped, .

[0044]

Described this in a comprehensible way, the use of the above API upon requesting the home server 1 to communicate with each electrical device in the house H obviates the need to arrange a request electronic message in a format corresponding to the communication protocol of the electrical device, and a relatively simple electronic message suffices.

[0045]

This will be described in more detail. When the user requests the home server 1 to control each air conditioner, an HTTP request, specifically the selection result data, which will be described subsequently herein, is sent from the user terminal 3 to the home server 1 as shown in Fig. 5. On the other hand, upon receiving the HTTP request from the user terminal 3, the home server 1 communicates with the air conditioner and transmits a control signal to the air conditioner. As a result, the home server 1 starts to control the air conditioner as a control target in accordance with a control rule designated in the HTTP request. The communication protocol to be employed when the home server 1 transmits a control signal is set to the communication protocol employed by the air conditioner as a transmission destination of the control signal.

[0046]

The home server 1 further communicates with the air conditioner which has received the control signal, and receives a response signal from the air conditioner. Here, the communication protocol to be employed by the home server 1 is set to the communication protocol employed by the air conditioner as a transmission source of the response signal.

At the stage of completion of the control processing requested by the user, the home server 1 transmits, to the user terminal 3, data in the XML format (hereinafter, verification screen data) to picture a screen for the verification of the control status of each air conditioner. On the side of the user terminal 3, the verification screen data is loaded so that a verification screen shown in Fig. 14 is displayed on a display of the user terminal 3. By viewing the verification screen, the user may visually confirm that the control for each air conditioner is performed properly. The verification screen will be described in detail subsequently herein.

[0047]

As described above, the exchange of data between the user terminal 3 and the home server 1 is performed by a versatile communication protocol in the system S. On the other hand, communications between the home server 1 and the air conditioner in the system S are performed by the communication protocol conforming to the communication protocol adopted by the air conditioner. The user may, therefore, request the home server 1 to control each air conditioner without needing to consider

the difference or differences in protocol among the air conditioners.

[0048]

In the system, control signals and response signals in are data signals, and are transmitted and received through the home network 5. On the other hand, the home network 5 may be a wired communication network, or may be a wireless communication network. Here, the term "communication network" means a network that enables to perform two-way communications as communications between the home server 1 and each device as a communication target, and excludes a network that deals with communications in only one-way from the home server 1 to each device as a communication target.

[0049]

<<Control specifications of air conditioners>>

Control specifications of the air conditioners in the system S will be described next. In the following, described is a case where out of the four air conditioners installed in the house H, a first air conditioner (hereinafter, air conditioner A) is installed in a tea-ceremony room on the second floor, a second air conditioner (hereinafter, air conditioner B) is installed in a children's room on the second floor, a third air conditioner (hereinafter, air conditioner C) is installed in a living room on the first floor, and a fourth air conditioner (hereinafter, air conditioner D) is installed in a bedroom on the first floor.

[0050]

In the system S, the user may select a control type for the air conditioners through the user terminal 3. Control types that may be selected in the system S are an individual control type, a collective control type and a schedule control type. It is to be noted that these control types are merely illustrative and control types other than the above may also be included.

[0051]

The individual control type is a type that individually controls each air conditioner in the house H in accordance with an instructed condition indicated from the user terminal 3. Here, the term "instructed condition" means a control condition when the individual control type is selected, and is indicated by the user. Described specifically, when the individual control type is selected, the user indicates an operation mode of the air conditioner, such as on/off, cooling, heating and dehumidification, and operation control values such as temperature and humidity through the user terminal 3. Upon reception of such an indication, the home server 1 identifies the air conditioner as a control target, and controls it in accordance with the above instructed condition.

[0052]

When the individual control type is selected, the user terminal 3 transmits, to the home server 1, data, which indicates an instructed condition, in a format corresponding to the communication protocol used by each air conditioner to be subject to the individual control. Described specifically, when the communication protocol used by the air conditioner to

be subject to the individual control is the ECHONET, the user terminal 3 transmits, as data indicating the instructed condition, commands defined by the ECHONET device object. With such a configuration, when the individual control type is selected, data indicating an instructed condition is transmitted from the user terminal 3 in a format corresponding to the communication protocol of the air conditioner to be subject to the individual control. As a result, it is no longer needed to perform a change or the like to the communication protocol on the side of the home server 1, and thus the processing for the control is simplified.

[0053]

The collective control type is a type in which the air conditioners in the house H are controlled all together. When the user selects the collective control type, the home server 1 performs control to turn off all the air conditioners in the house H.

[0054]

The schedule control type is a type in which the one-day operation of each of the air conditioners in the house H is controlled in accordance with the operation pattern set beforehand for the air conditioner. Here, the term "operation pattern" means one that defines in what period of time and under what operation condition the air conditioner is operated, and indicates a time schedule on the operation control of an air conditioner as shown in Fig. 6. Described more specifically, the operation pattern defines what period of time is set as an ON period or OFF period in a day. The operation pattern also

defines under how much load the air conditioner is operated during the ON period, specifically at which set temperature the air conditioner is operated.

[0055]

In the system S, when the user selects the schedule control type, the selection of an operation mode is further required. The operation mode corresponds to a control policy in the schedule control, and a plurality of operation modes are set for each air conditioner in the house H. Operation modes selectable in the system S are a mode X, a mode Y and a mode Z. It is to be noted that these modes are merely examples of the operation mode, and one or more modes other than the above may also be included.

[0056]

The mode X is a mode that according to the lifestyle of the user, controls the operation of the air conditioner installed in only each room of high use frequency. The mode Y is a mode that according to the user's life rhythm, switches each air conditioner as a control target depending on the time period. The mode Z allows all the air conditioners installed in the house H to perform continuous operation for 24 hours and, in addition, controls the set temperature of each air conditioner according to the user's life rhythm.

[0057]

For each operation mode, an operation pattern is set corresponding to each air conditioner. If the schedule control is performed in one of the operation modes, the home server 1, therefore, identifies the operation pattern corresponding to

the operation mode for each air conditioner and, in accordance with the operation pattern so identified for the air conditioner, controls the corresponding air conditioner.

[0058]

Described more specifically with reference to Fig. 7, when the user selects the mode X from among the three operation modes, the home server 1 identifies, for each air conditioner, the operation pattern that corresponds to the mode X. Here, the operation pattern to be applied to the air conditioner A when the mode X is selected is a pattern A as shown in Fig. 7. Likewise, when the mode X is selected, the operation pattern to be applied to the air conditioner B is a pattern B, the operation pattern to be applied to the air conditioner C is a pattern C, and the operation pattern to be applied to the air conditioner D is a pattern D. Based on such a correspondence relationship, the home server 1 identifies, for each air conditioner, the operation pattern that corresponds to the mode X.

[0059]

In the system S, the operation pattern to be applied in each operation mode is, as shown in Fig. 7, associated not only with a device ID as identification information of the air conditioner, but also with an air conditioner installation location and a type of the installation location. In other words, the operation pattern to be applied in each operation mode, the device ID and the installation location of the corresponding air conditioner, and the type of the installation location are stored in the memory 1b of the home server 1 in the state of

being associated with one another. This is because the operation pattern originally stored in the memory 1b of the home server 1 (hereinafter, a preset pattern) is determined by the operation mode and the type of the air conditioner installation location.

[0060]

The preset pattern will be described with reference to Fig. 8. The operation pattern that is applied to each air conditioner in each operation mode is initially set to a preset pattern. As shown in Fig. 8, the preset patterns are provided for each operation mode and are stored in the memory 1b of the home server 1 with the preset pattern in a form that they are associated with the type of installation location of the air conditioner. Here, the expression "the type of installation location" means a concept indicating the room style to which the location belongs (for example, a Japanese-style room, a Western-style room, or the like), or the use of the room (for example, a children's room, a tea-ceremony room, or the like).

As long as no modification is made to the operation pattern, the home server 1 controls, upon execution of the schedule control, each air conditioner in accordance with the preset pattern corresponding to the type of installation location of each air conditioner. If the operation mode X is selected, for example, the air conditioner C installed in the living room on the first floor is controlled in accordance with the preset pattern shown at the top in Fig. 8.

[0061]

On the other hand, it is possible to modify the operation pattern. Described specifically, when the user performs a modification operation to the operation pattern through the user terminal 3, the operation pattern designated as the modification target is modified on the side of the home server 1 based on the modification result in the modification operation. Because a modification is possible to each operation pattern in the system S, the operation pattern may be customized in accordance with the user's request.

[0062]

<<Configuration of each unit of the system>>

Referring next to Fig. 9, the configuration of each unit of the system S will be described in terms of its function. With respect to the air conditioners, the user terminal 3, and the home server 1 among the devices that the system S is provided with, their configurations will hereinafter be described respectively.

[0063]

(Air conditioners)

As shown in Fig. 9, the four air conditioners each include a control signal reception unit 31, a control unit 32 and a response signal transmission unit 33. The control signal reception unit 31, control unit 32 and response signal transmission unit 33 are constituted by a microcomputer, a control circuit and a communication interface incorporated in the air conditioner. The control signal reception unit 31 receives, via the home network 5, a control signal transmitted from the home server 1. The control unit 32 controls the air

conditioner itself in response to the control signal which the control signal reception unit 31 has received.

[0064]

When the control signal reception unit 31 has received the control signal and the control unit 32 has controlled the air conditioner itself, the response signal transmission unit 33 generates a response signal for its notification, and transmits the response signal to the home server 1. In particular, the response signal transmission unit 33 provided in the system S transmits a signal, which indicates the operation state of the air conditioner at the stage of having been controlled on the basis of the control signal, as a response signal to the home server 1.

[0065]

(User terminal)

As shown in Fig. 9, the user terminal 3 includes an operation reception unit 21, a data generation unit 22, a data transmission unit 23, a data reception unit 24, and a display unit 25. The operation reception unit 21 is constituted by a touch panel provided in the user terminal 3 and accepts an input operation from the user. It is to be noted that operations, which the operation reception unit 21 accepts, include a selection operation of the operation mode by the user.

[0066]

Described specifically, upon selection of an operation mode, the operation mode selection screen shown in Fig. 12 is pictured on the touch panel of the user terminal 3, and a selection button Ta1 labelled "MODE X", a selection button Ta2

labelled "MODE Y", and a selection button Ta3 labelled "MODE Z" are displayed on the screen. In order to select one mode from among the three operation modes, the user presses the button, on which the name of the mode to be selected is labelled, among the three selection buttons Ta1, Ta2 and Ta3. The input operation described above corresponds to the operation mode selection operation to be carried out by the user, and the operation reception unit 21 receives the selection operation.

[0067]

It is to be noted that the operations which the operation reception unit 21 receives include a user's modification operation to any one of the operation patterns stored in the memory 1b of the home server 1.

[0068]

Described specifically, the update buttons Tb1, Tb2 and Tb3 illustrated in Fig. 12 are displayed on the operation mode selection screen described above. The update buttons Tb1, Tb2 and Tb3 are provided in a form corresponding to the respective operation modes and are disposed on the right sides of the corresponding selection buttons Ta1, Ta2 and Ta3 described above. When the button corresponding to the operation mode to which the operation pattern to be modified belongs is pressed among the update buttons Tb1, Tb2 and Tb3, the operation pattern modification screen shown in Fig. 13 is pictured on the touch panel of the user terminal 3. On this operation pattern modification screen, the operation pattern to which the modification is planned is displayed. When the user then conducts a predetermined operation on the screen, for example,

an operation of touching the displayed operation pattern, a modification panel Tc for modifying the operation pattern is popped up.

[0069]

In input fields Tc1 and Tc2 of the time period on the modification panel Tc, the user inputs the start time and the end time of the time period, and in the input field of operation condition Tc3, also inputs the operation condition to be applied in the time period identified by the clock times inputted in the input fields Tc1 and Tc2,. The input operation described above corresponds to the modification operation by the user for the operation pattern, and the operation reception unit 21 accepts the modification operation.

[0070]

The data generation unit 22 is composed of a CPU and a memory of the user terminal 3 and a program installed in the user terminal 3, and generates data indicating the contents of the input operation of the user which the operation reception unit 21 has received (hereinafter, the input data) .

[0071]

The data transmission unit 23 serves to transmit the input data described above to the home server 1 through the home network 5, and is constituted by the CPU, the memory and a communication interface of the user terminal 3 and a communication program installed in the user terminal 3.

[0072]

It is to be noted that the input data, which the data transmission unit 23 transmits to the home server 1, includes

selection result data representing the selection result in the operation mode selection operation conducted by the user, and modification result data that indicates the modification result of the user's modification operation to the operation pattern. When the data transmission unit 23 transmits the selection result data or the modification result data to the home server 1 in the system S, these pieces of data are transmitted as an HTTP request. Described more specifically, the data transmission unit 23 transmits the input data to the home server 1 in accordance with the REST (Representational State Transfer).

[0073]

The data reception unit 24 serves to receive data from the home server 1 through the home network 5, and is constituted by the CPU, memory and communication interface of the user terminal 3 and a communication program installed in the user terminal 3. The data received from the home server 1 by the data reception unit 24 includes the verification screen data described above. In the system S, the above-mentioned verification screen data which the data reception unit 24 receives from the home server 1 is data in the XML format.

[0074]

The display unit 25 expands the verification screen data which has been received by the data reception unit 24, and pictures the verification screen shown in Fig. 14 on the touch panel of the user terminal 3. The display unit 25 is composed of the CPU and memory of the user terminal 3, and a program installed in the user terminal 3. Since the verification screen

data received by the data reception unit 24 is data in the XML format, the display unit 25 may picture the verification screen in a display format corresponding to the specification of the user terminal 3.

[0075]

A description will now be made about the verification screen. As shown in Fig. 14, the operation state of each air conditioner is displayed, corresponding to the installation location of the air conditioner, on the screen. Here, the operation state of each air conditioner as displayed on the verification screen shows the operation state indicated by the response signal transmitted by the response signal transmission unit 33 of the air conditioner, that is, shows the operation state when the control of the air conditioner has been executed after the reception by the air conditioner of the control signal transmitted from the home server 1.

[0076]

Further, the operation state of each air conditioner is displayed corresponding to the installation location of the air conditioner. By viewing the verification screen, the user may clearly grasp the current operation state of the air conditioner at each installation location. This advantageous effect has been brought about because upon generating the verification screen data on the side of the home server 1, the verification screen data is generated such that the operation state of each air conditioner is displayed corresponding to its installation location.

[0077]

It is to be noted that the screen shown in Fig. 14 is merely an example of the verification screen and that the design and layout of the verification screen may be set as desired.

[0078]

(Home server)

As shown in Fig. 9, the home server 1 includes a selected mode identification unit 11, a storage unit 12, an operation pattern reading unit 13, an operation condition identification unit 14, a control signal transmission unit 15, a response signal reception unit 16, an operation state identification unit 17, a communication protocol switching unit 18, an operation pattern update unit 19, and a verification screen data transmission unit 20.

[0079]

The selected mode identification unit 11 serves to identify the selected mode selected by the user among the plurality of operation modes set for each air conditioner, and is constituted by the CPU 1a, the memory 1b, the communication interface 1c and communication bundles of the home server 1. Described more specifically, the selected mode identification unit 11 receives the selection result data transmitted from the user terminal 3, and analyzes the selection result data to identify the selected mode.

[0080]

The storage unit 12 is composed of the memory 1b of the home server 1, and for each operation mode, stores the operation pattern individually set for each of the four air conditioners. In the system S, the storage unit 12 stores the installation

location information, which shows each air conditioner installation location in the house H, and the operation pattern in the state of being associated with each other. Because the installation location of the air conditioner and the operation pattern to be applied to the air conditioner installed at the installation location are associated with each other as described above, the control of the air conditioner may be appropriately performed after having grasped in what operation pattern the air conditioner at each location is to be controlled.

[0081]

Among the operation patterns stored in the storage unit 12, the operation pattern reading unit 13 reads out the operation pattern corresponding to the selected mode and identified by the selected mode identification unit 11 for each air conditioner. The operation pattern reading unit 13 is constituted by the CPU 1a and memory 1b of the home server 1, and an air conditioner control bundle installed in the home server 1.

[0082]

Based on the operation pattern which the operation pattern reading unit 13 has read for each air conditioner, the operation condition identification unit 14 identifies the operation condition corresponding to the time point of control of the air conditioner. The operation condition identification unit 14 is constituted by the CPU 1a and memory 1b of the home server 1, and the air conditioner control bundle installed in the home server 1. It is to be note that the

expression "the operation condition corresponding to the time point of control of the air conditioner" means an operation condition at the time when the home server 1 transmits the control signal to the air conditioner in the operation pattern. When an air conditioner is operated in accordance with the operation pattern shown in Fig. 6, for example, the air conditioner is controlled under the operation condition, in which the set temperature is 20 degrees, if the time of the time point of control is 15 o'clock.

[0083]

The control signal transmission unit 15 generates a control signal for each air conditioner for controlling the air conditioner in accordance with the operation condition identified by the operation condition identification unit 14 for the air conditioner, and serves to transmit the control signal, which has been generated for the air conditioner, to the corresponding one of the plurality of air conditioners. The control signal transmission unit 15 is constituted by the CPU 1a and memory 1b of the home server 1, and the air conditioner control bundle and communication bundles installed in the home server 1.

[0084]

In the system S, the communication protocol to be used when the control signal transmission unit 15 transmits a control signal may be switched by the communication protocol switching unit 18, which has been realized by the function of the OSGi framework 103 described above. In other words, the control signal transmission unit 15 in the system S changes a

communication protocol, which is to be used upon transmission of the control signal to the air conditioner, in accordance with the communication protocol used by the air conditioner as a transmission destination. Since the communication protocol may be switched in accordance with the communication protocol used by each air conditioner as a communication counterpart in the system S, the user may request the home server 1 to control the air conditioner without needing for the side of the user to consider a difference in communication protocol.

[0085]

The response signal reception unit 16 serves to receive a response signal transmitted from each air conditioner when a control signal transmitted from the control signal transmission unit 15 is received by the air conditioner, and in the system S, the response signal reception unit 16 receives a response signal transmitted from each of the plurality of air conditioners. The response signal reception unit 16 is constituted by the CPU 1a and memory 1b of the home server 1, and the air conditioner control bundle and communication bundles installed in the home server 1.

[0086]

In the system S, the communication protocol to be used when the response signal reception unit 16 receives a response signal from each air conditioner may be switched by the communication protocol switching unit 18. In this system S, the communication protocols may be switched according to the transmission source of the response signal. It is, therefore, possible to grasp the state of operation of each air conditioner

without any need for the user to consider the communication protocol of the transmission source of the response signal, namely, the communication protocol of the air conditioner.

[0087]

The operation state identification unit 17 serves to analyze the response signal received by the response signal reception unit 16 from each air conditioner, and to identify the operation state of the air conditioner. The operation state identification unit 17 is constituted by the CPU 1a and memory 1b of the home server 1, and the air conditioner control bundle installed in the home server 1. The air conditioner operation state identified by the operation state identification unit 17 is the operation state of the air conditioner at the stage where the control has been performed after the reception of the control signal. Specifically, it indicates the ON/OFF of the power supply, and in the case of power-on, indicates control values such as a set temperature and a set humidity.

[0088]

The operation pattern update unit 19 corresponds to an update unit that updates the operation patterns stored in the storage unit 12, and is constituted by the CPU 1a and memory 1b of the home server 1, and the air conditioner control bundle installed in the home server 1. The operation pattern update unit 19 communicates with the user terminal 3 and receives the modification result data described above from the user terminal 3. Based on the modification result data, the operation pattern update unit 19 updates the operation patterns stored in the storage unit 12.

Described specifically, the operation pattern update unit 19 analyzes the modification result data, and identifies an operation pattern to be modified and the modification contents. Described more strictly, the operation pattern updating unit 19 analyzes the modification result data to identify the installation location of the air conditioner, to which the operation pattern to be modified is applied, and the operation mode to which the operation pattern belongs. The operation pattern update unit 19 then finds the operation pattern corresponding to the identified installation location and the operation mode of the air conditioner, and sets the operation pattern as a modification target. The operation pattern update unit 19 then reads out the operation pattern of the modification target among the operation patterns stored in the storage unit 12, and updates (modifies) the operation pattern according to the modification contents indicated by the modification result data.

[0089]

The verification screen data transmission unit 20 serves to generate verification screen data and transmits it to the user terminal 3 to picture, on the user terminal 3, a verification screen showing the operation state of each air conditioner identified by the operation state identification unit 17. The verification screen data transmission unit 20 is constituted by the CPU 1a and memory 1b of the home server 1, and the air conditioner control bundle and communication bundles installed in the home server 1.

[0090]

The verification screen data transmission unit 20 generates the verification screen data such that the operation state of each air conditioner is displayed corresponding to the installation location of the air conditioner on the verification screen pictured on the user terminal 3. For executing such processing, the verification screen data transmission unit 20 reads the installation location information stored in the installation location storage area 1t in the memory 1b and identifies the installation location of each air conditioner. Upon generation of the verification screen data, the verification screen data transmission unit 20 incorporates data, which indicates both the operation state and the installation information, into the verification screen data such that the operation state and the installation location of each air conditioner are displayed in a corresponding form.

[0091]

If there exists any abnormal air conditioner that despite the transmission of a control signal, no control is performed and no response signal is transmitted, the verification screen data transmission unit 20 generates verification screen data to display an error on the verification screen for an air conditioner corresponding to the abnormal air conditioner. By viewing the verification screen, the user may thus confirm the existence and installation location of the abnormal air conditioner.

[0092]

<<Air conditioner control method>>

About the air conditioner control method useful in the system S that has been described above, a description will be made with reference to Figs. 10 and 11.

The air conditioner control method useful in the system S is an example of the control method according to the present invention for the energy-consuming device, and more specifically, is applied in air conditioner control processing to be executed in the system S. Therefore, procedures of the air conditioner control processing will hereinafter be described as a description of the air conditioner control method.

[0093]

The air conditioner control processing starts, for example, from the activation of the air conditioner control program on the side of the user terminal 3 by the performance of a predetermined operation by the user. When the air conditioner control program is activated, a control type selection screen (not shown) is pictured on the touch panel of the user terminal 3. The user selects the type of control by operating the touch panel of the user terminal 3 while viewing the screen. With this selection operation, data indicating the selection result of the type of control is transmitted from the user terminal 3 to the home server 1.

[0094]

The subsequent procedures are as shown in Fig. 10. First, the home server 1 receives the above-mentioned data and identifies the control type selected by the user (S001). If

the individual control type is selected as the control type, the home server 1 performs the individual control (S002).

[0095]

Before the home server 1 executes the individual control, the user designates an air conditioner to be controlled and a control condition by operating the touch panel of the user terminal 3 or the like. Then, data indicating what the user has indicated is transmitted from the user terminal 3 to the home server 1. Based on the data received from the user terminal 3, the home server 1 finally and individually controls the air conditioner as a control target under the instructed condition.

[0096]

If the collective control type is selected as a control type, the home server 1 executes the collective control and sends a control signal of the power-off to all the air conditioners in the house H (S003).

[0097]

If the schedule control type is selected as a control type, on the other hand, the operation mode selection screen shown in Fig. 12 is pictured on the touch panel of the user terminal 3. The user selects an operation mode by operating the touch panel of the user terminal 3 while viewing the screen. With this selection operation, selection result data indicating a selection result of the operation mode is transmitted from the user terminal 3 to the home server 1. The home server 1 receives the selection result data, and identifies the selected mode selected by the user among the plurality of set operation modes (S004).

As described above, the selection result data is an HTTP request. In other words, the home server 1 acquires the above selection result data by communicating with the user terminal 3 by the HTTP communication.

[0098]

Then, the home server 1 acquires the device ID which is identification information of the air conditioner as a control target (S005). Described specifically, the device ID is stored as a list of information in the memory 1b of the home server 1, and by reading the information stored in the memory 1b, the device ID of each air conditioner is acquired. It is to be noted that, when the schedule control type has been selected as a control type, all the air conditioners in the house H become control targets, and therefore, the device IDs for all the air conditioners in the house H are acquired.

[0099]

After the acquisition of the device ID, the home server 1 executes the schedule control (S006). In the step S006 of the schedule control, the control of the air conditioner is performed for each acquired device ID, and particularly in the system S, the control is executed in the order of acquisition of the device ID.

[0100]

After the control for all the air conditioners in the house H has been completed, unless there is an operation of switching the control type on the user terminal 3 side (No in S007), , the above-mentioned schedule control step S006 is repeatedly executed whenever a predetermined time elapses (Yes

in S008). In the system S, the step S006 of the schedule control is performed at 0 minute, 15 minutes, 30 minutes and 45 minutes in every hour. However, the execution interval of the step S006 of the scheduled control may be freely set without being limited to the above case.

[0101]

The flow of the step S006 of the schedule control will next be described with reference to Fig. 11.

In the step S006 of the schedule control, the home server 1 first reads the operation pattern, which corresponds to the selected mode identified in the previous step S004, from memory 1b, namely, from the storage unit 12 for each air conditioner (S011). Based on the operation pattern read for each air conditioner, the operation condition corresponding to the time point of control of each air conditioner, namely, the present time is then identified for each air conditioner (S012). In other words, the home server 1 identifies, for each of the four air conditioners, the operation condition at the present time based on the corresponding operation pattern.

[0102]

To each of the four air conditioners, the home server 1 then transmits a control signal for controlling the air conditioner in accordance with the operation condition identified for the air conditioner (S013). Here, the home server 1 switches the communication protocol as needed depending on the communication protocol used by each air conditioner. On the side of each air conditioner which has received the control signal, the control is performed based on

the control signal and as a result, the operation state comes to match the operation condition identified in the previous step S012.

[0103]

When the control is performed in each air conditioner, a response signal is transmitted from each air conditioner. The home server 1 receives the response signal transmitted from each air conditioner (S014). Here again, the home server 1 switches the communication protocol as needed depending on the communication protocol used by each air conditioner. Based on the received response signal, the home server 1 then identifies the operation state of the air conditioner. On the other hand, any air conditioner, from which no response signal has been received, is determined to be an abnormal air conditioner as described above.

[0104]

The home server 1 then generates verification screen data for picturing a verification image that indicates the operation state of each air conditioner and the presence or absence of any abnormal air conditioner or conditioners, and transmits the data to the user terminal 3 (S015). Upon reception of the above-mentioned verification screen data on the side of the user terminal 3, the verification screen data is loaded so that the verification screen shown in Fig. 14 is pictured on the touch panel of the user terminal 3. By viewing this verification screen, the user may confirm the operation state of each air conditioner and the presence or absence of any abnormal air conditioner or conditioners.

It is to be noted that as described above, the verification screen data is data of the XML format. Therefore, when the user terminal 3 receives the verification screen data, the verification screen is pictured on the touch panel in a display format conforming to the specification of the user terminal 3.

[0105]

<<Other embodiments>>

The embodiments which have been described in the above are merely examples relating to the control device, control method, and control system of the present invention for energy-consuming device or devices, and are intended to facilitate the understanding of the present invention, and are not intended to limit the present invention. The present invention may be modified or improved without departing from the spirit thereof, and the present invention includes equivalents thereof as a matter of course.

[0106]

In the above embodiments, the home server 1 is installed in the house H, and is described to control the electrical devices used in the house H, but is not limited to such an installation or application. For example, the cloud server installed outside the house H may communicate, via an external network such as the Internet, with the electrical devices in the house H to exhibit a similar function as the home server 1 in the above embodiments.

[0107]

In the above embodiments, the plurality of electrical devices, specifically the plurality of air conditioners are controlled in accordance with their corresponding operation patterns in the schedule control. However, the present invention shall not be limited to such control, and a plurality of lighting devices installed in the house H may be controlled in accordance with the corresponding operation patterns. Furthermore, a single electrical device may be controlled in accordance with its operation pattern in the schedule control. In the above embodiments, the schedule control is performed for the electrical devices of the same type. However, the schedule control may be performed on electrical devices of different types. Furthermore, the schedule control is performed on the electrical devices as examples of energy-consuming devices in the above embodiment. The energy-consuming devices also include batteries and fuel cells, and on these devices, the schedule control may be also carried out.

[0108]

In the above embodiments, among the plurality of air conditioners, there are air-conditioners which communicate with different communication protocols. When transmitting a control signal to each air conditioner, the home server 1 switches its communication protocol depending on that of the air conditioner as a communication destination. It is configured that, when the user requests the home server 1 to control each air conditioner through the user terminal 3, on the other hand, an HTTP request as a control execution request is transmitted from the user terminal 3. Without needing for

the user to consider any difference or differences in communication protocol among the air conditioners, it is thus possible to request the home server 1 to control each air conditioner. However, the present invention shall not be limited to the use of such an HTTP request. If the communication protocol is unified among the air conditioners, the electronic message of the control execution request may be transmitted to the home server 1 in the communication protocol common among the air conditioners when the control of each air conditioner is requested to the home server 1 through the user terminal 3.

[0109]

In the above embodiments, the installation location information indicating the installation locations of the respective electrical devices is stored in the memory 1b of the home server 1. However, the present invention shall not be limited to such a manner of storage, and together with the installation location information or instead of the installation location information, information indicating electrical circuits to which the respective electrical devices are connected (specifically, branch circuits in a distribution board) may be stored.

[0110]

In the above embodiments, the ECHONET and ECHONETLite have been illustrated as communication protocols for electrical devices. Obviously however, each electrical device in the house H may adopt a communication protocol other than these exemplified communication protocols.

[0111]

In the above embodiments, the plurality of operation modes set for each air conditioner are intended to be applied when the schedule control of the air conditioner is executed. In other words, a plurality of operation modes are set for the schedule control type in the above embodiment. However, the application of such a plurality of operation modes shall not be limited to the schedule control, and for control types other than the schedule control, a plurality of operation modes may be provided for selective applications.

[0112]

In the above embodiments, the operation states of electrical devices (more specifically, air conditioners), on which control has been executed, are displayed on the verification screen pictured on the user terminal 3 based on the data received from the home server 1. However, the information to be displayed on the verification screen is not limited to these. Other information such as, for example, the load of each electrical device (electric power consumption) or the operation mode currently applied thereto may be displayed.

Reference Numerals

[0113]

- S system
- H house
- 1 home server
- 1a CPU
- 1b memory
- 1c communication interface

1s operation pattern storage area
1t installation location storage area
1u bundle storage area
3 user terminal
5 home network
7 power data logger
11 selected mode identification unit
12 storage unit
13 operation pattern reading unit
14 operation condition identification unit
15 control signal transmission unit
16 response signal reception unit
17 operation state identification unit
18 communication protocol switching unit
19 operation pattern update unit
20 verification screen data transmission unit
21 operation reception unit
22 data generation unit
23 data transmission unit
24 data reception unit
25 display unit
31 control signal reception unit
32 control unit
33 response signal transmission unit
101 OS
102 JVM
103 OSGi framework
104 first communication bundle

105 second communication bundle

106 third communication bundle

Ta1, Ta2, Ta3 selection button

Tb1, Tb2, Tb3 update button

Tc modification panel

Tc1, Tc2, Tc3 input field

CLAIMS

1. A control device for an energy-consuming device, which is communicably connected with the energy-consuming device, the control device comprising:

a selected mode identification unit that identifies a selected mode selected by a user among a plurality of operation modes which have been set for the energy-consuming device;

a storage unit that stores operation patterns corresponding to the operation modes, each operation pattern defining in what period of time and under what operation condition the energy-consuming device is operated;

an operation pattern reading unit that reads an operation pattern corresponding to the selected mode identified by the selected mode identification unit among the operation patterns stored in the storage unit;

an operation condition identification unit that identifies the operation condition corresponding to a time point of control of the energy-consuming device based on the operation pattern read by the operation pattern reading unit;

a control signal transmission unit that transmits a control signal for controlling the energy-consuming device under the operation condition identified by the operation condition identification unit to the energy-consuming device;

a response signal reception unit that receives a response signal transmitted from the energy-consuming device when the control signal transmitted from the control signal transmission unit is received by the energy-consuming device;

an operation state identification unit that analyzes the response signal received by the response signal reception unit from the energy-consuming device, and identifies an operation state of the energy-consuming device when control has been executed after the reception of the control signal; and

a verification screen data transmission unit that generates verification screen data and transmits it to a user terminal employed by a user to picture, on the user terminal, a verification screen showing the operation state identified by the operation state identification unit,

wherein the control device controls each of a plurality of energy-consuming devices of the same type installed in a building by communicating with the plurality of energy-consuming devices, and

wherein the storage unit stores the operation patterns, which are set individually for each of the plurality of energy-consuming devices, corresponding to each of the respective operation modes, and

wherein the operation pattern reading unit reads the operation pattern, which corresponds to the selected mode identified by the selected mode identification unit, for each of the plurality of energy-consuming devices among the operation patterns stored in the storage unit, and

wherein the operation condition identification unit identifies the operation condition, which corresponds to the time point of control of the energy-consuming device, for each of the plurality of energy-consuming devices based on the

operation pattern read by the operation pattern reading unit,
and

wherein the control signal transmission unit transmits the control signal for controlling the corresponding energy-consuming device in accordance with the operation condition identified by the operation condition identification unit for the corresponding energy-consuming devices to each of the plurality of energy-consuming devices, and

wherein the response signal reception unit receives the response signal transmitted from the energy-consuming device controlled properly after the reception of the control signal,
and

wherein the verification screen data transmission unit generates the verification screen data such that the operation state of the energy-consuming device controlled properly is displayed on the verification screen, corresponding to installation location of the energy-consuming device controlled properly and an error is displayed on the verification screen for the energy-consuming device which is not controlled despite transmission of the control signal and transmits no response signal.

2. The control device according to claim 1, wherein when the plurality of energy-consuming devices communicate using communication protocols different from each other, the control signal transmission unit changes a communication protocol, which is to be used when transmitting the control signal to the

energy-consuming device, in accordance with the communication protocol used by the energy-consuming device as a destination.

3. The control device according to claim 2, wherein:

the selected mode identification unit communicates with a user terminal which accepts a selection operation of the operation mode as conducted by the user to receive selection result data indicating a result of selection by the selection operation from the user terminal, and identifies the selected mode based on the selection result data; and

the selection result data is an HTTP request.

4. The control device according to claim 3, wherein:

the control device selects, as a control type upon controlling the energy-consuming device, a schedule control type or an individual control type, the schedule control type being for controlling the energy-consuming device in accordance with the operation condition identified by the operation condition identification unit based on the operation pattern, and the individual control type being for individually controlling the energy-consuming device in accordance with an instructed condition indicated from the user terminal; and

when the individual control type is selected, data indicating the instructed condition is received from the user terminal in a form corresponding to a communication protocol used by the energy-consuming device to be controlled.

5. The control device according to any one of claims 1 to 4, further comprising:

an update unit that updates the operation patterns stored in the storage unit,

wherein the update unit communicates with the user terminal which receives a modification operation by the user to the operation patterns stored in the storage unit, receives modification result data indicating a modification result of the modification operation from the user terminal, and updates the operation patterns stored in the storage unit based on the modification result data.

6. The control device according to claim 1, wherein:

the storage unit stores installation location information, which indicates an installation location of the energy-consuming device in the building, and the operation patterns in a mutually-associated state.

7. A control method for energy-consuming device, for controlling an energy-consuming device by communicating with the energy-consuming device, the control method comprising:

identifying a selected mode selected by a user among a plurality of operation modes set for the energy-consuming device;

reading, from a storage unit that stores operation patterns corresponding to the operation modes, each operation pattern defining in what period of time and under what operation condition the energy-consuming device is operated, the

operation pattern corresponding to the identified selected mode;

identifying the operation condition corresponding to a time point of control of the energy-consuming device based on the operation pattern so read;

transmitting a control signal for controlling the energy-consuming device under the operation condition so identified to the energy-consuming device;

receiving a response signal transmitted from the energy-consuming device when the control signal so transmitted is received by the energy-consuming device;

analyzing the response signal received from the energy-consuming device and identifying an operation state of the energy-consuming device when control has been executed after the reception of the control signal; and

generating verification screen data and transmitting it to a user terminal employed by a user to picture, on the user terminal, a verification screen showing the operation state identified by the operation state,

wherein each of a plurality of energy-consuming devices of the same type installed in a building is controlled by communicating with the plurality of energy-consuming devices, and

wherein the storage unit stores the operation patterns which are set individually for each of the plurality of energy-consuming devices, corresponding to each of the respective operation modes, and

wherein in reading the operation pattern, the pattern, which corresponds to the selected mode identified in the identifying the selected mode, is read for each of the plurality of energy-consuming devices among the operation patterns stored in the storage unit, and

wherein in identifying the operation condition, the operation condition, which corresponds to the time point of control of the energy-consuming device, is identified for each of the plurality of energy-consuming devices based on the operation pattern read in the reading the operation pattern, and

wherein in transmitting the control signal, the control signal for controlling the corresponding energy-consuming device in accordance with the operation condition identified for the corresponding energy-consuming devices is transmitted to each of the plurality of energy-consuming devices, and

wherein in receiving the response signal, the response signal transmitted from the energy-consuming device controlled properly after the reception of the control signal is received, and

wherein in generating the verification screen data, the verification screen data is generated such that the operation state of the energy-consuming device controlled properly is displayed on the verification screen, corresponding to installation location of the energy-consuming device controlled properly and an error is displayed on the verification screen for the energy-consuming device which is

not controlled despite transmission of the control signal and transmits no response signal.

8. A control system for an energy-consuming device, the control system including an energy-consuming device, a control device for the energy-consuming device communicably connected with each other, and a user terminal employed by a user wherein:

the control device comprises:

a selected mode identification unit that identifies a selected mode selected by a user among a plurality of operation modes which have been set for the energy-consuming device;

a storage unit that stores operation patterns corresponding to the operation modes, each operation pattern defining in what period of time and under what operation condition the energy-consuming device is operated;

an operation pattern reading unit that reads an operation pattern corresponding to the selected mode identified by the selected mode identification unit among the operation patterns stored in the storage unit;

an operation condition identification unit that identifies the operation condition corresponding to a time point of control of the energy-consuming device based on the operation pattern read by the operation pattern reading unit;

a control signal transmission unit that transmits a control signal for controlling the energy-consuming device under the operation condition identified by the operation condition identification unit to the energy-consuming device;

a response signal reception unit that receives a response signal transmitted from the energy-consuming device when the control signal transmitted from the control signal transmission unit is received by the energy-consuming device;

an operation state identification unit that analyzes the response signal received by the response signal reception unit from the energy-consuming device, and identifies an operation state of the energy-consuming device when control has been executed after the reception of the control signal; and

a verification screen data transmission unit that generates verification screen data and transmits it to a user terminal employed by a user to picture, on the user terminal, a verification screen showing the operation state identified by the operation state identification unit,

wherein the control device controls each of a plurality of energy-consuming devices of the same type installed in a building by communicating with the plurality of energy-consuming devices, and

wherein the storage unit stores the operation patterns, which are set individually for each of the plurality of energy-consuming devices, corresponding to each of the respective operation modes, and

wherein the operation pattern reading unit reads the operation pattern, which corresponds to the selected mode identified by the selected mode identification unit, for each of the plurality of energy-consuming devices among the operation patterns stored in the storage unit, and

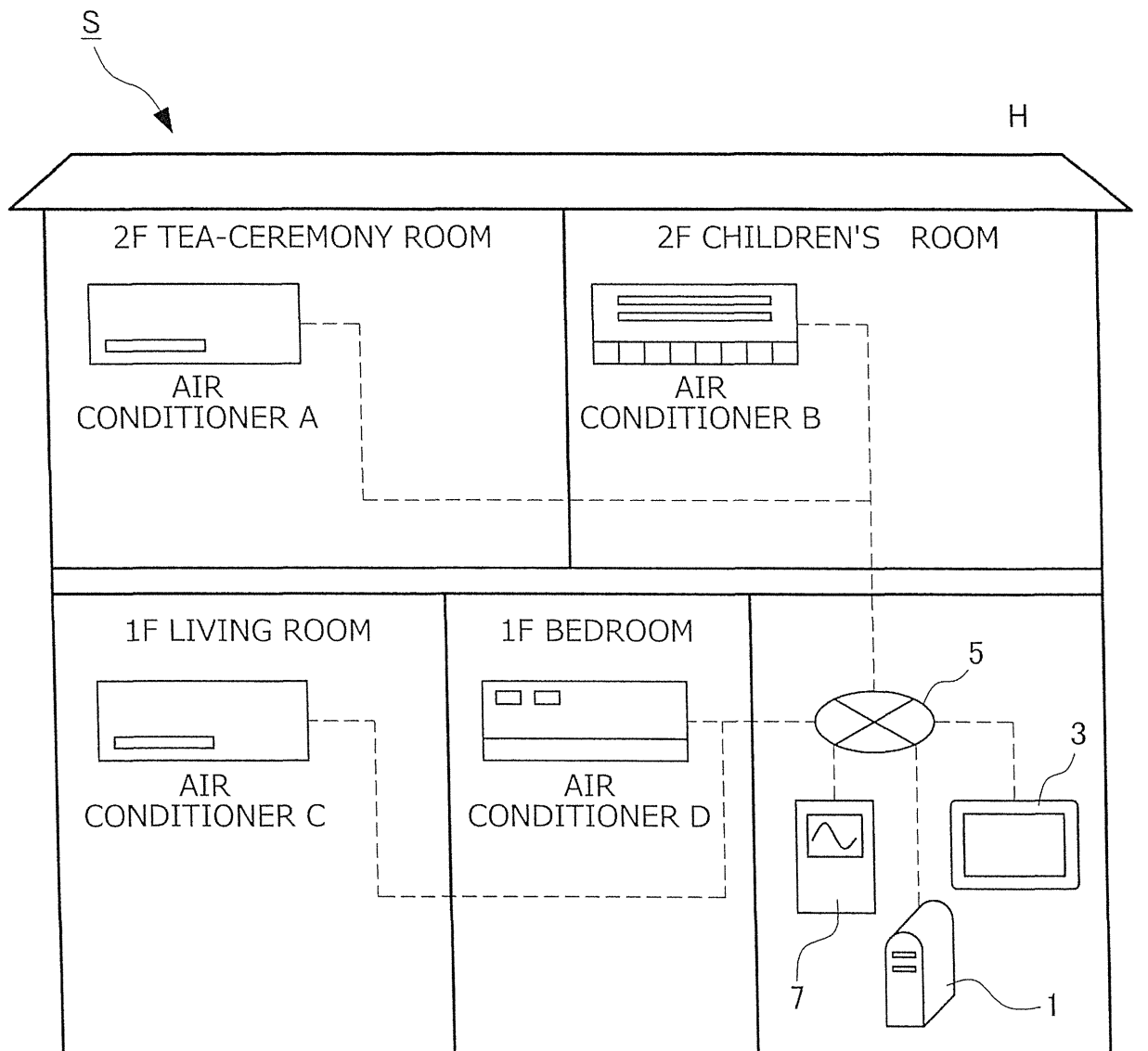
wherein the operation condition identification unit identifies the operation condition, which corresponds to the time point of control of the energy-consuming device, for each of the plurality of energy-consuming devices based on the operation pattern read by the operation pattern reading unit, and

wherein the control signal transmission unit transmits the control signal for controlling the corresponding energy-consuming device in accordance with the operation condition identified by the operation condition identification unit for the corresponding energy-consuming devices to each of the plurality of energy-consuming devices, and

wherein the response signal reception unit receives the response signal transmitted from the energy-consuming device controlled properly after the reception of the control signal, and

wherein the verification screen data transmission unit generates the verification screen data such that the operation state of the energy-consuming device controlled properly is displayed on the verification screen, corresponding to installation location of the energy-consuming device controlled properly and an error is displayed on the verification screen for the energy-consuming device which is not controlled despite transmission of the control signal and transmits no response signal.

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FIG. 1



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FIG. 2

HOME SERVER 1

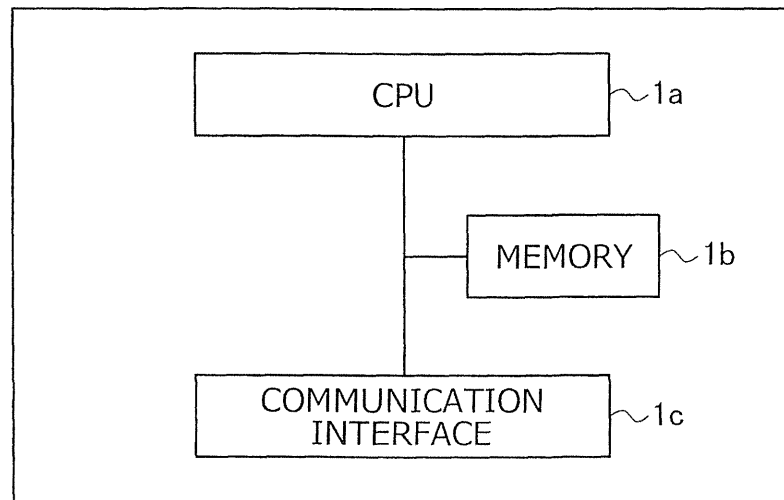


FIG. 3

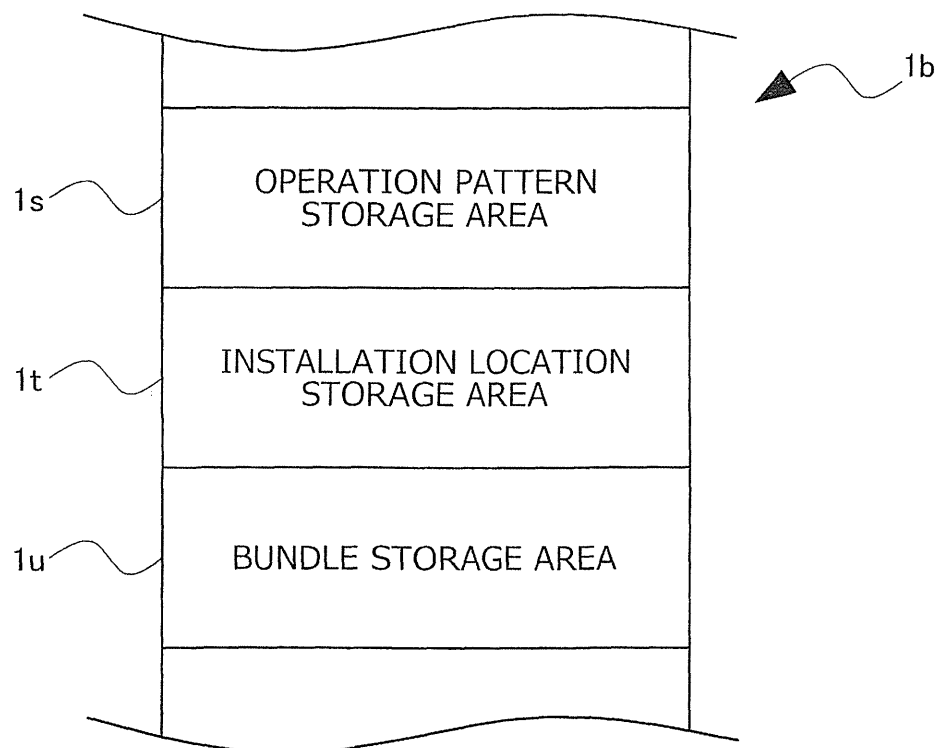


FIG. 4

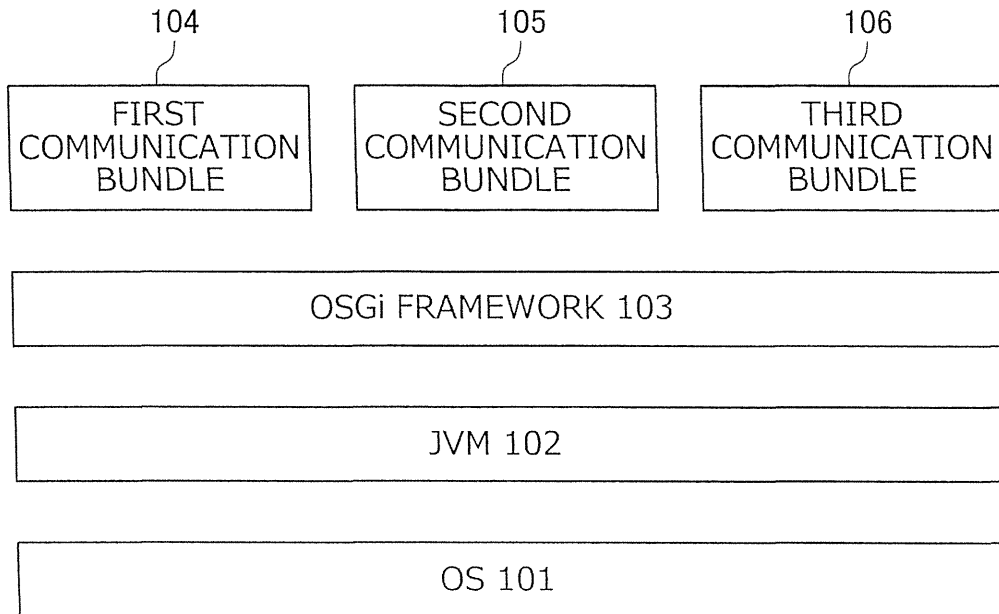
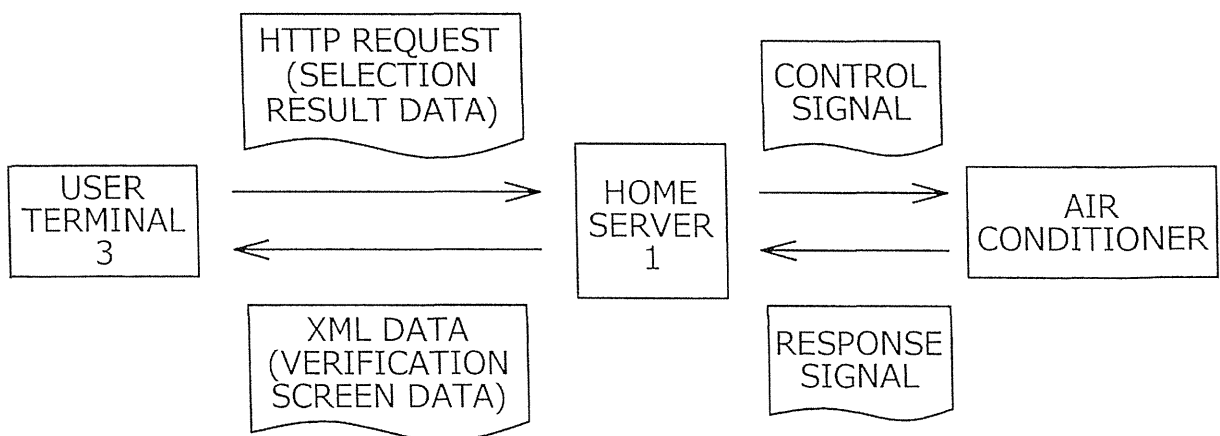


FIG. 5



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FIG. 6

TIME PERIOD	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
OPERATION CONDITION	OFF						20℃				17℃				20℃									

FIG. 7

<MODE X>

AIR CONDITIONER	DEVICE ID	LOCATION	TYPE	OPERATION PATTERN
AIR CONDITIONER A	AC_001	2F TEA-CEREMONY ROOM	JAPANESE-STYLE ROOM	PATTERN A
AIR CONDITIONER B	AC_002	2F CHILDREN'S ROOM	WESTERN-STYLE ROOM	PATTERN B
AIR CONDITIONER C	AC_003	1F LIVING ROOM	LIVING ROOM	PATTERN C
AIR CONDITIONER D	AC_004	1F BEDROOM	BEDROOM	PATTERN D

FIG. 8

<MODE X>

LIVING ROOM

TIME PERIOD	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
OPERATION CONDITION	OFF									28°C														

BEDROOM

TIME PERIOD	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
OPERATION CONDITION	30℃						OFF														28℃			

JAPANESE-STYLE ROOM

TIME PERIOD	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
OPERATION CONDITION	OFF																							

WESTERN-STYLE ROOM

TIME PERIOD	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
OPERATION CONDITION	30℃						OFF									28℃								

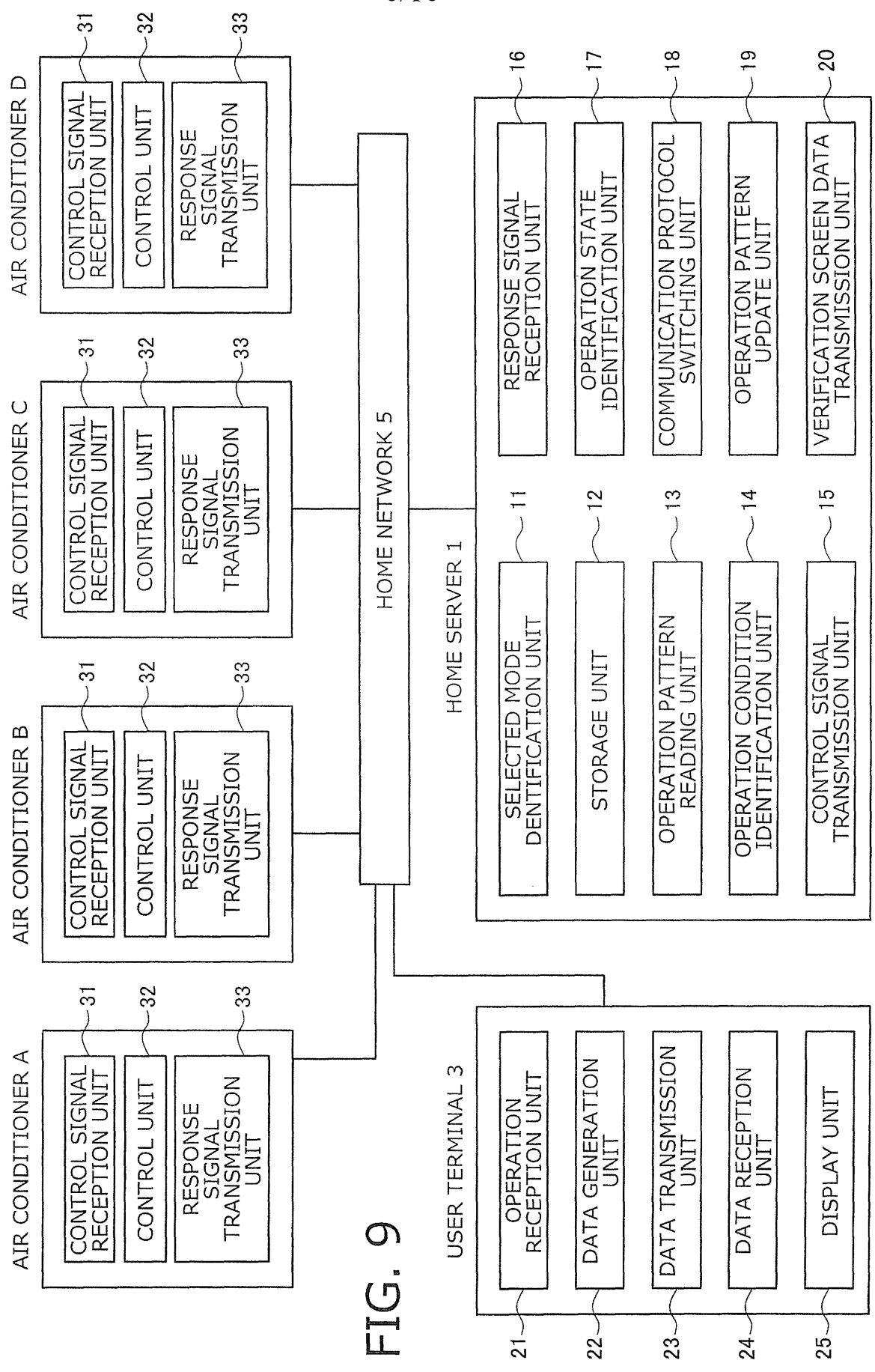


FIG. 9

FIG. 10

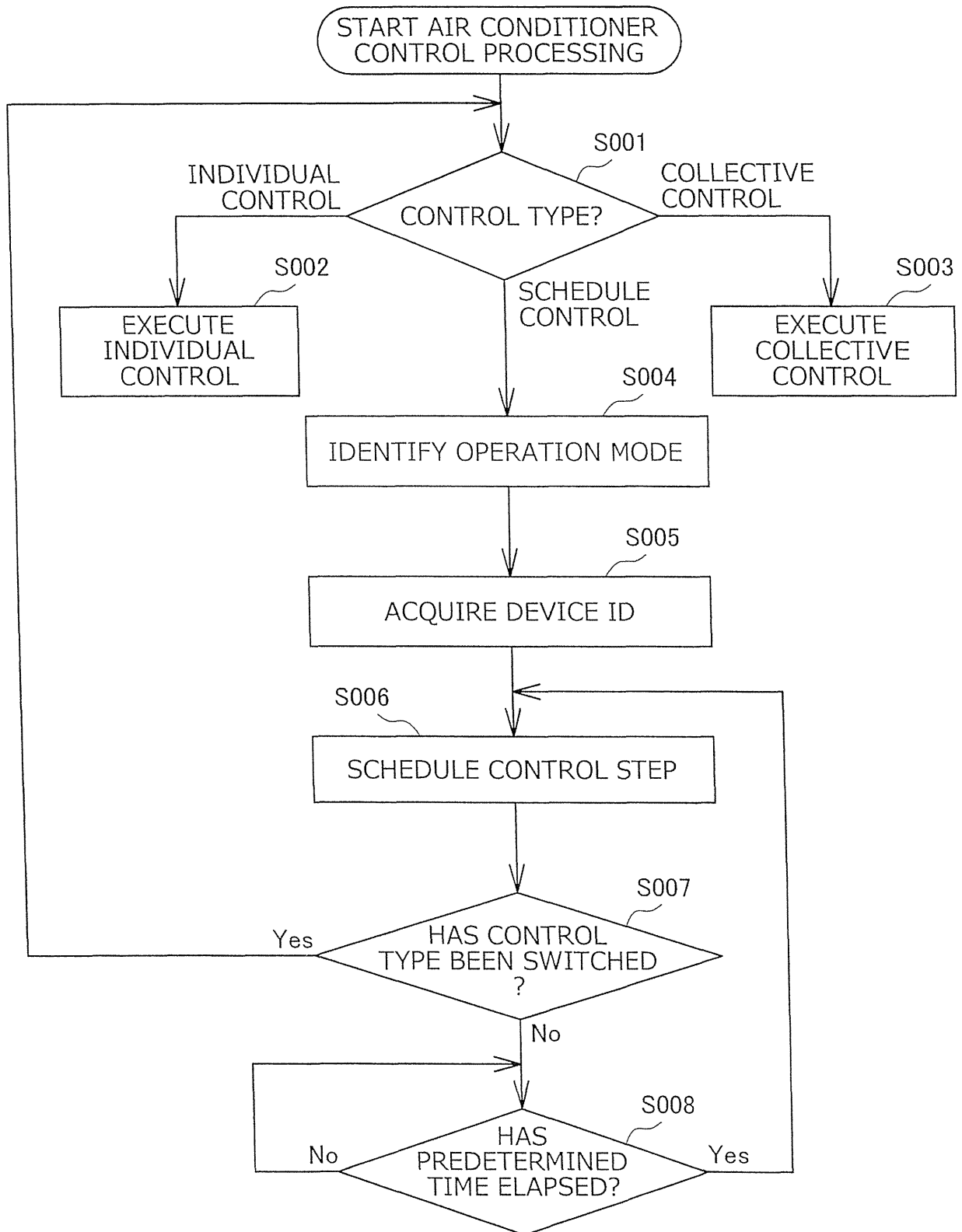


FIG. 11

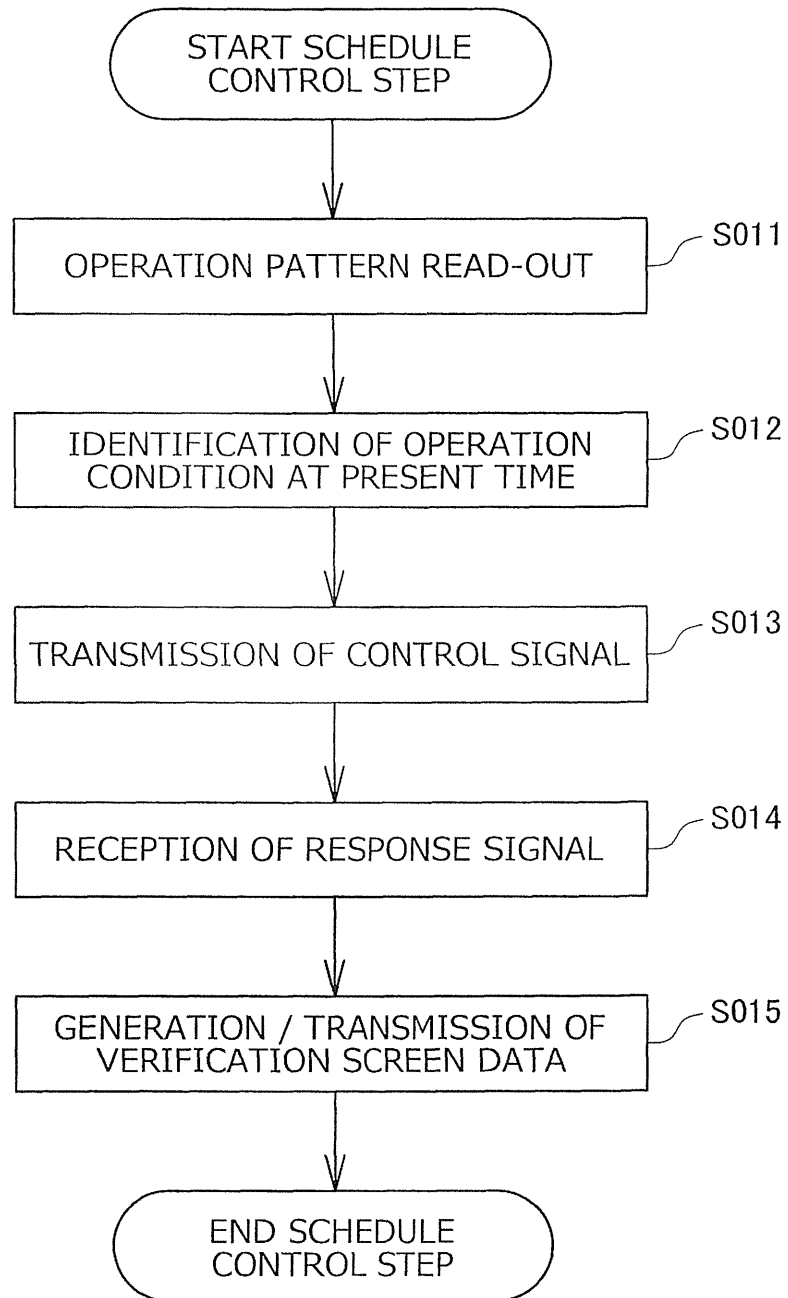


FIG. 12

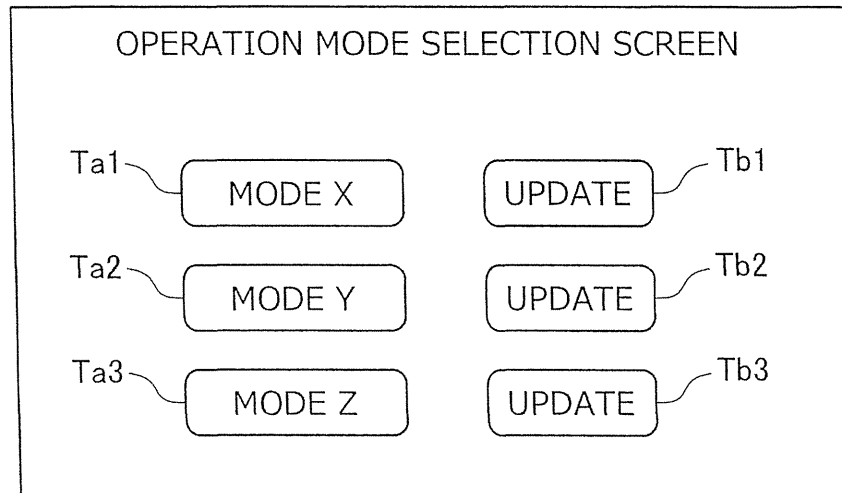


FIG. 13

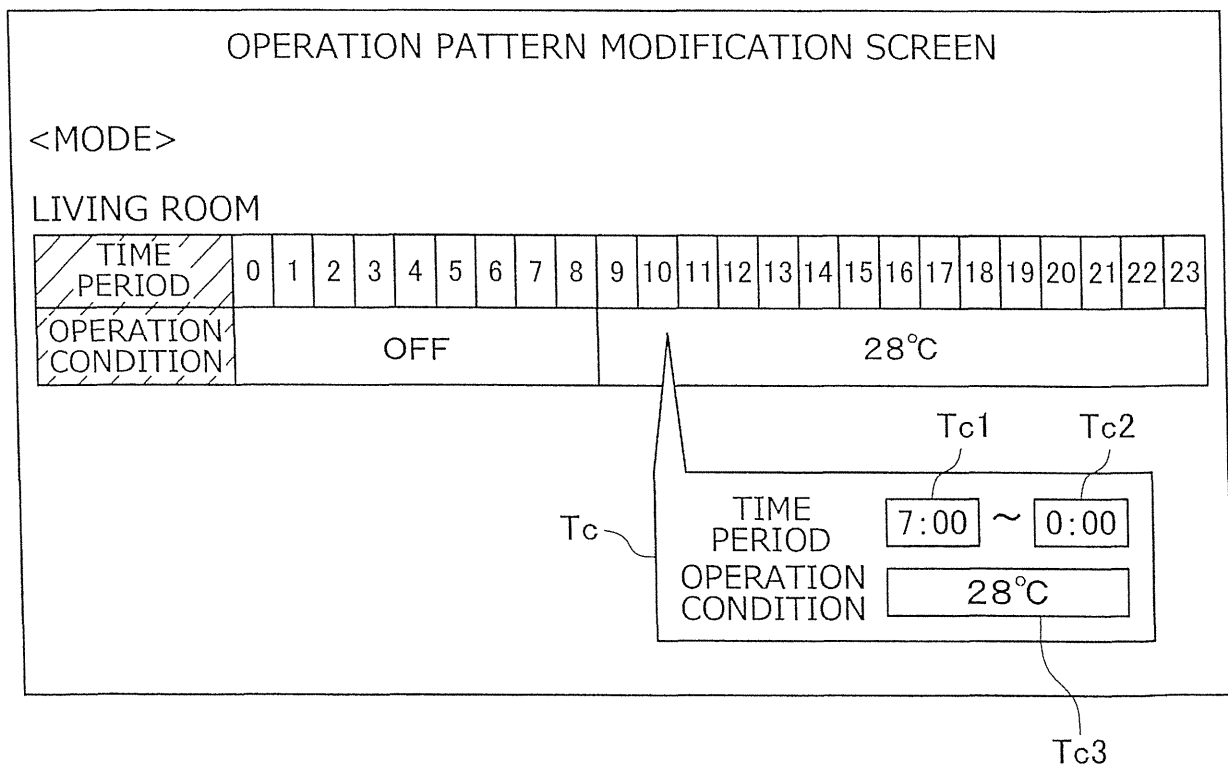


FIG. 14

VERIFICATION SCREEN	
	STATUS
2F TEA-CEREMONY ROOM (AIR CONDITIONER A)	<u>OFF</u>
2F CHILDREN'S ROOM (AIR CONDITIONER B)	<u>28°C</u>
1F LIVING ROOM (AIR CONDITIONER C)	<u>28°C</u>
1F BEDROOM (AIR CONDITIONER D)	<u>28°C</u>