

DESCRIPTION
CONTROL DEVICE FOR ENERGY-CONSUMING DEVICE
AND CONTROL METHOD THEREFOR

Technical Field

[0001]

The present invention relates to a control device and control method for controlling a plurality of energy-consuming devices installed in a building.

Background Art

[0002]

A variety of techniques have been proposed for registering control schedules for a plurality of air conditioners in a database and for allowing the plurality of air conditioners to operate in accordance with the control schedules. (For example, see Patent Document 1).

The control device and control method for air conditioners as described in Patent Document 1 perform are a step of storing a plurality of operation patterns of the operation capacity of each air conditioner in an operation setting database, a step of receiving, from an input unit, an input selected from among the plurality of operation patterns that are stored in the operation setting database as an operation pattern of the air conditioner for a predetermined time period, a step of storing, in an operation schedule database, the input of the operation pattern for the predetermined time period received from the input unit, and a

step of sending a control signal to the air conditioner in accordance with the operation pattern for the predetermined time period stored in the operation schedule database.

[0003]

As described in Patent Document 1, there are many techniques for the schedule management of air conditioners. However, there has been no technique that may collectively subject a plurality of air conditioners to schedule control and may also change the schedule of each air conditioner.

Citation List

Patent Document

[0004]

Patent Document 1: JP 2007-183035 A

DISCLOSURE OF THE INVENTION

Problem to be Solved by the Invention

[0005]

The present invention has been made in view of the above circumstances, and an object of the present invention is to provide a control device and control method for energy-consuming devices, which may automatically control the energy-consuming devices in a building in accordance with a default schedule, and at the same time which may modify the schedules for the individual energy-consuming devices.

Means for Solving Problem

[0006]

The above-described problem may be also solved by the invention as described in an embodiment. According to this

invention, there is provided a control device for controlling a plurality of energy-consuming devices installed in a building, the control device comprising a switching section which switches a plurality of different operation modes to control the energy-consuming devices in accordance with default schedules different depending on characteristic types classified according to characteristics in advance; a default schedule storage section which stores a default schedule property with control data of the default schedules kept therein; an individual schedule storage section that stores an individual schedule property which keeps control data of an individual schedule set for specific at least one of the energy-consuming devices; an individual schedule presence/absence determination section which refers to the individual schedule storage section by using a current time and an device ID of the energy-consuming device as keys and which determines if control data for the current time is registered for the energy-consuming device in the individual schedule property; and a control execution section which controls the energy-consuming device in accordance with the schedule kept in the default schedule property if the control data for the current time for the energy-consuming device is not registered in the individual schedule property.

[0007]

The above-described problem may be also solved by the invention as described in an embodiment. According to this invention, there is provided a control method for controlling a plurality of energy-consuming devices installed in a building,

wherein the control method may switch a plurality of different operation modes to control the energy-consuming devices in accordance with default schedules different depending on characteristic types classified according to characteristics in advance; and the control method comprises the following steps: referring to an individual schedule storage section, which stores an individual schedule property that keeps control data of an individual schedule set for specific at least one of the energy-consuming devices, by using a current time and an device ID of the each energy-consuming device as keys, and determining if control data for the current time is registered for the each energy-consuming device in the individual schedule property, and controlling the energy-consuming device in accordance with the default schedule kept in a default schedule storage section which stores the default schedule property with control data of the default schedule kept therein, if the control data for the current time is not registered for the energy-consuming device in the individual schedule property.

[0008]

According to the control device of the present invention configured as described above, it becomes possible to collectively control the energy-consuming devices in a building and also to set a different schedule or different schedules for some of the individual energy-consuming devices. By providing, for example, the setting of an energy saving mode, which may save energy in a whole building, as a default while maintaining comfort in each room, a fine change or fine changes to the setting are thus possible according to the family composition while

ensuring the convenience of the user, thereby allowing to maintain the convenience and comfort of the user in good balance.

The control device is provided with the control execution section that controls the energy-consuming devices in accordance with the schedule kept in the default schedule property if control data for a current time are not registered for the energy-consuming devices in the individual schedule property, the individual schedule and the default schedule may be switched automatically, and with respect to the some energy-consuming devices in the building, an individual schedule or individual schedules may each be set for only a predetermined range of time. It is, therefore, possible to set fine individual schedule according to the user's life patterns and the preferences.

Moreover, the default schedules are set different depending on the characteristic types. It is, therefore, easy to set default schedules corresponding to the uses of living spaces.

[0009]

Moreover, an individual energy-consuming device information storage section which associates the device IDs of the energy-consuming devices with the characteristic types thereof may be provided, and the control data in the default schedule property may include information on the operation modes, the characteristic types, switching times of settings, and contents of settings to which the former settings are to be switched at the switching times. In addition, the control

execution section may acquire the operation mode under execution, may also acquire the characteristic type of the each energy-consuming device by referring to the individual energy-consuming device information storage section while using the device ID of the each energy-consuming device as a key. Further the control execution section may acquire the switching time and the content of the setting by referring to the default schedule property while using the characteristic type, the operation mode and the current time as keys, and may control the each energy-consuming device in accordance with the content of the setting.

Due to this configuration, with regard to each energy-consuming device, in which an individual schedule is not set, the energy-consuming device in a building is controlled in accordance with the default schedule or the like which has been designed beforehand by putting importance on the user's comfort and energy conservation. It is hence possible to improve the convenience of the user.

[0010]

Furthermore, the control data in the individual schedule property may include information on the device IDs, the operation modes, switching time of setting and contents of settings to which the former setting are to be switched at the switching times, and the individual schedule presence/absence determination section may determine if the control data for the current time is registered for the energy-consuming device in the individual schedule property, by referring to the individual schedule storage section while using the operation

mode under execution in addition to the current time and the device ID as keys.

Because of such a configuration, while controlling in accordance with the preset operation mode, it is possible to set an individual schedule only for some of the energy-consuming devices for a part of time period. Thus, individual schedules do not need to be set from the beginning, and, because they may be set by partial changes of a default schedule offered beforehand, it is easy to set such individual schedules.

[0011]

The control execution section, if the control data for the current time is registered in the individual schedule property, may control the energy-consuming device according to the content of the setting registered in the individual schedule property.

Due to this configuration, it is possible not only to control the energy-consuming devices in the building collectively, but also to set different schedules for some of the individual energy-consuming devices.

[0012]

Furthermore, the control data in the individual schedule property may be able to be updated and deleted by a command from an information input section which is installed in the building.

Since the control device is configured as described above, the user may set one or more individual schedules at will.

[0013]

Also, a protocol changing section that changes a communication protocol, which is to be used when transmitting

a control signal to the energy-consuming device, in accordance with a communication protocol, which is used by the energy-consuming device as a transmission destination, to control the energy-consuming device, when the plurality of energy-consuming devices communicate using communication protocols different from each other may be provided.

With the configuration described above, the switching of the communication protocol by the protocol changing section according to the communication counterpart makes it possible to request the control device to control each energy-consuming device without taking into consideration the difference in communication protocol on the side of the user.

Advantageous Effects of the Invention

[0014]

According to the control device of the present invention, it is possible not only to collectively control the energy-consuming devices in a building, but also to set a different schedule or different schedules for some of the individual energy-consuming devices. By providing, for example, the setting of an energy saving mode, which may save energy in a whole building, as a default while maintaining the comfort in each room, it becomes possible to conduct a fine change or fine changes to the setting according to the family composition while ensuring the convenience of the user, thereby allowing to maintain the convenience and comfort of the user in good balance.

The control device is provided with the control execution section that controls the air conditioners in accordance with the schedule kept in the default schedule property. If the control data for a current time is not registered for some of the energy-consuming devices in the individual schedule property, the individual schedule and default schedule may be switched automatically, and with respect to some energy-consuming devices in the building, individual schedules may each be set for only a predetermined range of time. It is, therefore, possible to set fine individual schedules according to the user's life patterns and preferences.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a schematic diagram of an air conditioner control system controlled by an air conditioner control device according to an embodiment of the present invention;

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

Fig. 3 is a block diagram showing a program execution environment of the air conditioner control device according to the embodiment of the present invention;

Fig. 4 is an explanatory diagram showing examples of the storage of an individual schedule property after receiving a schedule setting request;

Fig. 5 is an explanatory diagram showing resetting of a schedule of the individual schedule property;

Fig. 6 is an explanatory diagram of data transmission between a user terminal, a control device (home server) and an air conditioner in the air conditioner control system which is controlled by the air conditioner control device according to the embodiment of the present invention;

Fig. 7 is an explanatory diagram showing an example of an operation mode in the embodiment of the present invention;

Fig. 8 is a diagram showing an example of an operation panel for update of the schedule;

Fig. 9 is an explanatory view showing an example of an operation mode customized by an individual schedule in the embodiment of the present invention;

Fig. 10 is a flowchart showing processing of an air conditioner control method according to the another embodiment of the present invention; and

Fig. 11 is a flowchart showing further processing of the air conditioner control method according to the another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0016]

Hereinafter, embodiments of the present invention will be described with reference to figures. In addition, members, arrangement and the like to be described below, are not intended to limit the present invention, and various modifications may be allowed according to the gist of the present invention as a matter of course.

[0017]

The air conditioner control device according to an embodiment of the energy-consuming device of the present invention is a computer, which automatically controls the operation of the air conditioners in a house H for a day in accordance with a predetermined schedule, and at the same time which manages an air conditioner control system which may change the schedule for each individual air conditioner.

The house H is an example of the building, and the invention is also applicable to the case of controlling the energy-consuming devices used in a building other than the house H, such as commercial buildings, buildings of factories, shops or the like.

It is to be noted that the house H is a concept that also includes one room in an apartment complex, such as a condominium other than a single-family house, that is, the present invention is applicable to the case of controlling air conditioners used in a building or in a room of a building.

The house H of the present embodiment contains, a living-room/dining-room/kitchen, a main bedroom, a Western-style room, a Japanese-style room, a hallway, other rooms and other spaces, and an air conditioner is installed in each room and space. Also a home server 1 as an air conditioner control device and a user terminal 3 which is installed as a display installed in the living room are furnished.

[0018]

<<Overall configuration of the air conditioner control system>>

Referring first to Fig. 1, the overall configuration of an air conditioner control system S which is controlled by the air conditioner control device according to an embodiment of the present invention (hereinafter, the system) will be outlined.

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

[0019]

With the configuration described above, a resident in the house H (hereinafter, user), may remotely operate the electric devices through the home server 1, and based on the data collected from the power data logger 7, may view and recognize the power consumption of the house H. It is to be note that the user employs the user terminal 3 in order to utilize the function of the home server 1. Described specifically, the user may request the transmission of data or the control of the electrical devices from the home server 1 by performing a predetermined input operation with the user terminal 3,. Here, the user terminal 3 is a communication terminal constituted by a PDA, a smart phone, a PC, and an operation panel or the like, and executes a predetermined processing by receiving an input

operation from the user. In the following description, a case where the user terminal 3 is made up of a PDA used in the house H will be described. A more specific description will hereinafter be made about the user terminal 3 that communicates with the home server 1 through the home network 5 will be described. However, the invention shall not be limited to this, and the user terminal 3 may be one that communicates with the home server 1 through an external network such as the Internet.

[0020]

In the system S, the home server 1, in response to control requests made by the user through the user terminal 3, may control each of a plurality of air conditioners, which are installed in the house H, in accordance with a preset schedule. In other words, in the schedule control, the home server 1 controls the operation conditions of each of the plurality of air conditioners by communicating with the plurality of air conditioners simultaneously.

Although an example of four air conditioners being installed is illustrated in Fig. 1, the number of the air conditioners is not particularly limited, and may be set to any number. Also, in the system S, although the air conditioners in the house H are subject to the schedule control, without being limited to this, a plurality of other electrical devices installed in the house H, for example, the lighting equipment may be subject to the schedule control.

[0021]

To give a general description for the schedule control, a schedule for the operation control of the air conditioner is

set in advance and stored in the home server 1. When a user requests the execution of the schedule control, the home server 1 reads the stored schedule and identifies an operation condition corresponding to the execution time of the schedule control based on the read schedule for each air conditioner. Then, the home server 1 controls the corresponding air conditioner respectively, in accordance with the identified operation condition for each air conditioner.

[0022]

Furthermore, in the system S, during the execution of the schedule control, it is possible to perform a number restriction operation for limiting the number of air conditioners in the start-up state.

When trying to operate equal to or more than a predetermined number of air conditioners at the same time at a certain time in accordance with the schedule, there is a case where the total power consumption in the house H exceeds the upper limit of the power to be described later. If the number restriction operation is designated in such a case, the number of the air conditioners to be operated simultaneously at a certain time may be limited, and a smaller number of air conditioners than the number of air conditioners to be operated in the certain time in accordance with the schedule are allowed to operate and the rest of the air conditioners are started later sequentially.

By performing the above number restriction operation, the rapid increase of the power consumption in the house H may be suppressed. As a result, shut-off of the circuit breaker

disposed in the distribution switchboard in the house H and an excess of the power consumption in the house H over the contracted consumption determined under an agreement with a power company may be prevented.

[0023]

<< Configuration of the home server 1 >>

Next, the configuration of the home server 1 will be described with reference to Figs. 2 and 3.

The home server 1 is communicably connected to electrical devices and the power data logger 7 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.

[0024]

Also, in the memory 1b, the installation location storage area (not shown) stores information on the installation locations in the house H of the electrical devices used in the house H, such as air conditioners. When inspecting a connection state between the home server 1 and each of the electrical devices at the construction stage of the house H, the installation location of each electrical device is written into the memory 1b through a predetermined input device by the inspector. However, how to obtain the installation locations shall not be limited to the above case, and, for example, it may be acquired by finding the installation locations of the electrical devices from the data representing the construction drawing of the house H.

[0025]

The memory 1b stores an energy-saving air-conditioning function program for controlling an air conditioner in each room with an energy-saving air-conditioning function.

The memory 1b stores an air-conditioner management information table, and a setting control table for an energy-saving air-conditioning function.

The air-conditioner management information table is a table for storing management information for individual air conditioners, and includes device IDs, locations (air conditioner names), remarks, room types as characteristic types, humidity handling (presence/absence of humidity handling) as items. The room type is a parameter necessary for controlling the energy-saving air-conditioning function in the default operation mode, and includes a living-room/dining-room/kitchen, a main bedroom, a Western-style room, a Japanese-style room, a hallway, and others. By classifying the room types into six types, the work at the time of construction and design of the house H is simplified, and it becomes possible to prepare in advance the air conditioner control schedule in accordance with the default operation mode. This means that the air conditioning schedule has been set for each room type by default. In the present embodiment, though the room type is adopted as the characteristic type, any type is acceptable if it classifies a plurality of energy-consuming devices according to the role that each device plays or the characteristic that each device has in the house H.

A list of room types is shown in Table 1.

[0026]

[Table 1]

List of room types

Acquired data	Item
ldk	Living-room/dining-room/kitchen
masterBedroom	Main bedroom
wRoom	Western-style room
jRoom	Japanese-style room
passage	Hallway
other	Others

[0027]

The setting control table is a table for storing a setting control items for energy-saving air-conditioning function, and provided with as items, an operation state (ON / OFF), an operation content (cooling / heating), an operation mode, a saving operation (ON / OFF), a power saving setting (ON / OFF), and a schedule setting.

The operation state shows whether the energy-saving air-conditioning function is ON. In the case where it is ON, the operation is performed in accordance with the schedule set by the operation mode. One operation state is kept for the energy-saving air-conditioning function.

The operation mode indicates the operation mode of the energy-saving air-conditioning function. The control of the air conditioner is performed in accordance with the schedule that is kept for each operation mode. Different operation modes

are kept for cooling and heating. The range of operation modes and operation types are shown in Table 2.

[0028]

[Table 2]

List of operation modes/operation types

Acquired data	Operation mode	Operation type
c1	Cooling-Comfort in Occupied Rooms	Cooling
c2	Cooling-Just Comfort	
C3	Cooling-Everywhere Comfort	
C4	Cooling-Continued in Whole House	
co1	Cooling-Original 1	
co2	Cooling-Original 2	
co3	Cooling-Original 3	
h1	Heating-Comfort in Occupied Rooms	Heating
h2	Heating-Just Comfort	
h3	Heating-Everywhere Comfort	
h4	Heating-Continued in Whole House	
ho1	Heating-Original 1	
ho2	Heating-Original 2	
ho3	Heating-Original 3	

The default of the operation mode is "Cooling-Comfort in Occupied Rooms".

[0029]

The saving operation indicates whether the saving operation function for shifting the start time for operation

is turned ON in order to suppress the rapid power increase when the number of the air conditioners which start at the same time exceeds a prescribed number, and the saving operation has ON / OFF as the range. One saving operation is kept for the energy-saving air-conditioning function.

The power saving setting is for setting collectively the set temperature of the air conditioner to a slightly weak power side (cooling 30 °C, heating 17 °C), and indicates whether the power saving setting as a mode for saving power consumption by the air conditioner is turned ON, and the power saving setting has ON / OFF as the range.

The schedule setting is intended to set the schedule for each operation mode.

[0030]

The memory 1b keeps the individual schedule property in addition.

The individual schedule property is used to set the schedule for each device (air conditioner), and when receiving a request for the schedule setting from the user terminal 3, the home server 1 acquires from this update request, the device IDs, the operation mode, the time and the value so as to store them in an individual schedule property which is control data.

It should be noted that the default schedule property is used for default, and thus addition or removal of data is not performed.

Fig. 4 shows two examples of a storage of the individual schedule property after receiving the schedule setting request. The individual schedule not only changes the temperature and

time, but also may set the manual control zone which gives priority to the manual setting.

[0031]

The reset of the schedule is possible for each operation mode, and as shown in Fig. 5, when receiving a reset request from the user terminal 3, the home server 1 deletes data including the operation mode whose parameter has been acquired as a key, from the individual schedule property.

[0032]

The memory 1b keeps the room type correspondence property in addition.

The room type correspondence property is intended to manage the room type, and stores the device IDs as a key, and the room type as a value.

The memory 1b retains the default schedule property in addition.

The default schedule property is intended to manage the default schedule, and keeps the operation mode, the room type and the operation time so that the combination of them is a key, and further keeps the setting control data as a value.

[0033]

In general, for the house H where the HEMS is mounted, it is recommended to use the electrical devices employing a common communication protocol (synonymous with a communication mode and communication standard), for example, it is desired that the electrical devices are unified into devices all adopting a communication protocol proposed by the ECHONET consortium. On the other hand, as the protocols that the

ECHONET consortium proposes, there are the ECHONET (registered trademark) and the ECHONETLite (registered trademark) which is a successor standard of the former, and there is a case where both protocols are mixed in the electrical devices in the house H. Also, among the electric devices the user purchases, there also contains a device using a communication protocol other than the ECHONET and the ECHONETLite.

[0034]

Then, in the system S, among a plurality of air conditioners used in the house H, there are air conditioners to communicate with different communication protocols from each other. Therefore, in the bundle storage area (not shown) of the memory 1b, communication bundles for the home server 1 communicating with a communication partner in the house H are stored separately for each communication protocol. That is, in the system S, the same number of communication bundles as the number of types of communication protocols employed by the electrical devices in the house H are stored in the memory 1b. To describe specifically, in the bundle storage area, a bundle for communication using the first communication protocol (e.g., ECHONET), a bundle for communication using a second communication protocol (e.g., ECHONETLite) and a bundle for communication using the third communication protocol (for example, a communication protocol other than ECHONET and ECHONETLite) are stored.

[0035]

Then, in the system S, among the communication bundles stored in the bundle storage area (not shown), a communication

bundle that is to be read and executed is adapted to be switched in response to the communication partner. Thus, the home server 1 may switch the communication protocols to be employed when communicating with the air conditioner, in accordance with the communication protocol that the air conditioner of the communication partner employs. Note that the switch between the communication protocols is synonymous with rewriting the electronic message (command) to be transmitted with a certain communication protocol in accordance with a different communication protocol when the message is to be transmitted to a communication device using the different communication protocol.

[0036]

Here, to describe the program execution environment in the home server 1, the home server 1 has 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 as shown in Fig. 3. The OSGi framework 103 is built on the JVM 102 to manage the life cycle of the bundle that runs on the OSGi framework 103, such as a download, installation, a start-up and a stop. Then, the bundle running on the OSGi framework 103 may be replaced dynamically, and also, a plurality of bundles may be run in parallel.

[0037]

Here, among bundles running on the OSGi framework 103, a first communication bundle 104 for communicating using the first communication protocol, the second communication bundle

105 for communicating using the second communication protocol, and the third communication bundle 106 for communicating using the third communication protocol as described above. And, among the functions that the OSGi framework 103 has, by the function of exchanging bundles dynamically, the bundle to be executed is replaced in accordance with the communication protocol of the electric device which is the communication partner when the home server 1 communicates. Because of such replacement of communication bundles, the communication protocol employed by the home server 1 is changed. As a result, the home server 1, regardless of the difference of the communication protocols, may communicate with the electrical device in the house H.

[0038]

Furthermore, when each communication bundle 104, 105 or 106 is registered in the OSGi framework 103, an interface for using the function of each communication bundle 104, 105 or 106 is registered in the service registry. The OSGi framework 103 provides a synthesis of these interfaces as an API (Application Program Interface). By use of this API, on the user side, the need to be aware of the difference in communication bundles, that is, the difference in communication protocols between electrical devices is eliminated. This means that when developing a program that requests the control of electrical devices by the home server 1, only if the developer grasps the object regulation of each electrical device, a common development method of the Web communication program may be applied.

[0039]

By using the above-mentioned API, when requesting the home server 1 to communicate with the electric device in the house H, it is not necessary to adjust the request electronic message to the format corresponding to the communication protocol, and the message becomes relatively simple. When the user requests the home server 1 to control the air conditioner, as shown in Fig. 6, an HTTP request (execution request for the control of air conditioner) is transmitted from the user terminal 3 to the home server 1. On the other hand, upon receiving the HTTP request from the user terminal 3, the home server 1 transmits a control signal to the air conditioner by communicating therewith. As a result, the home server 1, in accordance with a designated control rule in the HTTP request, controls the air conditioner to be controlled. The communication protocol employed when the home server 1 transmits a control signal is set to the communication protocol which the air conditioner of the destination of the control signal employs.

[0040]

Also, the home server 1 further communicates with the air conditioner which has received the control signal, and receives a response signal indicating the operation state of the air conditioner. In this case, the communication protocol to be employed by the home server 1 is set to the communication protocol adopted by the air conditioner of the transmission source of the response signal.

[0041]

In the system S as described above, bidirectional communication is performed between the home server 1 and the air conditioner. Specifically, the control signal is transmitted from the home server 1 to each air conditioner, and the response signal is transmitted from each air conditioner to the home server 1. Thus, among a plurality of air conditioners installed in the house H, it becomes possible to clearly distinguish the air conditioner to be controlled and other air conditioners on the home server 1 side.

[0042]

In the system S, while the exchange of data between the user terminal 3 and the home server 1 is performed by a versatile communication protocol, communication between the home server 1 and the air conditioner is performed by a communication protocol in accordance with the communication protocol adopted by the air conditioner. Thus, the user may, without being aware of the difference in communication protocols between the air conditioners, it is possible to request the control of each air conditioner from the home server 1.

Also, the control signals and response signals in the system 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 communication network means a network enabled to perform two-way communication as communication between the home server 1 and a communication object device, and a network corresponding to only the one-way

communication from the home server 1 to the communication object device is excluded from the network.

[0043]

<< Function of the air conditioner control system >>

The system S is also referred to as an energy-saving air-conditioning system, and is a system which controls an air conditioner in each room in the house H in accordance with a mode selected by the user on a display of the user terminal 3, from among control modes for the air conditioners registered in advance.

[0044]

In this embodiment, as control functions for air conditioners, three functions are provided, namely an individual control function for controlling the air conditioners separately, a collective control function for turning the air conditioner power source off in the house H collectively by clicking the "outing button" displayed on the display of the terminal 3, and an energy-saving air-conditioning function.

[0045]

The individual control function is a type of controlling air conditioners in the house H individually, and is selected by touching a select button on the screen (not shown). In the case where the individual control function is selected, a setting panel (not shown) is pictured on the display of the user terminal 3, and then the user, as well as designates the air conditioner to be individually controlled through the setting panel, may perform a switch of start-stop, a switch of the

operation form such as cooling, heating and dehumidification, and also, may perform setting of the operation control values such as temperature and humidity for the air conditioner. When the operation on the setting panel is completed, an instruction corresponding to the operation is transmitted from the user terminal 3 to the home server 1, and the home server 1 which has received the instruction described above, identifies the air conditioner to be individually controlled, so as to control the air conditioner in accordance with the instruction.

The energy-saving air-conditioning function is a function for controlling the operation of all the air conditioners in the house H for a day by using the user terminal 3, and is a type for controlling in accordance with the schedule in which the operation of each air conditioner in the house H for a day is preset. Here, the schedule is intended to define which air conditioner is operated on what operation condition in what time period of a day, and for example, is a time schedule related to the operation control of the air conditioners shown in Fig. 7.

[0046]

To be more specific, the schedule is configured by assembling the same number of separated schedules as the number of the air conditioners, and each of the schedules defines what time period and what state of load the air conditioner is operated in for each air conditioner. In such a sense, it may be said that the schedule defines a time period when each of the plurality of air conditioners is operated under the

operation condition where the load is equal to or greater than a predetermined amount.

[0047]

Here, the word "load" means the electric power load, and the phrase "is operated under the operation condition where the load is equal to or greater than a predetermined amount", means that after consuming start-up power of the air conditioner, the air conditioner is operated under the operation condition where power more than the rated power of the air conditioner is consumed, that is, it means that the air conditioner is started up. However, it is not limited to this, the phrase "is operated under the operation condition where the load is equal to or greater than a predetermined amount" may mean an operation under an operation condition where cooling temperature is set at or below a predetermined value, or heating temperature is set at or above a predetermined value.

[0048]

When the schedule control is selected, the home server 1 controls the operation state of each air conditioner in the house H in accordance with the schedule. To be more specific, the home server 1 reads the schedule from the memory 1b, to identify the operation condition at the execution time of the regular control for each air conditioner. Here, the regular control means a control which the home server 1 executes at constant intervals in the schedule control, and in the system S, at 0 minute, 15 minutes, 30 minutes, and 45 minutes of every hour, the control is executed. However, the execution interval

of the regular control shall not be limited to the above, it may be set at will.

[0049]

At each time of the regular control, the home server 1 transmits a control signal for controlling the operation state to the respective air conditioners so that each air conditioner starts the operation in accordance with the operation condition specified for each air conditioner. Specifically, when the home server 1 controls each air conditioner in accordance with the schedule of Comfort in Occupied Rooms in Fig. 7, in the regular control of 21 o'clock, while the home server 1 keeps the air conditioners in the Western-style room, Japanese-style room and others in a stopped state, allows the air conditioner in the main bedroom to start operating, and causes the air conditioners in the living-room/dining-room/kitchen and the hallway, which have been already in a start-up state, to maintain the state.

[0050]

The home server 1 transmits a start-up request signal to the air conditioner in the main bedroom in the regular control of 21 o'clock. Here, the start-up request signal is an example of the operation request signals, and specifically is a control signal in order to operate in the standard operation condition. And, the air conditioner in the main bedroom, upon receiving the start-up request signal through the home network 5, starts the operation by taking this opportunity.

[0051]

In this system S, it is intended that if the schedule control type is selected, the operation mode shall be selected together. The operation mode is a control policy in the schedule control and a plurality of modes are set for air conditioners in the house H. The user may select the operation mode on a screen (not shown).

[0052]

As the operation mode, for each of the cooling and heating, five types of modes in total are provided, namely, the modes of Comfort in Occupied Rooms, Just Comfort, Everywhere Comfort, Continued in Whole House, and Original modes 1-3. In the mode of Comfort in Occupied Rooms, the schedule operation is executed only for the family shared space and the main bedroom, and in the mode of Just Comfort, the operation is at a stop in the bedroom and children's room with no people in the daytime, and at night the operation is executed in the living room, bedroom and children's room and the like, which are occupied, in order to perform the schedule operation matching with the life rhythm such as attendance at work, school attendance, and returning home. In the mode of Everywhere Comfort, the scheduled operation is performed in all the rooms for 24 hours continuously so as to fit the life rhythm of the day and night, and in the mode of Continued in Whole House, the operation is performed at the same comfortable temperature in all the rooms for 24 hours, and further in the Original modes 1-3, the room temperature and the schedule for each room may be set from scratch by the user.

Then, in the system S, a schedule is prepared for each operation mode, and when the home server 1 in the system S performs the schedule control in a certain operation mode, each air conditioner in the house H is operated in accordance with the schedule corresponding to the certain operation mode.

Fig. 7 shows an example of heating controls in the operation modes of Comfort in Occupied Rooms, Just Comfort, and Everywhere Comfort as preset operation modes.

[0053]

Moreover, preset operation modes other than the Original mode may also be customized by the user.

Described specifically, on the schedule screen (not shown), the default schedules are displayed. Among the schedules being displayed, when the user touches the area to be modified, the display of an update panel shown in Fig. 8 pops up. The user, through the update panel, inputs modification matters for the area of the modification object in the schedule, specifically inputs the operation condition, the start time and end time of the time period to which the operation condition is applied, and the air conditioner to which the operation condition concerning the modification is applied. Then, when the user touches the update button Bt4 on the update panel after the input operation of the modification matters is complete, a schedule setting request is transmitted from the user terminal 3 to the home server 1. The schedule setting request includes information on an device ID, an operation mode, setting time, and a value (temperature, ON and OFF).

The home server 1, when the request is received, updates by overwriting the corresponding control data of the device IDs, the operation mode, and the set time in the individual schedule property in the memory 1b, as shown in Fig. 4.

[0054]

It is possible to modify the schedule for each operation mode in accordance with the steps described above. On the other hand, the schedule of each operation mode is a default schedule, if the modification has not been performed even once. To be more specific, among the default schedules, the individual schedule concerning each air conditioner has a content corresponding to the room type of the each air conditioner.

Fig. 9 shows an example of the default schedule when the mode of Comfort in Occupied Rooms that is a preset mode is set, and an example of the mode of Comfort in Occupied Rooms which has been customized.

Fig. 9 shows an example in which the preset operation mode has been customized by the individual schedule, and a schedule set by default has been modified, and then Comfort in Occupied Rooms is overwritten with the contents of the modification. The setting modification cannot be carried out for each room type but for each air conditioning device.

[0055]

<< Air conditioner control method: processing of the energy-saving air-conditioning function program >>

The air conditioner control processing for the energy-saving air-conditioning function by the home server 1 as an air conditioner control device will be described with

reference to the flowcharts in Figs. 10 and 11. The processing shown in these flowcharts is processing of the energy-saving air-conditioning function program stored in the HDD 4 of the home server 1, and is controlled by the CPU 1a of the home server 1.

The home server 1 starts processing of the flowchart in Fig. 10 at 00 minute, 15 minutes, 30 minutes, 45 minutes of every hour in the step S1, and at the same time obtains information on the hour and minute of the time when the processing is started. The hour and minute of the time when the processing is started corresponds to the current time described in the embodiments.

Next, in the step S2, by referring to the setting control table, the operation state of the energy-saving air-conditioning function is obtained.

[0056]

In the step S3, whether the operation state of the energy-saving air-conditioning function is ON or not is determined. If it is OFF (step S3: No), it is considered that the next monitoring time is waited for, and the processing ends.

In the case of ON (step S3: Yes), the operation mode is obtained in the step S4.

Then, in the step S5, a list of the device IDs is obtained. The device ID of the object is an device ID of an device whose code which each of various types of devices has is for an air conditioner.

In the step S6, one device ID in the list of the device IDs acquired in the step S5 is read.

In the step S7, a control of the air conditioner is implemented, and in step S8, it is determined whether there is an device ID which has not been read yet among the device IDs obtained in the step S5, .

[0057]

If there is an device ID which has not been read yet (step S8: Yes), one of the device IDs in the list of device IDs acquired in the step S5 is read in the step S6.

If there is no device ID which has not been read yet (step S8: No), it is considered that the control processing of the air conditioners in the step S7 is completed for the air conditioners of all the device IDs, and the processing is terminated.

[0058]

The air conditioner control processing in the step S7 is performed in accordance with the air conditioner control processing flowchart of Fig. 11.

First, in the step S11, the control data of individual schedule is obtained.

In this step, by using the operation mode acquired in the step S4, the device ID acquired in the step S5, and the numerical values of the hour and minute acquired in the step S1 as keys, the individual schedule property are referred so as to obtain the control data.

[0059]

Next, it is determined whether there is data in the step S12.

If there is no data (step S12: No data), by using the device ID obtained in the step S5 as a key, the room type is obtained from the room type correspondence property in the step S13.

[0060]

Next, in the step S14, by using the operation mode acquired in the step S4, the room type acquired in the step S13, and the numerical values of the hour and minute acquired in the step S1 as keys, control data is acquired from the default schedule property. Then, in the step S15, judgment of the control data is carried out.

In the step S12, when there is data (step 12: Data is present), the control data judgment is carried out in the step S15.

In this step, it is determined which is the value of the control data obtained in the step S11 or the step S14 among the value 17-30 indicating temperature, OFF indicating power-off, and ANY indicating priority of the manual setting.

[0061]

If it is OFF (step S15: OFF), the control execution is implemented in the step S16 to turn the power off, and then the processing is terminated.

If it is ANY (step S15: ANY), for example, as the end part of the schedule setting request 2 of the schedule image 2 in Fig. 4, if it is set to "ANY", the priority of the manual setting is designated, and the processing is terminated for waiting for the next monitoring time.

That is, the value of the schedule setting request "ANY" is for instruction to obey the manual setting by the user without

carrying out any control of the air conditioner, and in the time period for which the "ANY" is requested, the air conditioner maintains the state at this time point, which is an operating state or a standstill state.

If it is the value 17-30 (step S15: 17-30), the power state of the air conditioner is acquired in the step S17, and whether the power state of the air conditioner is ON or OFF is determined in the step S18.

In the case of ON (step S18: ON), the operation state of the power saving setting is obtained in the step S23.

[0062]

In the case of OFF (step S18: OFF), by referring to the setting control table, the operation state of the saving function is acquired in the step S19.

Next, in the step S20, whether the operation state of the saving function is ON or OFF is determined.

In the case of OFF (step S20: OFF), the operation state of the power saving setting is obtained in the step S23.

If the operation state of the saving function is ON (step S20: ON), a determination is made whether the power of the air conditioners may be turned ON in the step S21.

Previously, the number of the air conditioners which may be started simultaneously is set to "n", and the air conditioners after the "n" units are intended to execute the processing at the next opportunity.

In the step S22, when the power of the air conditioners which has been turned OFF is turned ON, whether the number of

air conditioners to be started at the same time is less than "n" is determined.

[0063]

If it is equal to or greater than "n" (step S22: No), since the air conditioners cannot be turned ON, the processing is terminated in order to wait for the next monitoring time.

If it is less than "n" (step S22: OK), by referring to the setting control table, the operation state of the power saving setting is acquired in the step S23.

Next, in the step S24, whether the operation state of the power saving setting is ON or OFF is determined.

In the case of ON (step S24: ON), the temperature is adjusted in the step S25.

In this step, the control data obtained in the step S11 or step S14 is changed into the control data of the power saving setting in accordance with the operation type of the operation mode acquired in the step S4.

That is, in the case of the cooling operation mode, the control data is set to 30 °C, and in the heating operation mode, it is set to 17 °C.

[0064]

Then, in the step S26, the control contents are executed.

In this step, the processing for air conditioners is executed in accordance with the control data acquired in the step S11 or step S14, the power state of the air conditioner obtained in the step S17, and the operation type of the operation mode acquired in the step S4.

The processing contents are shown in Table 3.

[0065]

[Table 3]

List of execution of the control contents

Control data	State of air conditioner	Operation mode	Contents of processing
17-30	ON	Cooling operation mode	Set the operation mode of air conditioner to cooling Set the set temperature of air conditioner to 17-30
17-30	ON	Heating operation mode	Set the operation mode of air conditioner to heating Set the set temperature of air conditioner to 17-30
17-30	OFF	Cooling operation mode	Set the operation state of air conditioner to ON Set the operation mode of air conditioner to cooling Set the set temperature of air conditioner to 17-30
17-30	OFF	Heating operation mode	Set the operation state of air conditioner to ON Set the operation mode of air conditioner to heating Set the set temperature of air conditioner to 17-30

OFF	-	-	Turn the power source of air conditioner off
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[0066]

Then, the processing of the flowchart of Fig. 11 is finished.

According to the processing of the energy-saving air-conditioning function program of Figs. 10 and 11 described above, the control data of the individual schedule is acquired in the step S11, if it is determined that the data is not present in the step S12, the control data corresponding to the room type attached to the device ID of the air conditioner and the current time given at that time is obtained from the default schedule property so as to control the air conditioner based on the control data. Therefore, the air conditioner is controlled based on the individual schedule if there is an individual schedule set by the user, and the air conditioner is controlled based on the default schedule if there is no individual schedule, and therefore precise setting is possible such as conversion of a part of the default schedule into the individual schedule after setting the default schedule in advance.

In the present embodiment, as an example of energy-consuming devices, an air conditioner control device for controlling an air conditioner in each room has been described. However without being limited thereto, as long as a common communication protocol is adopted such as a communication protocol that the ECHONET consortium proposes, and devices may be controlled from the home server 1, the present invention may

be applied to other energy-consuming devices as a matter of course such as lighting equipment in each room, outdoor lights, floor heating, warm toilet seats, robot cleaners, electric blinds, storage batteries or fuel cells, etc. installed in the house H.

Reference Numerals

[0067]

S air conditioner control system

H house

1 home server

1a CPU

1b memory

1c communication interface

3 user terminal

5 home network

7 power data logger

101 OS

102 JVM

103 OSGi framework

104 first communication bundle

105 second communication bundle

106 third communication bundle

Bt4 update button

CLAIMS

1. A control device for energy-consuming device, for controlling a plurality of energy-consuming devices installed in a building, the control device comprising:

a first switching section that switches a plurality of different operation modes to control the plurality of energy-consuming devices in accordance with different default schedules depending on a plurality of characteristic types classified according to a plurality of characteristics in advance;

a second switching section switches an operation state of a saving function for limiting a number of the plurality of the energy-consuming devices to be operated simultaneously at a certain time to a predetermined number;

a default schedule storage section that stores a default schedule property with control data of the default schedules kept therein;

an individual schedule storage section that stores an individual schedule property which keeps control data of an individual schedule set for a specific energy-consuming device;

an individual schedule presence/absence determination section that, as a regular control at constant intervals, refers to the individual schedule storage section by using a current time and an device ID of the specific energy-consuming device as keys and that determines if control data for the current time is registered for the specific energy-consuming device in the individual schedule property; and

a control execution section that controls the specific energy-consuming device in accordance with the schedule kept in the default schedule property if the control data for the current time for the specific energy-consuming device is not registered in the individual schedule property; and

when the operation state of the saving function is ON, the control execution section determines whether the number of the plurality of energy-consuming devices to be operated simultaneously is equal to or greater than the predetermined number, wherein, if the number of the plurality of energy-consuming devices is smaller than the predetermined number, turns ON a plurality of powered-OFF energy-consuming devices, and if the number of the plurality of energy-consuming devices is equal to or greater than the predetermined number, avoids turning ON any of the plurality of powered-off energy-consuming devices in order to wait for a monitoring time of the regular control at constant intervals.

2. The control device for energy-consuming device, according to claim 1, further comprising:

an individual energy-consuming device information storage section that associates the device IDs of the energy-consuming device with the characteristic types thereof,

wherein the control data in the default schedule property include information on the operation modes, the characteristic types, switching times of settings, and contents of settings to which the former settings are to be switched at the switching times, and

wherein the control execution section acquires the operation mode under execution, acquires the characteristic type of the each energy-consuming device by referring to the individual energy-consuming device information storage section while using the device ID of the each energy-consuming device as a key, acquires the switching time and the content of the setting by referring to the default schedule property while using the characteristic type, the operation mode and the current time as keys, and controls the each energy-consuming device in accordance with the content of the setting.

3. The control device for energy-consuming device, according to claim 1 or 2, wherein:

the control data in the individual schedule property includes information on the device IDs, the operation modes, switching times of settings and contents of settings to which the former settings are to be switched at the switching times, and

the individual schedule presence/absence determination section determines if the control data for the current time is registered for the energy-consuming device in the individual schedule property, by referring to the individual schedule storage section while using the operation mode under execution in addition to the current time and the device ID as keys.

4. The control device for energy-consuming device, according to claim 3, wherein the control execution section, if the control data for the current time is registered in the individual schedule property, controls the energy-consuming device according to the content of the setting registered in the individual schedule property.

5. The control device for energy-consuming device, according to any one of claims 1 to 4, wherein the control data in the individual schedule property is updated or deleted by a command from an information input section installed in the building.

6. The control device for energy-consuming device, according to any one of claims 1 to 5, further comprising: a protocol changing section that changes a communication protocol, which is to be used when transmitting a control signal to the energy-consuming device, in accordance with a

communication protocol, which is used by the energy-consuming device as a transmission destination, to control the energy-consuming device, when the plurality of energy-consuming devices communicate using communication protocols different from each other.

7. A control method for energy-consuming device, for controlling a plurality of energy-consuming devices installed in a building, wherein:

the control method switches a plurality of different operation modes to control the plurality of energy-consuming devices in accordance with default schedules depending on a plurality of characteristic types classified according to a plurality of characteristics in advance;

the control method switches an operation state of a saving function for limiting a number of the plurality of energy-consuming devices to be operated simultaneously at a certain time to a predetermined number;

and the control method comprises the following steps:

as a regular control at constant intervals, referring to an individual schedule storage section, which stores an individual schedule property that keeps control data of an individual schedule set for a specific energy-consuming device, by using a current time and an device ID of the specific energy-consuming device as keys, and determining if control data for the current time is registered for the specific energy-consuming device in the individual schedule property, and

controlling the specific energy-consuming device in accordance with the default schedule kept in a default schedule storage section which stores the default schedule property with control data of the default schedule kept therein, if the control data for the current time is not registered for the

specific energy-consuming device in the individual schedule property; and

when the operation state of the saving function is ON, the step of controlling the energy-consuming device comprises a step of determining whether the number of the plurality of energy-consuming devices to be operated simultaneously is equal to or greater than the predetermined number, wherein, if the number of the plurality of energy-consuming devices is smaller than the predetermined number, turns on a plurality of powered-OFF energy-consuming devices, and if the number of the plurality of energy-consuming devices is equal to or greater than the predetermined number, avoids turning ON any of the plurality of the powered-OFF energy-consuming devices in order to wait for a monitoring time of the regular control at constant intervals.