



(19) Korean Intellectual Property Office (KR)
(12) Korean Unexamined Patent Publication (A)

(11) Publication No. 10-2010-0083686
(43) Publication Date July 22, 2010

(51) Int. Cl. *F25D 29/00* (2006.01) *F25D 23/00* (2006.01)
 (21) Application No. 10-2009-0080630
 (22) Application Date August 28, 2009
 Examination Request Date: **None**
 (30) Priority claim
 1020090003133 January 14, 2009 Republic of Korea (KR)

(71) Applicant
LG Electronics Co., Ltd.
 20 Yeouido-dong, Yeongdeungpo-gu, Seoul
 (72) Inventor
Moon-seok Seo
 LG Electronics DA Research Center, 222-22, Guro 3-dong, Guro-gu, Seoul
Jun-young Lim
 LG Electronics DA Research Center, 222-22, Guro 3-dong, Guro-gu, Seoul
Jin-seong Hwang
 LG Electronics DA Research Center, 222-22, Guro 3-dong, Guro-gu, Seoul
 (74) Agent
Jang-won Park

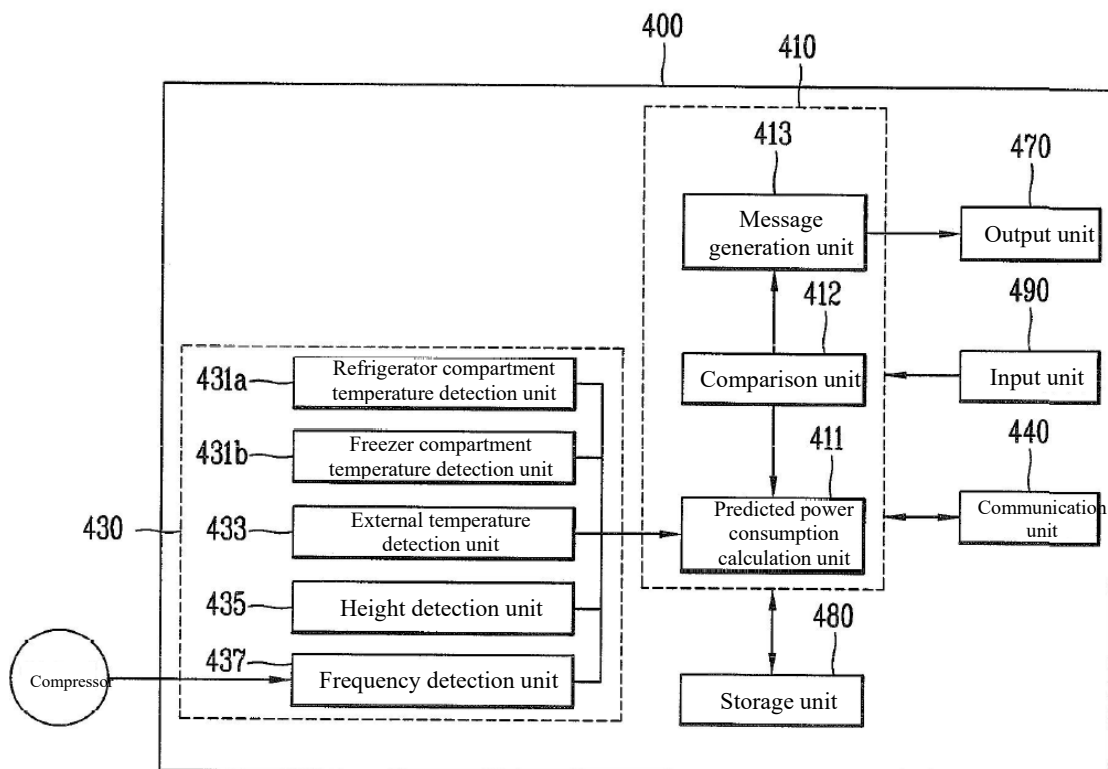
Total number of claims: 42 claims in total

(54) REFRIGERATOR CONTROL DEVICE AND CONTROL METHOD THEREOF

(57) Abstract

A refrigerator control device and a control method for the same are disclosed. The present invention allows a user to check consumed power amount and electricity fee by individually estimating or measuring the power consumption according to the use of a refrigerator, and can output and display information on energy savings based on the internal and external state of the refrigerator and operating status. In addition, the present invention enables a user or the like to actively save power by detecting the internal and external states of a refrigerator and generating and providing messages such as information on changes in the internal and external states, actual or estimated consumed power amount, type of energy source, greenhouse gas emissions based on the actual or estimated consumed power amount, usage fee, and energy saving tips.

Representative Drawing - FIG. 3



Scope of Patent Claims**Claim 1**

A refrigerator control device comprising:

a state detection unit for detecting a plurality of internal and external states of a refrigerator;

a predicted power consumption calculation unit for calculating predicted power consumption based on the detected states;

a control unit for generating one or more messages corresponding to the internal and external states; and

an output unit for outputting the predicted power consumption and the messages.

Claim 2

The refrigerator control device according to claim 1, further comprising a power consumption detection unit connected to an input power source and detecting a power consumption supplied to the refrigerator.

Claim 3

The refrigerator control device according to claim 1 or claim 2, wherein the state detection unit comprises a frequency detection unit that detects a driving frequency of a compressor for driving the refrigerator.

Claim 4

The refrigerator control device according to claim 3, wherein the predicted power consumption calculation unit calculates the predicted power consumption based on the driving frequency of the compressor.

Claim 5

The refrigerator control device according to claim 1 or claim 2, the state detection unit comprising:

one or more internal temperature detection units that detect a temperature in one or more storage spaces provided inside the refrigerator;

one or more height detection units that detect a height of stored items stored in the one or more storage spaces provided inside the refrigerator; and

an external temperature detection unit that detects a temperature outside the refrigerator.

Claim 6

The refrigerator control device according to claim 5, wherein the predicted power consumption calculation unit calculates the predicted power consumption based on state values of the states detected through the state detection unit.

Claim 7

The refrigerator control device according to claim 1 or claim 2, wherein the output unit comprises a screen display unit that displays the predicted power consumption or the supplied power consumption, and the message, on a screen.

Claim 8

The refrigerator control device according to claim 7, wherein the screen display unit selectively outputs the internal and external states, or outputs the message, or simultaneously outputs some or all of the internal and external states and the message.

Claim 9

The refrigerator control device according to claim 1 or claim 2, further comprising an input unit that inputs a command to output the power consumption and the message through the output unit.

Claim 10

The refrigerator control device according to claim 9, wherein the input unit comprises a selection unit composed of a plurality of buttons.

Claim 11

The refrigerator control device according to claim 10, wherein the predicted power consumption calculation unit calculates the predicted power consumption corresponding to state values of the states that are changed by a set value input through the input unit.

Claim 12

The refrigerator control device according to claim 1 or claim 2, wherein the control unit calculates an estimated greenhouse gas emission amount based on the calculated predicted power consumption.

Claim 13

The refrigerator control device according to claim 2, wherein the control unit calculates an estimated greenhouse gas emission amount based on the detected supplied power consumption.

Claim 14

The refrigerator control device according to claim 1 or claim 2, wherein the control unit further comprises:
a comparison unit that compares the internal and external states with preset reference states; and
a message generation unit that generates one or more messages corresponding to the internal and external states based on a comparison result.

Claim 15

The refrigerator control device according to claim 1 or claim 2, further comprising a storage unit in which types of the internal and external states and reference states are preset and stored.

Claim 16

The refrigerator control device according to claim 15, wherein the storage unit further comprises a greenhouse gas index and a corresponding electricity fee table.

Claim 17

The refrigerator control device according to claim 16, wherein the storage unit stores state values of the states and the predicted power consumption calculated corresponding to the state values.

Claim 18

The refrigerator control device according to claim 1 or claim 2, wherein the message is one of: types of the internal and external states, current values of the internal and external states, trends of the internal and external states, control set values, or energy saving tips.

Claim 19

The refrigerator control device according to claim 1 or claim 2, further comprising a communication unit connected to an external power device via a wired or wireless communication method and exchanges information with the external power device.

Claim 20

The refrigerator control device according to claim 19, wherein the communication unit receives a type of energy source and a greenhouse gas index corresponding to the energy source from the external power device.

Claim 21

The refrigerator control device according to claim 19, wherein the communication unit is connected between the output unit and the external device, and transmits data detected, calculated, or generated through the control unit or the state detection unit to the external device.

Claim 22

A refrigerator control method, comprising:
a step for detecting a plurality of internal and external states of a refrigerator;

a step for calculating predicted power consumption and usage fees based on the states;
a step for generating one or more messages corresponding to the internal and external states; and
a step for outputting the power consumption and the messages.

Claim 23

The refrigerator control method according to claim 22, further comprising a step for detecting the power consumption supplied to the refrigerator.

Claim 24

The refrigerator control method according to claim 22 or claim 23, wherein the step for outputting further comprises a step for selectively outputting the internal and external states, or outputting the message, or simultaneously outputting some or all of the internal and external states and the message.

Claim 25

The refrigerator control method according to claim 22 or claim 23, further comprising a step for inputting a command to output the power consumption and the message.

Claim 26

The refrigerator control method according to claim 22 or claim 23, further comprising:

a step for presetting types of the internal and external states and reference states; and

a step for comparing the detected internal and external states with the reference states,

wherein the step for generating one or more messages generates the one or more messages based on a comparison result.

Claim 27

The refrigerator control method according to claim 22 or claim 23, further comprising a step for storing the detected internal and external states.

Claim 28

The refrigerator control method according to claim 27, wherein the step for calculating predicted power consumption and usage fees calculates the predicted power consumption based on state values of the detected internal and external states.

Claim 29

The refrigerator control method according to claim 28, wherein the step for storing the detected internal and external states stores the detected internal and external states and the predicted power consumption calculated based on state values of the states.

Claim 30

The refrigerator control method according to claim 29, wherein the step for calculating predicted power consumption and usage fees calculates the predicted power consumption based on state values of the states that vary according to settings of the refrigerator.

Claim 31

The refrigerator control method according to claim 22 or claim 23, wherein the message is one of: types of the internal and external states, current values of the internal and external states, trends of the internal and external states, control settings, or energy saving tips.

Claim 32

The refrigerator control method according to claim 23, further comprising a step for calculating an estimated greenhouse gas emission of the energy source supplying power to the refrigerator based on the calculated predicted power consumption or the detected supplied power.

Claim 33

The refrigerator control method according to claim 32, further comprising a step for presetting and storing a greenhouse gas index according to the energy source and a corresponding electricity fee table.

Claim 34

The refrigerator control method according to claim 31, further comprising a step for connecting to an external power device via wired or wireless communication and receiving information on a type of the energy source and the greenhouse gas index corresponding to the energy source from the external power device.

Claim 35

The refrigerator control method according to claim 32, wherein the message is one of: types of the internal and external states, current values of the internal and external states, trends of the internal and external states, control settings, or energy saving tips.

Claim 36

The refrigerator control method according to claim 35, further comprising a step for transmitting externally the predicted or detected power consumption, the usage fees calculated based on the power consumption, the greenhouse gas emission, and the message.

Claim 37

A refrigerator control method, comprising:

- a step for detecting a plurality of internal and external states of a refrigerator;
- a step for calculating predicted power consumption and usage fees based on the detected states;
- a step for calculating an estimated greenhouse gas emission of the energy source supplying power to the refrigerator based on the calculated predicted power consumption;
- a step for generating one or more messages corresponding to the internal and external states; and
- a step for outputting the power consumption and the messages.

Claim 38

A refrigerator control method, comprising:

- a step for detecting a plurality of internal and external states of the refrigerator;
- a step for calculating predicted power consumption based on the detected states;
- a step for detecting the supplied power to the refrigerator;
- a step for calculating usage fees based on the predicted power consumption or the supplied power;
- a step for calculating an estimated greenhouse gas emission of the energy source supplying power to the refrigerator based on the calculated predicted power consumption;
- a step for generating one or more messages corresponding to the internal and external states; and
- a step for outputting the power consumption and the messages.

Claim 39

The refrigerator control method according to claim 37 or 38, further comprising a step for displaying the power consumption and the calculated estimated greenhouse gas emission of the energy source.

Claim 40

The refrigerator control method according to claim 37 or 38, further comprising a step for connecting to an external power device via wired or wireless communication and receiving information on a type of the energy source and the greenhouse gas index corresponding to the energy source from the external power device.

Claim 41

The refrigerator control method according to claim 37 or 38, wherein the message is one of: types of the internal

and external states, current values of the internal and external states, trends of the internal and external states, control settings, or energy saving tips.

Claim 42

The refrigerator control method according to claim 41, wherein the step for outputting the power consumption and the message further comprises a step for transmitting externally the predicted or detected power consumption, the usage fees calculated based on the power consumption, the greenhouse gas emission, and the message.

Specification

Detailed Description of the Invention

Technical Field

[0001] The present invention provides a refrigerator control device and a control method thereof, which detect the internal and external states of the refrigerator, generate and provide messages such as changes in state, power consumption, usage fees, greenhouse gas emissions, and energy saving tips according to the internal and external states, thereby enabling energy saving and improving usage efficiency.

Background Art

- [0002] Generally, a refrigerator is an appliance used to keep stored items such as food and beverages fresh over an extended period of time, and preserves the stored items by freezing or refrigerating them according to the type of items to be stored.
- [0003] The refrigerator is operated by the driving of a compressor equipped inside the refrigerator. The cold air supplied to the inside of the refrigerator is generated by the heat-exchange action of the refrigerant and is continuously supplied to the inside of the refrigerator by repeatedly performing the compression-condensation-expansion-evaporation cycle, and the refrigerant supplied to the inside of the refrigerator is evenly distributed inside the refrigerator by convection, thereby allowing the food inside the refrigerator to be stored at the desired temperature.
- [0004] Recently, among consumers of refrigerators, there has been an increasing demand not only for conventional cooling efficiency but also for refrigerators with high storage space utilization, capable of storing a wide variety of items reflecting changes in living standards. In addition, there has been a growing demand for the inclusion of various functions that enhance user convenience.
- [0005] In addition, recently, as energy consumption has increased, the development of additional energy sources and energy generation has become increasingly necessary. However, the generation of the above energy results in the emission of a large amount of greenhouse gases, giving rise to environmental problems such as global warming. Furthermore, to reduce greenhouse gas emissions, particularly carbon dioxide, development of alternative energy sources such as nuclear power, fuel cells, wind power, solar power, solar heat, geothermal power, tidal power, and hydropower has been progressing.
- [0006] In the prior art, because the power consumption of a refrigerator was measured using a cumulative power meter that integrates the total household power consumption, the individual power consumption of the refrigerator could not be determined, and accordingly, users were unable to confirm the consumed power amount of individual appliances, the greenhouse gas emissions of the energy source, or the electricity fee.
- [0007] In addition, when using a refrigerator according to the prior art, the user cannot obtain information regarding energy saving according to the state of the interior and exterior of the refrigerator and according to the operating conditions of the refrigerator, and therefore, there is a problem in that the efficiency of using the refrigerator is reduced.
- [0008] Furthermore, the control devices and control methods according to the prior art do not take into account the greenhouse gas emissions from the energy sources that generate energy, thereby failing to address environmental problems such as global warming.

Contents of the Invention

Problems to be Solved

[0009] The present invention aims to provide a refrigerator control device and a control method thereof that detect the state of the interior and exterior of the refrigerator and generate and provide messages such as changes in state, consumed power amount, usage fees, greenhouse gas emissions, and energy saving tips according to the state of

the interior and exterior of the refrigerator, thereby enabling energy saving and improving the efficiency of using the refrigerator.

[0010] In addition, another object of the present invention is to provide a refrigerator control device and a control method thereof that provide the predicted consumed power amount, greenhouse gas emissions, and usage fees corresponding to user settings and other settings.

[0011] Furthermore, another object is to provide a refrigerator control device and its control method that may detect in real time the actual power consumption used individually by the refrigerator, or accumulate such data to provide users with information on consumed power amount, greenhouse gas emissions, usage fee, and usage time.

Means for Solving Problem

[0012] A refrigerator control device according to the present invention for achieving the above object is configured to include a state detection unit for detecting a plurality of internal and external states of a refrigerator, a predicted power consumption calculation unit for calculating predicted power consumption based on the detected states, a control unit for generating one or more messages corresponding to the internal and external states, and an output unit for outputting the predicted power consumption and the messages. In addition, the configuration further includes a power consumption detection unit connected to an input power source for detecting a power consumption supplied to the refrigerator. In addition, the refrigerator control device is further configured to include a communication unit connected to an external power device to exchange information. Here, the communication unit may receive information from the external power device, a type of energy source, a greenhouse gas index corresponding to the energy source, and the like. Further, the communication unit is connected between the output unit and the external device, and transmits data detected, calculated, or generated through the control unit or the state detection unit to the external device.

[0013] A refrigerator control method according to the present invention for achieving the above object is configured to include a step for detecting a plurality of internal and external states of a refrigerator, a step for calculating predicted power consumption and usage fees based on the detected states, a step for generating one or more messages corresponding to the internal and external states, and a step for outputting the power consumption and the messages. The method further includes a step for detecting the power consumption supplied to the refrigerator. Further, the method further includes a step for calculating an estimated greenhouse gas emission of the energy source based on the calculated predicted power consumption or the detected supplied power.

Effect

[0014] According to the present invention, the consumed power amount and the internal and external states of the refrigerator are detected, and the greenhouse gas emissions of the energy source and the usage fees may be provided to the user.

[0015] According to the present invention, it is possible to provide a user or the like with a predicted amount of the consumed power amount, usage fee, and greenhouse gas emissions of an energy source corresponding to setting values specified by the user or the like.

[0016] Further, according to the present invention, the internal and external states of the refrigerator are detected, and messages such as changes in state, consumed power amount, greenhouse gas emissions of the energy source, usage fees, and energy saving tips are generated and provided according to the internal and external states, thereby enabling the user to actively save energy based on such information.

[0017] Furthermore, according to the present invention, the refrigerator may detect in real time the actual power consumption used individually by the refrigerator, or accumulate such data to provide users with information on the consumed power amount, greenhouse gas emissions, usage fee, and usage time, and to provide information related to energy saving so that the user or the like may actively perform energy saving.

Detailed Description of Embodiments

[0018] Hereinafter, a refrigerator control device and a control method thereof according to the present invention will be described in detail with reference to the accompanying drawings.

[0019] A refrigerator provided with a refrigerator control device according to the present invention includes, as illustrated in FIGS. 1 and 2, a main body 100 having a storage space therein; a refrigerator compartment 200, which has one or more doors 210 and stores items under refrigeration; and a freezer compartment 300, which has one or more doors 310 and stores items in a frozen condition. In addition, depending on the type of refrigerator, the refrigerator may include a home bar 600 provided on the refrigerating compartment door 210 to allow items to be easily taken out or placed therein, and a dispenser 700 provided on the front surface of the freezing compartment door 310.

- [0020] A control device 400 according to a first embodiment of the present invention, as illustrated in FIG. 3, is configured to include a state detection unit 430 for detecting a plurality of internal and external states of the refrigerator, a predicted power consumption calculation unit 411 for calculating the predicted power consumption based on the detected states, a control unit 410 for generating one or more messages corresponding to the internal and external states, and an output unit 470 for outputting the predicted power consumption and the messages.
- [0021] The state detection unit 430 detects the internal and external states of the refrigerator. The state detection unit 430 may, as necessary, include some or all of the detection units described below.
- [0022] The predicted power consumption calculation unit 411 is provided in the control unit 410 and calculates the predicted power consumption based on the internal and external state values detected by the state detection unit 430. That is, the state detection unit 430 may include a frequency detection unit 437 that detects the driving frequency of the compressor operating the refrigerator. In general, in controlling a refrigerator, the compressor is driven to supply cold air into the interior of the refrigerator, and this cold air is generated by the heat exchange action of the refrigerant and is continuously supplied into the interior of the refrigerator by repeatedly performing the cycle of compression-condensation-expansion-evaporation. The supplied refrigerant is evenly distributed throughout the interior of the refrigerator by convection, allowing the food inside the refrigerator to be stored at the desired temperature. The predicted power consumption calculation unit 411 may calculate the consumed power amount required to drive the compressor based on the driving frequency input from the frequency detection unit 437, and on this basis, calculates the predicted power consumption of the refrigerator. Meanwhile, although not shown, the predicted power consumption of the refrigerator may be calculated based on detecting changes in the voltage or current applied to the compressor that drives the refrigerator.
- [0023] The control unit 410 calculates a usage fee based on the predicted power consumption amount computed by the predicted power consumption calculation unit 411. The control unit 410 continuously receives the computed predicted power consumption amount over a predetermined period or up to the present time, and calculates a usage fee by using a currently applied electricity fee table. These usage fees can be calculated hourly, daily, monthly, annually, or for a set period of time. In addition, the calculated predicted power consumption amount and usage fee are stored again in the control unit 410. In the case where a storage unit 480, described later, is provided, the electricity fee table may be preset in the storage unit 480 and read to calculate a usage fee based on the calculated predicted power consumption amount. In addition, the calculated power consumption and the calculated usage fee are again stored in the storage unit 480.
- [0024] In addition, the control unit 410 calculates the estimated greenhouse gas emissions of the energy source supplied to the refrigerator based on the calculated predicted power consumption. For example, the estimated carbon dioxide emissions can be calculated by multiplying the carbon dioxide index of the energy source by the calculated predicted power consumption. Here, the energy sources may include fossil fuels such as oil and gas, alternative energy sources such as solar power, solar heat, wind power, tidal power, hydropower, and geothermal energy, nuclear power, and fuel cells, and a greenhouse gas index for each energy source, for example a carbon dioxide index, can be set through experiments or the like. The electric power generated from the energy sources is supplied to the refrigerator through a power cable and, after undergoing voltage transformation or the like, becomes the input power of the refrigerator.
- [0025] The carbon dioxide index has a higher value for fossil fuels than for other energy sources, and the greenhouse gas index, which includes the carbon dioxide index, is set through the entire process, from the construction of the power generation facility to the generation and supply of energy and the treatment of waste and the like. Therefore, in the case of alternative energy sources, the carbon dioxide index should ideally be zero; however, because fossil fuels are actually used in the construction of power generation facilities and the like, the carbon dioxide index assumes a certain value that is not zero.
- [0026] In the case where a storage unit 480, described later, is provided, the storage unit 480 stores in advance the greenhouse gas index according to the type of energy source and the corresponding electricity fee table, and the control unit 410 can read these to calculate the estimated carbon dioxide emissions corresponding to the calculated predicted power consumption.
- [0027] The state detection unit 430 may include one or more internal temperature detection units 431 that detect the temperature within one or more storage compartments provided inside the refrigerator. The internal temperature detection unit 431 includes a refrigerator compartment temperature detection unit 431a for detecting the temperature within the refrigerator compartment 200 and a freezer compartment temperature detection unit 431b for detecting the temperature within the freezer compartment 300. In addition, when there are multiple refrigerator compartments or freezer compartments, multiple internal temperature detection units may be respectively installed, and multiple internal temperature detection units may be installed within each refrigerator compartment or freezer compartment.
- [0028] The state detection unit 430 may include an external temperature detection unit 433 that detects the temperature outside the refrigerator, that is, the room temperature.

- [0029] The state detection unit 430 may include one or more height detection units 435 that detect the height of items stored within one or more storage compartments provided inside the refrigerator. The height detection unit 435 may be installed in the refrigerator compartment 200 or the freezer compartment 300. In addition, when there are multiple refrigerator compartments or freezer compartments, a plurality of height detection units may be installed in each refrigerator or freezer compartment, and when each compartment includes multiple shelves, a plurality of height detection units may likewise be installed in each shelf. The height detection unit 435 may use a pair of infrared sensors including a transmitter and a receiver, an ultrasonic sensor, or the like, and the height of stored items can be easily detected by determining whether a signal emitted from the transmitter is received by the receiver.
- [0030] In addition, the state detection unit 430 may further include a sensor (not shown) that detects the opening and closing of the door.
- [0031] The state detection unit 430 may further include a gas sensor (not shown) that detects greenhouse gases, such as carbon dioxide, generated within the refrigerator itself.
- [0032] At this time, the predicted power consumption calculated by the predicted power consumption calculation unit 411 may be corrected based on the state values detected by each of the units of the state detection unit 430. That is, the change in consumed power amount according to the state values of each unit may be converted into data, and the predicted power consumption may be corrected based on this data.
- [0033] In addition, the predicted power consumption calculation unit 411 may calculate the predicted power consumption based on the respective state values of the state detection unit 430. If the state values detected by other state detection units 430 remain constant and only the state value detected by a single state detection unit changes, the predicted power consumption calculation unit 411 may calculate the predicted power consumption by observing the trend of power consumption corresponding to the changing state value. For example, if the other state values of the state detection units 430 remain unchanged, and only the temperature detected by the refrigerator compartment temperature detection unit 431a within the refrigerator compartment 200 changes, the predicted power consumption calculation unit 411 may calculate the predicted power consumption based on the changing refrigerator compartment temperature by tabulating or formulating the corresponding power consumption.
- [0034] The control unit 410 generates one or more messages corresponding to the internal and external states of the refrigerator detected by the state detection unit 430. The internal and external states detected by the state detection unit 430, such as the temperature in the refrigerator compartment, the internal temperature in the freezer compartment, the external temperature, the height of stored items, the quantity of stored items according to their height, the operating frequency of the compressor, and the number and duration of door openings, are analyzed, and one or more messages corresponding thereto are generated. For example, when the internal temperature of the refrigerator compartment becomes excessively low and drops below zero, causing the stored items to freeze, a message such as “The temperature in the refrigerator compartment is below zero” is generated to prompt an increase in the refrigerator compartment temperature. Additionally, when the amount of stored items in the freezer compartment is excessively large, resulting in increased power consumption, a message such as “Please reduce the amount of items in the freezer compartment” is generated. In addition, when the currently supplied energy source is expected to produce a high amount of greenhouse gases, particularly estimated carbon dioxide, messages such as “Carbon dioxide emissions are high” or “Please switch to a different energy source” are generated.
- [0035] In the control unit 410, the types of the internal and external states and the corresponding reference state values may be preset. That is, some or all of the internal and external states may be used as necessary. In addition, reference states for each internal and external state are preset, the current values of the internal and external states are compared with the preset reference values, and messages are generated based on the comparison results. That is, the control unit 410 further includes a comparison unit 412 that compares the internal and external states with the preset reference states, and a message generation unit 413 that generates one or more messages corresponding to the internal and external states based on the comparison results.
- [0036] In addition, the control unit 410 further includes a storage unit in which an electricity fee table is stored. In addition, the types of the internal and external states and the reference states may be preset in the storage unit. In addition, in the storage unit, the electricity fee table or the consumed power amount corresponding to each state value may be preset. The storage unit may be installed separately from the control unit 410, as illustrated in FIG. 3. The storage unit 480 stores the predicted power consumption and the corresponding usage fee in accordance with control commands from the control unit 410, and accumulates various internal and external states detected by the state detection unit 430. In addition, the storage unit stores an electricity fee table that serves as the basis for calculating the usage fees. In addition, the storage unit 480 may further include a basic format for messages to be generated by the control unit 410, and the control unit 410 can more easily generate messages by reflecting state values in the basic format.
- [0037] The storage unit 480 stores the greenhouse gas index according to the type of energy source and the corresponding electricity fee table. For example, the storage unit 480 may store the carbon dioxide index according to the energy

source and an electricity fee table based on the estimated carbon dioxide emissions calculated corresponding to the calculated predicted power consumption. That is, the storage unit 480 may store a message indicating that the usage fee may increase sharply if the carbon dioxide emissions exceed a certain level, and this message may be conveyed to the user or the like through the control unit 410.

- [0038] Meanwhile, the control unit 410 can determine the trend of consumed power amount using the number of door openings detected by the sensor that senses door opening and closing, or the duration of door openings, and calculate the corresponding greenhouse gas emissions or usage fee. In addition, based on the consumed power amount, greenhouse gas emissions, or usage fee, energy saving tips such as "Please reduce the number of door openings" can be generated.
- [0039] The messages generated by the control unit 410 include the types of internal and external states such as the current values of the internal and external states, trends of the internal and external states, control settings, or energy saving tips. That is, the values detected by the state detection unit 430 are either directly converted into messages and output, or the trends calculated based on the detected internal and external state values are converted into messages and output. In addition, control settings required for refrigerator operation can be converted into messages and output, or energy saving tips based on the internal and external states can be generated as messages.
- [0040] The message generated by the control unit 410 is output to the user or administrator through the output unit 470. In addition, the output unit 470 displays the calculated predicted power consumption and the corresponding greenhouse gas emissions and usage fee. The output unit 470 may, as necessary, display statistical data such as trends or cumulative values of the predicted power consumption, greenhouse gas emissions, and usage fee. The output unit 470 can display the types of internal and external states and the corresponding state values detected by the state detection unit 430. In addition, the output unit 470 displays the control settings set by the control unit 410.
- [0041] Meanwhile, the output unit 470 includes a screen display unit that outputs the power consumption and the corresponding usage fees. The screen display unit may be a liquid crystal display device (LCD). The screen display unit selectively outputs, or simultaneously outputs in full, the internal and external states detected through the state detection unit 430, that is, the internal temperature of the refrigerator compartment, the internal temperature of the freezer compartment, the external temperature (room temperature), and the consumed power amount and the corresponding usage fee. In addition, the screen display unit outputs messages generated by the control unit 410, or simultaneously displays some or all of the internal and external states along with the messages. The screen display unit may display the estimated greenhouse gas emissions of the energy source and output a corresponding message.
- [0042] In addition, the output unit 470 can transmit and output the data detected, calculated, or generated by the control unit 410 or the state detection unit 430 to external devices, such as a remote controller or a server, through the communication unit described below.
- [0043] The refrigerator control device 400 according to the present invention further includes an input unit 490 configured to input a command to output the power consumption and the message through the output unit 470. According to the input selection command, the input unit 490 transmits the selection command to the control unit 410 so that the internal and external states are selectively output through the output unit 470 or the screen display unit, or so that the message is output, or so that some or all of the internal and external states and the message are output simultaneously..
- [0044] In addition, a user or the like can select one of the energy sources through the input unit 490. That is, the control device may replace the energy source with one having a relatively lower greenhouse gas index when the estimated greenhouse gas emissions exceed, or are expected to exceed, a certain amount while the refrigerator is operating using a fossil fuel as the energy source.
- [0045] The input unit 490 is configured to include a selection unit that allows the input of the selection command. Here, the selection unit may be configured of a plurality of buttons. For example, the selection unit includes a menu button that causes a menu screen to be displayed on the output unit 470, up and down buttons that allow navigation within the displayed menu, a set button that selects a menu item, a reset button, a confirmation button, and a state setting button. In addition, the plurality of buttons of the selection unit can each be set as illustrated in FIG. 5. The menu button can be designated as A 491, the up and down buttons as B and C 492/493, the set button as D 494, the reset button as E 495, and the confirmation button as F 496.
- [0046] In addition, the predicted power consumption calculation unit 411 can calculate the predicted power consumption based on the set values input through the input unit 490. The state values detected by the state detection unit 430 are transferred to other state values through the input unit 490, and the changes in power consumption are experimentally observed. At this time, the state values that change according to the settings and the corresponding changes in power consumption are organized into a table as data, or are represented mathematically. Thereafter, based on the values set through the input unit 490, the predicted power consumption calculation unit 411 can calculate the predicted power consumption using the tabulated or formulated data, that is, the state values and power consumption. In addition, each time the set values are changed through the input unit 490, the predicted

power consumption calculated using the tabulated or formulated data can be displayed in real time.

- [0047] The control device may include a power consumption detection unit (not shown) that is connected to the input power for detecting the amount of power consumption supplied to the refrigerator. Hereinafter, the power consumption supplied to the refrigerator is referred to as the supplied power consumption so as to be distinguished from the predicted power consumption. The power consumption detection unit (not shown) detects the supplied power consumption input to the refrigerator main body 100. The power consumption detection unit (not shown) can detect power consumption in various ways, for example, by detecting the current and voltage applied to the refrigerator main body 100 through a current detection unit (not shown) and a voltage detection unit, not shown, and determining the power consumption by reflecting the measurement time using a timer or the like. The above power consumption detection unit (not shown) is, unlike a conventional power meter that detects the total power supplied to a home, individually connected to a refrigerator and detects the power consumption of the refrigerator itself according to the state inside and outside the refrigerator or according to a change of state command from a user or the like. The control device can calculate the greenhouse gas emissions and usage fees of the energy source based on the detected supplied power consumption and provide information regarding energy saving to a user or the like accordingly. In addition, the control device can provide a user or the like with statistical information, such as trends and cumulative values, of the supplied power consumption, greenhouse gas emissions, and usage fees through the output unit.
- [0048] The output unit 470 and the input unit 490 may be configured as a single module or package, forming an input/output unit. The input/output unit may take the form of a touch screen capable of both display and input/output. The input/output unit may physically include the buttons, or the buttons may be displayed or hidden according to changes on the screen. When an input command is received through the buttons, the input/output unit outputs the state values, control settings, or messages through its own built-in output unit.
- [0049] In addition, the control device according to the present invention further includes a communication unit 440, which is connected to an external power device and exchanges information therewith. The communication unit 440 is connected to the external power device by wired or wireless communication, and may be connected in particular through serial communication, the Internet, power line communication, wireless LAN, or the like. In addition, the control device can receive, through the communication unit 440, information such as the type of energy source and the greenhouse gas index corresponding to the energy source from the external power device. The external power device may be installed at a power supply company or at a site such as a home or residence.
- [0050] Meanwhile, when information regarding the consumed power amount of individual appliances, that is, the refrigerator, is received from the external power device, the control device can calculate the electricity fee or the greenhouse gas emissions based on the received information of the consumed power amount.
- [0051] The communication unit 440 is connected between the output unit 470 and an external device, and transmits to the external device the data detected, calculated, or generated by the control unit 410 or the state detection unit 430. That is, the communication unit 440 transmits the consumed power amount of the refrigerator, such as the calculated predicted power consumption or the detected supplied power consumption, the usage fee corresponding to the consumed power amount, the estimated greenhouse gas emissions of the energy source corresponding to the consumed power amount, trends or cumulative statistics of the consumed power amount, estimated greenhouse gas emissions, and usage fee, internal and external state values of the refrigerator such as the amount of stored food and energy saving information, operating information, and messages, and, as necessary, receives various information or control commands. The communication unit 440 is connected to the external device by wired or wireless communication methods such as serial communication, the Internet, power line communication, or wireless LAN, and the external device may include wired or wireless communication appliance such as mobile phones and PDA phones, monitoring devices such as monitors and televisions, remote controllers, or servers.
- [0052] FIG. 6 illustrates a screen displayed through the output unit 470. Referring to this, according to the operation of the input unit 490, the control unit 410 operates to output, through the output unit 470, the predicted power consumption 471, the usage fee 472 corresponding to the predicted power consumption, the power consumption trend 473, the amount of stored food 474, energy saving tips 475, and other state values and messages. The predicted power consumption 471 can display daily, weekly, monthly, yearly, or specified period power consumption according to the operation of the buttons, and the trend of the power consumption trend 473 can also be set with different time intervals. The output unit 470 also displays control settings or internal and external state values, including the locations of the refrigerator and freezer 476a, the internal temperatures of each compartment 476b, the ice making status 476c, the current time 476d, and the external room temperature 477. For example, as illustrated in FIG. 6, the current internal temperature inside the refrigerator compartment is 2°C, the current internal temperature inside the freezer compartment is -19°C, the current predicted power consumption is 88.2 W, and the monthly usage fee is 5,600 won. In addition, the current room temperature is 23°C. Meanwhile, if the height of the stored food inside is detected to be high, indicating a large quantity of items, the control unit 410 outputs a message requesting a reduction of the refrigerated storage. Meanwhile, each time a setting is changed through the input unit 490, for example, when the refrigerator temperature is changed from 2°C to 0°C, the predicted power consumption calculated in real time using the tabulated or formula based data can be displayed, for instance, changing from 88.2

W to 89.3 W. In addition, in FIG. 6, the output unit 470 may provide information based on the supplied power instead of the predicted power consumption, and can output state values and messages such as the supplied power consumption 471, the usage fee 472 based on the supplied power, the power consumption trend 473, the amount of stored food 474, and energy saving tips 475.

- [0053] FIG. 7, like FIG. 6, is a diagram illustrating a screen displayed through the output unit 470, and displays the estimated greenhouse gas emissions of the energy source 472a calculated based on the predicted power consumption instead of the usage fee 472 according to the predicted power consumption. The predicted power consumption, the usage fee 472 according to the predicted power consumption, and the estimated greenhouse gas emissions 472a can be displayed simultaneously as needed. In addition, the output unit 470 may provide information based on the supplied power instead of the predicted power consumption, and can output state values and messages such as the supplied power 471, the greenhouse gas emission 472a based on the supplied power, the power consumption trend 473, the amount of stored food 474, and energy saving tips 475.
- [0054] According to a second embodiment of the present invention, the control device 400, as illustrated in FIG. 4, includes a state detection unit 430 for detecting a plurality of internal and external states of the refrigerator, a predicted power consumption calculation unit 411 for calculating predicted power consumption based on the detected states, a control unit 410 for generating one or more messages corresponding to the internal and external states, an output unit 470 for outputting the predicted power consumption and the messages, and a power consumption detection unit 450, connected to the input power source, for detecting the power consumption supplied to the refrigerator. Hereinafter, the power consumption supplied to the refrigerator is referred to as the supplied power consumption so as to be distinguished from the predicted power consumption.
- [0055] The power consumption detection unit 450 detects the supplied power consumption input to the refrigerator main body 100. The power consumption detection unit 450 can detect power consumption in various ways; for example, it may detect the current and voltage applied to the refrigerator main body 100 through a current detection unit (not shown) and a voltage detection unit (not shown) and determine the power consumption by reflecting the measurement time using a timer or the like. Unlike a conventional cumulative power meter that detects the total power consumption supplied to a household, the power consumption detection unit 450 is connected individually to the refrigerator and detects the power consumption of the refrigerator itself as needed, based on the internal and external states of the refrigerator or in response to a state change command from a user or the like. The control device can calculate the greenhouse gas emissions and usage fees of the energy source based on the detected supplied power consumption and provide information regarding energy saving to a user or the like accordingly. In addition, the control device can provide a user with statistical information, such as trends and cumulative values, of the supplied power consumption, greenhouse gas emissions, and usage fees through the output unit.
- [0056] The state detection unit 430 detects the internal and external states of the refrigerator. The state detection unit 430 may include, as necessary, some or all of the following detection units.
- [0057] That is, the state detection unit 430 may include one or more internal temperature detection units 431 that detect the temperature within one or more storage compartments provided inside the refrigerator. The internal temperature detection unit 431 includes a refrigerator compartment temperature detection unit 431a for detecting the temperature within the refrigerator compartment 200 and a freezer compartment temperature detection unit 431b for detecting the temperature within the freezer compartment 300. In addition, when there are multiple refrigerator compartments or freezer compartments, multiple internal temperature detection units may be respectively installed, and multiple internal temperature detection units may be installed within each refrigerator compartment or freezer compartment.
- [0058] The state detection unit 430 may include an external temperature detection unit 433 that detects the temperature outside the refrigerator, that is, the room temperature.
- [0059] The state detection unit 430 may further include a gas sensor (not shown) that detects greenhouse gases, such as carbon dioxide, generated within the refrigerator itself.
- [0060] The state detection unit 430 may include one or more height detection units 435 that detect the height of items stored within one or more storage compartments provided inside the refrigerator. The height detection unit 435 may be installed in the refrigerator compartment 200 or the freezer compartment 300. In addition, when there are multiple refrigerator compartments or freezer compartments, a plurality of height detection units may be installed in each refrigerator or freezer compartment, and when each compartment includes multiple shelves, a plurality of height detection units may likewise be installed in each shelf. The height detection unit 435 may use a pair of infrared sensors including a transmitter and a receiver, an ultrasonic sensor, or the like, and the height of stored items can be easily detected by determining whether a signal emitted from the transmitter is received by the receiver.
- [0061] In addition, the predicted power consumption calculation unit 411 may calculate the predicted power consumption based on the respective state values of the state detection unit 430. If the state values detected by other state detection units 430 remain constant and only the state value detected by a single state detection unit changes, the

predicted power consumption calculation unit 411 may calculate the predicted power consumption by observing the trend of power consumption corresponding to the changing state value. For example, if the other state values of the state detection units 430 remain unchanged, and only the temperature detected by the refrigerator compartment temperature detection unit 431a within the refrigerator compartment 200 changes, the predicted power consumption calculation unit 411 may calculate the predicted power consumption based on the changing refrigerator compartment temperature by tabulating or formulating the corresponding power consumption.

- [0062] Additionally, the state detection unit 430 may include a frequency detection unit 437 that detects the driving frequency of the compressor operating the refrigerator. In general, in controlling a refrigerator, the compressor is driven to supply cold air into the interior of the refrigerator, and this cold air is generated by the heat exchange action of the refrigerant and is continuously supplied into the interior of the refrigerator by repeatedly performing the cycle of compression-condensation-expansion-evaporation. The supplied refrigerant is evenly distributed throughout the interior of the refrigerator by convection, allowing the food inside the refrigerator to be stored at the desired temperature.
- [0063] The predicted power consumption can be calculated by the predicted power consumption calculation unit 411 provided in the control unit 410 based on the drive frequency detected by the frequency detection unit 437. That is, by respectively providing the power consumption detection unit 450 and the frequency detection unit 437, the supplied power is detected based on the power supplied to the refrigerator main body 100 through the power consumption detection unit 450, and the predicted power consumption is calculated based on the driving frequency detected through the frequency detection unit 437. In this way, the predicted power consumption can be corrected by reflecting the detected supplied power, and accurate data can be stored based on this. Accordingly, the power consumption of the refrigerator can be accurately predicted for each state value within the refrigerator. Meanwhile, although not shown, the predicted power consumption of the refrigerator may be calculated based on detecting changes in the voltage or current applied to the compressor that drives the refrigerator.
- [0064] The control unit 410 can also calculate the usage fee based on the supplied power detected through the power consumption detection unit 450. The control unit 410 continuously receives the supplied power consumption detected through the power consumption detection unit 450 over a predetermined period or up to the present time, and calculates a usage fee by using a currently applied electricity fee table. The detected supplied power consumption and the calculated usage fee are stored together with the predicted power consumption.
- [0065] In addition, the control unit 410 calculates the estimated greenhouse gas emissions of the energy source by the predicted power consumption or the supplied power consumption supplied in the refrigerator. For example, the estimated carbon dioxide emissions can be calculated by multiplying the carbon dioxide index of the energy source by the predicted power consumption or the supplied power consumption.
- [0066] In the case where a storage unit 480, described later, is provided, the storage unit 480 stores in advance the greenhouse gas index according to the type of energy source and the corresponding electricity fee table, and the control unit 410 can read these to calculate the estimated carbon dioxide emissions corresponding to the predicted power consumption or the supplied power consumption.
- [0067] In addition, the control unit 410 generates one or more messages corresponding to the internal and external states of the refrigerator detected by the state detection unit 430. The internal and external states detected by the state detection unit 430, such as the temperature in the refrigerator compartment, the internal temperature in the freezer compartment, the external temperature, the height of stored items, the quantity of stored items according to their height, the operating frequency of the compressor, and the number and duration of door openings, are analyzed, and one or more messages corresponding thereto are generated. For example, when the internal temperature of the refrigerator compartment becomes excessively low and drops below zero, causing the stored items to freeze, a message such as “The temperature in the refrigerator compartment is below zero” is generated to prompt an increase in the refrigerator compartment temperature. Additionally, when the amount of stored items in the freezer compartment is excessively large, resulting in increased power consumption, a message such as “Please reduce the amount of items in the freezer compartment” is generated. In addition, when the currently supplied energy source has high greenhouse gas emissions, particularly a high estimated carbon dioxide emission, messages such as “Carbon dioxide emissions are high” or “Please switch to a different energy source” are generated.
- [0068] The control unit 410 may have the types of internal and external states and their corresponding reference state values preset. That is, some or all of the internal and external states may be used as necessary. In addition, reference states for each internal and external state are preset, the current values of the internal and external states are compared with the preset reference values, and messages are generated based on the comparison results. That is, the control unit 410 includes a comparison unit 412 that compares the internal and external states with the preset reference states, and a message generation unit 413 that generates one or more messages corresponding to the internal and external states based on the comparison results.
- [0069] In addition, the control unit 410 further includes a storage unit in which an electricity fee table is stored. In addition, the types of the internal and external states and the reference states may be preset in the storage unit. The storage

unit may be installed separately from the control unit 410, as illustrated in FIG. 4. The storage unit 480, in accordance with control commands from the control unit 410, stores the supplied power consumption detected through the power consumption detection unit 450 and the corresponding usage fees together with the predicted power consumption, and accumulates various internal and external states detected through the state detection unit 430. In addition, the storage unit stores an electricity fee table that serves as the basis for calculating the usage fees. In addition, the storage unit 480 may further include a basic format for the messages to be generated by the control unit 410.

- [0070] The storage unit 480 stores the greenhouse gas index according to the type of energy source and the corresponding electricity fee table. For example, the storage unit 480 may store the carbon dioxide index according to the energy source and an electricity fee table based on the estimated carbon dioxide emissions calculated corresponding to the calculated predicted power consumption. That is, the storage unit 480 may store a message indicating that the usage fee may increase sharply if the carbon dioxide emissions exceed a certain level, and this message may be conveyed to the user or the like through the control unit 410.
- [0071] Meanwhile, the refrigerator control device 400 according to the present invention may further include a sensor (not shown) that detects the opening and closing of the door, and the control unit 410 can determine the trend of the consumed power amount based on the number of door openings and closings or the door open time detected by the sensor, and calculate the corresponding usage fee. In addition, based on the consumed power amount, and usage fee, energy saving tips such as "Please reduce the number of door openings" can be generated.
- [0072] The messages generated by the control unit 410 include the types of internal and external states such as the current values of the internal and external states, trends of the internal and external states, control settings, or energy saving tips. That is, the values detected by the power consumption detection unit 450 or the state detection unit 430 are either directly converted into messages and output, or the trends calculated based on the detected internal and external state values are converted into messages and output. In addition, control settings required for refrigerator operation can be converted into messages and output, or energy saving tips based on the internal and external states can be generated as messages.
- [0073] The message generated by the control unit 410 is output to the user or administrator through the output unit 470. Further, the output unit 470 displays the detected supplied power or the calculated predicted power consumption, along with the corresponding usage fee for each power consumption value. The output unit 470 may, as necessary, display statistical data such as trends or cumulative values of the power consumption and usage fee. The output unit 470 can display the types of internal and external states and the corresponding state values detected by the state detection unit 430. In addition, the output unit 470 displays the control settings set by the control unit 410.
- [0074] *Meanwhile, the output unit 470 includes a screen display unit that outputs the power consumption and the corresponding usage fees. The screen display unit may be a liquid crystal display device (LCD). The screen display unit selectively outputs, or simultaneously outputs in full, the internal and external states detected through the state detection unit 430, that is, the internal temperature of the refrigerator compartment, the internal temperature of the freezer compartment, the external temperature (room temperature), and the supplied or predicted power consumption and the corresponding usage fees. In addition, the screen display unit outputs messages generated by the control unit 410, or simultaneously displays some or all of the internal and external states along with the messages.
- [0075] In addition, the output unit 470 can transmit and output the data detected, calculated, or generated by the control unit 410, the power consumption detection unit 450 and the state detection unit 430 to external devices, such as a remote controller or a server, through the communication unit described below.
- [0076] The refrigerator control device 400 according to the present invention further includes an input unit 490 configured to input a command to output the power consumption and the message through the output unit 470. According to the input selection command, the input unit 490 transmits the selection command to the control unit 410 so that the internal and external states are selectively output through the output unit 470 or the screen display unit, or so that the message is output, or so that some or all of the internal and external states and the message are output simultaneously.
- [0077] In addition, a user or the like can select one of the energy sources through the input unit 490. That is, the control device may replace the energy source with one having a relatively lower greenhouse gas index when the estimated greenhouse gas emissions exceed, or are expected to exceed, a certain amount while the refrigerator is operating using a fossil fuel as the energy source.
- [0078] The input unit 490 is configured to include a selection unit that allows the input of the selection command. Here, the selection unit may be configured of a plurality of buttons. For example, the selection unit includes a menu button that causes a menu screen to be displayed on the output unit 470, up and down buttons that allow navigation within the displayed menu, a set button that selects a menu item, a reset button, a confirmation button, and a state setting button. In addition, the plurality of buttons of the selection unit can each be set as illustrated in FIG. 5. The menu button can be designated as A 491, the up and down buttons as B and C 492/493, the set button as D 494,

the reset button as E 495, and the confirmation button as F 496.

- [0079] In addition, the predicted power consumption calculation unit 411 can calculate the predicted power consumption based on the set values input through the input unit 490. The state values detected by the state detection unit 430 are transferred to other state values through the input unit 490, and the changes in power consumption are experimentally observed. At this time, the state values that change according to the settings and the corresponding changes in power consumption are organized into a table as data, or are represented mathematically. Thereafter, based on the values set through the input unit 490, the predicted power consumption calculation unit 411 can calculate the predicted power consumption using the tabulated or formulated data, that is, the state values and power consumption. In addition, each time the set values are changed through the input unit 490, the predicted power consumption calculated using the tabulated or formulated data can be displayed in real time.
- [0080] The output unit 470 and the input unit 490 may be configured as a single module or package, forming an input/output unit. The input/output unit may take the form of a touch screen capable of both display and input/output. The input/output unit may physically include the buttons, or the buttons may be displayed or hidden according to changes on the screen. When an input command is received through the buttons, the input/output unit outputs the state values, control settings, or messages through its own built-in output unit.
- [0081] In addition, the control device according to the present invention further includes a communication unit 440, which is connected to an external power device and exchanges information therewith. The communication unit 440 is connected to the external power device by wired or wireless communication, and may be connected in particular through serial communication, the Internet, power line communication, wireless LAN, or the like. In addition, the control device can receive, through the communication unit 440, information such as the type of energy source and the greenhouse gas index corresponding to the energy source from the external power device.
- [0082] Meanwhile, when information regarding the consumed power amount of individual appliances, that is, the refrigerator, is received from the external power device, the control device can calculate the electricity fee or the greenhouse gas emissions based on the received information of the consumed power amount.
- [0083] The communication unit 440 is connected between the output unit 470 and an external device, and transmits to the external device the data detected, calculated, or generated by the control unit 410 or the state detection unit 430. That is, the communication unit 440 transmits the consumed power amount, including the predicted power consumption calculated in the refrigerator or the supplied power consumption detected, the usage fee according to the consumed power amount, the estimated greenhouse gas emissions of the energy source based on the consumed power amount, trends or cumulative statistics of the consumed power amount, usage fee, and estimated greenhouse gas emissions, as well as the refrigerator's internal and external state values, operating information, messages, the amount of food, and energy saving information, and receives various information or control commands as necessary. The communication unit 440 is connected to the external device by wired or wireless communication methods such as serial communication, the Internet, power line communication, or wireless LAN, and the external device may include wired or wireless communication appliance such as mobile phones and PDA phones, monitoring devices such as monitors and televisions, remote controllers, or servers.
- [0084] FIG. 6 illustrates a screen displayed through the output unit 470. Referring to this, according to the operation of the input unit 490, the control unit 410 operates to output, through the output unit 470, the power consumption 471, the usage fee 472 corresponding to the power consumption, the power consumption trend 473, the amount of stored food 474, energy saving tips 475, and other state values and messages. The power consumption 471 can display daily, weekly, monthly, yearly, or a specified period of power consumption according to the operation of the buttons, and, depending on the selection, either the predicted power consumption or the supplied power consumption is shown, while the power consumption trend 473 can also be set with different time intervals. The output unit 470 also displays control settings or internal and external state values, including the locations of the refrigerator and freezer 476a, the internal temperatures of each compartment 476b, the ice making status 476c, the current time 476d, and the external room temperature 477. For example, as illustrated in FIG. 6, the current internal temperature inside the refrigerator compartment is 2°C, the current internal temperature inside the freezer compartment is -19°C, the current predicted power consumption is 88.2 W, and the monthly usage fee is 5,600 won. In addition, the current room temperature is 23°C. Meanwhile, if the height of the stored food inside is detected to be high, indicating a large quantity of items, the control unit 410 outputs a message requesting a reduction of the refrigerated storage. Meanwhile, each time a setting is changed through the input unit 490, for example, when the refrigerator temperature is changed from 2°C to 0 °C, the predicted power consumption calculated in real time using the tabulated or formula based data can be displayed, for instance, changing from 88.2 W to 89.3 W.
- [0085] FIG. 7, like FIG. 6, is a diagram illustrating a screen displayed through the output unit 470, and displays the estimated greenhouse gas emissions of the energy source 472a calculated based on the predicted power consumption instead of the usage fee 472 according to the predicted power consumption. The predicted power consumption, the usage fee 472 according to the predicted power consumption, and the estimated greenhouse gas emissions 472a can be displayed simultaneously as needed. In addition, the output unit 470 may provide

information based on the supplied power instead of the predicted power consumption, and can output state values and messages such as the supplied power consumption 471, the greenhouse gas emission 472a based on the supplied power, the power consumption trend 473, the amount of stored food 474, and energy saving tips 475.

- [0086] A refrigerator control method according to an embodiment of the present invention, as illustrated in FIG. 8, is configured to include the step for detecting a plurality of internal and external states of the refrigerator S100, a step for calculating predicted power consumption and usage fees based on the detected states S200, a step for generating one or more messages corresponding to the internal and external states S400, and a step for outputting the power consumption and the messages S600. The configuration of the device is described with reference to FIGS. 1 to 7.
- [0087] The step S100 of detecting a plurality of internal and external states of the refrigerator detects the internal and external states of the refrigerator.
- [0088] The step S100 of detecting the plurality of states includes detecting the temperature within one or more storage compartments provided in the refrigerator as necessary. The step for detecting the internal temperature includes detecting the temperature within the refrigerator compartment 200 and detecting the temperature within the freezer compartment 300. In addition, when there are a plurality of refrigerator compartments or freezer compartments, the internal temperature of each compartment can be detected.
- [0089] The step for detecting the plurality of states (S100) may include detecting the temperature outside the refrigerator, that is, the room temperature.
- [0090] The step S100 of detecting the plurality of states may include detecting the height of stored items within one or more storage compartments provided in the refrigerator. The step for detecting the height detects the height of stored items in the internal space through a height detection unit installed in the refrigerator compartment 200 or the freezer compartment 300, or, when a plurality of shelves are provided in each compartment, through a plurality of height detection units corresponding to the shelves. At this time, the height of stored items can be easily detected by using a pair of sensors, such as an infrared sensor or an ultrasonic sensor, each including a transmitter and a receiver, and determining whether a signal transmitted from the transmitter is received by the receiver. The detected height can be used to detect or estimate the quantity of stored items. At this time, the step S200 of calculating the predicted power consumption and usage fee based on the states can calculate the predicted power consumption according to each state value. That is, if among the state values the other state values remain constant and only one state value changes, the predicted power consumption can be calculated by observing the trend of power consumption corresponding to the changing state value. For example, when the other state values remain constant and only the temperature within the refrigerator compartment changes, the consumed power corresponding to the changing temperature in the refrigerator compartment can be tabulated or expressed mathematically, and the predicted power consumption can then be calculated based on this data. The usage fee can also be calculated based on the calculated predicted power consumption.
- [0091] In addition, the step S200 of calculating the predicted power consumption and usage fee based on the states can calculate the predicted power consumption according to the setting values input by the user. That is, when the detected state values change according to the setting values, the change in power consumption is experimentally observed. At this time, the state values that change according to the settings and the corresponding changes in power consumption are organized into a table as data, or are represented mathematically. Thereafter, the predicted power consumption can be calculated based on the tabulated or mathematically expressed data, that is, the state values and consumed power, according to the values set by the user. In addition, the usage fee can also be calculated based on the calculated predicted power consumption.
- [0092] In addition, the step S100 of detecting the plurality of states may further include detecting the operating frequency of the compressor that drives the refrigerator. In general, in controlling a refrigerator, the compressor is driven to supply cold air into the interior of the refrigerator, and this cold air is generated by the heat exchange action of the refrigerant and is continuously supplied into the interior of the refrigerator by repeatedly performing the cycle of compression-condensation-expansion-evaporation. The supplied refrigerant is evenly distributed throughout the interior of the refrigerator by convection, allowing the food inside the refrigerator to be stored at the desired temperature.
- [0093] The step S200 of calculating the predicted power consumption and usage fee predicts the consumed power amount based on the state values detected in the previous step, and calculates the usage fee based on the predicted power consumption. For example, the power consumption required to drive the compressor can be calculated based on the operating frequency input from the step for detecting the operating frequency of the compressor, and the power consumption for operating the refrigerator can be calculated by reflecting the state values based on the consumed power of the compressor. At this time, the values can be stored in a database, and thereafter, the consumed power amount of the refrigerator can be predicted using only the state values during refrigerator operation.
- [0094] In addition, the refrigerator control method further includes the step S300 of detecting the power consumption supplied to the refrigerator. The step S300 of detecting the power consumption supplied to the refrigerator detects the power consumption input to the refrigerator main body 100. The step S300 may detect power consumption in

various ways, for example by detecting the current and voltage applied to the refrigerator and taking into account the measured time using a timer or the like to determine the power consumption. The step S300 does not use a conventional cumulative power meter that detects the total power consumption supplied to a household, but instead detects the power consumption of the refrigerator itself, which is individually connected to the refrigerator and required based on the internal and external states of the refrigerator or according to state change commands from a user. Based on the detected supplied power consumption, the greenhouse gas emissions of the energy source, usage fee, and the like can be calculated, and information related to energy saving can be provided to the user. In addition, statistics such as trends and cumulative values of the supplied power consumption, greenhouse gas emissions, and usage fee can be provided to the user.

- [0095] The step S400 of generating one or more messages corresponding to the internal and external states generates one or more messages corresponding to the detected internal and external states of the refrigerator. That is, the internal and external states, such as the temperature in the refrigerator compartment, the internal temperature in the freezer compartment, the external temperature, the height of stored items, the quantity of stored items according to their height, the operating frequency of the compressor, and the time and duration of door openings, are analyzed, and one or more messages corresponding thereto are generated. For example, when the internal temperature of the refrigerator compartment becomes excessively low and drops below zero, causing the stored items to freeze, a message such as “The temperature in the refrigerator compartment is below zero” is generated to prompt an increase in the refrigerator compartment temperature. Additionally, when the amount of stored items in the freezer compartment is excessively large, resulting in increased power consumption, a message such as “Please reduce the amount of items in the freezer compartment” is generated.
- [0096] The generated messages include the types of internal and external states such as the current values of the internal and external states, trends of the internal and external states, control settings, or energy saving tips. That is, the values detected in the steps are either directly converted into messages and output, or the trends calculated based on the detected internal and external state values are converted into messages and output. In addition, control settings required for refrigerator operation can be converted into messages and output, or energy saving tips based on the internal and external states can be generated as messages.
- [0097] The step for outputting the power consumption and the message S600 outputs the generated message to a user or an administrator. The step for outputting S600 can display the detected supplied power or the calculated predicted power consumption and the corresponding usage fee, and can also show the types and values of internal and external states. In addition, the set control values are displayed.
- [0098] Meanwhile, the step for outputting S600 selectively display, or simultaneously display all of, the detected internal and external states through the screen display unit, that is, the internal temperature the refrigerator compartment, the internal temperature the freezer compartment, the external temperature (room temperature), the consumed power amount, and the corresponding usage fee. In addition, the messages generated in the previous step can be output through the screen display unit, or some or all of the internal and external states can be output together with the messages simultaneously.
- [0099] In addition, the step for outputting S600 transmits the detected, calculated, or generated data as described above to an external device such as a remote controller or a server.
- [0100] In addition, the control method according to the present invention can calculate the usage fee based on the detected power consumption. In this case, the detected power consumption is continuously received over a predetermined period or up to the present, and the usage fee is calculated using a currently applicable electricity fee table. These usage fees can be calculated hourly, daily, monthly, annually, or for a set period of time.
- [0101] In addition, the method further includes a step (S500) of receiving a command to output the power consumption and the message. The step for receiving S500 the command allows a selection command to be input using a plurality of buttons or a touch screen, such that the internal and external refrigerator states are selectively output, or the message is output, or some or all of the internal and external states and the message.
- [0102] In addition, the control method may further include a step (not shown) of calculating the estimated greenhouse gas emissions according to the energy source based on the calculated predicted power consumption or the detected supplied power consumption. In this case, the estimated greenhouse gas emissions may be calculated by multiplying the power consumption by the greenhouse gas index. Here, the energy sources may include fossil fuels such as oil and gas, alternative energy sources such as solar power, solar heat, wind power, tidal power, hydropower, and geothermal energy, nuclear power, and fuel cells, and a greenhouse gas index for each energy source, for example a carbon dioxide index, can be set through experiments or the like.
- [0103] In addition, the control method may further include a step for pre-storing the greenhouse gas index and the corresponding electricity fee table (not shown). That is, the carbon dioxide index corresponding to each energy source may be stored, and an electricity fee table based on the estimated carbon dioxide emissions calculated according to the corresponding power consumption can be stored. When the amount of carbon dioxide emissions exceeds a predetermined threshold, a sharp increase in usage fees may occur, and such information can be

communicated to a user or the like. Further, when a refrigerator is operating using fossil fuels as an energy source, and the estimated greenhouse gas emissions exceed or are expected to exceed a predetermined threshold, a user or the like can be prompted to switch to an energy source having a relatively lower greenhouse gas index.

- [0104] Further, the control method may further include a step (not shown) of being connected to an external power device via a wired or wireless communication scheme, such as serial communication, the Internet, power line communication, or wireless LAN, and receiving from the external power device information regarding the type of the energy source and the greenhouse gas index corresponding to the energy source.
- [0105] In addition, the control method may further include a step for receiving, from the external power device, information regarding the consumed power amount of individual appliances, namely the refrigerator, and calculating the corresponding electricity fee or greenhouse gas emissions based on the received consumed power amount information.
- [0106] In addition, the control method may further include a step (not shown) for transmitting the detected, calculated, or generated data to an external device. That is, the control method transmits to an external device the consumed power amount in the refrigerator, such as the calculated predicted power consumption or the detected supplied power consumption, the usage fee corresponding to the consumed power amount, the estimated greenhouse gas emissions of the energy source corresponding to the consumed power amount, trends or cumulative statistics of the consumed power amount, usage fee, and estimated greenhouse gas emissions, internal and external state values of the refrigerator such as the amount of stored food and energy saving information, operating information, and messages, and, as necessary, receives various information or control commands from the external device. The external device is connected by wired or wireless communication methods such as serial communication, the Internet, power line communication, or wireless LAN, and the external device may include wired or wireless communication appliances such as mobile phones and PDA phones, monitoring devices such as monitors and televisions, remote controllers, or servers.
- [0107] The step for generating a message 400 generates one or more messages corresponding to the detected internal and external states of the refrigerator, and the step for outputting 600 selectively outputs, together with the message, the consumed power amount and the corresponding estimated greenhouse gas emissions, or outputs all of them simultaneously.
- [0108] For example, the message generation step 400 generates messages providing energy-saving tips, such as “Carbon dioxide emissions are high” or “Please switch to a different energy source,” when the currently supplied energy source has high greenhouse gas emissions, particularly a high estimated carbon dioxide emission, and the output step 500 outputs the generated messages.
- [0109] A refrigerator control method according to another embodiment of the present invention, as illustrated in FIG. 9, is configured to include the step for detecting a plurality of internal and external states of the refrigerator S100, a step for calculating predicted power consumption and usage fees based on the detected states S200, a step for generating one or more messages corresponding to the internal and external states S400, and a step for outputting the power consumption and the messages S600. Here, the step for generating one or more messages S400 includes a step for setting types of internal and external states and reference states S410, a step for comparing the detected states with the reference states S430, and a step for generating a message based on the comparison result S450. Further, the step for generating one or more messages S400 may further include a step for storing the detected states S470. In addition, the refrigerator control method further includes the step S300 of detecting the power consumption supplied to the refrigerator. The step S300 of detecting the power consumption supplied to the refrigerator detects the power consumption input to the refrigerator main body 100. The configuration of the device is described with reference to FIGS. 1 to 7. The description of the control method according to an embodiment is hereby incorporated by reference, and the detailed description thereof is omitted hereinafter.
- [0110] The step for generating one or more messages S400 generates one or more messages corresponding to the internal and external states of the refrigerator detected in the previous step. That is, the internal and external states, such as the temperature in the refrigerator compartment, the internal temperature in the freezer compartment, the external temperature, the height of stored items, the quantity of stored items according to their height, the operating frequency of the compressor, and the number and duration of door openings, are analyzed, and one or more messages corresponding thereto are generated. For example, when the internal temperature of the refrigerator compartment becomes excessively low and drops below zero, causing the stored items to freeze, a message such as “The temperature in the refrigerator compartment is below zero” is generated to prompt an increase in the refrigerator compartment temperature. Additionally, when the amount of stored items in the freezer compartment is excessively large, resulting in increased power consumption, a message such as “Please reduce the amount of items in the freezer compartment” is generated.
- [0111] The step for setting types of internal and external states and reference states S410 presets the types of internal and external states and corresponding reference state values for message generation.
- [0112] The step for comparing the detected states with the reference states S430 compares the reference state values for

each preset internal and external state with the current internal and external state values, and generates a message based on the comparison result. For example, the height of stored items may be compared with a reference height, or the temperature of the refrigerator compartment may be compared with a reference temperature of the refrigerator compartment.

- [0113] The step for generating a message based on the comparison result S450 generates a message according to the comparison result of the previous step S430. For example, when the height of items stored in the refrigerator compartment is greater than the reference height, indicating a large quantity of stored items, an energy saving tip such as “Please reduce the quantity of stored items” or “Please increase the refrigerator compartment temperature” may be generated, or a message prompting a decrease in the refrigerator compartment temperature may be generated. Further, the trend of the consumed power amount may be determined using the number of door openings and closings or the door open time, the corresponding usage fee may be calculated, and, based on this, an energy saving tips such as “Please reduce the number of door openings” may be generated. The generated messages include the types of internal and external states such as the current values of the internal and external states, trends of the internal and external states, control settings, or energy saving tips.
- [0114] The step for generating a message based on the comparison result S450 further includes a process of correcting the calculated predicted power consumption. That is, by converting the detected state values into data and correcting the calculated predicted power consumption based thereon, the consumed power amount of the refrigerator can be accurately predicted according to its future states. Further, the detected supplied power and the calculated predicted power consumption may be compared, and the predicted power consumption may be corrected based on the comparison result.
- [0115] The step for outputting the power consumption and the message S600 outputs the generated message to a user or an administrator. The step for outputting S600 displays the detected consumed power amount and the corresponding usage fee, and may also show the types of internal and external states and their state values. In addition, the set control values are displayed. Meanwhile, the step for outputting S600 selectively display, or simultaneously display all of, the detected internal and external states through the screen display unit, that is, the internal temperature the refrigerator compartment, the internal temperature the freezer compartment, the external temperature (room temperature), the consumed power amount, and the corresponding usage fee. In addition, the messages generated in the previous step can be output through the screen display unit, or some or all of the internal and external states can be output together with the messages simultaneously. In addition, the step for outputting S600 may transmit the detected, calculated, or generated data as described above to an external device such as a remote controller or a server.
- [0116] *In addition, the method further includes a step (S500) of receiving a command to output the power consumption and the message. The step for receiving S500 the command allows a selection command to be input using a plurality of buttons or a touch screen, such that the internal and external refrigerator states are selectively output, or the message is output, or some or all of the internal and external states and the message.
- [0117] The control method may further include a step (not shown) of calculating the estimated greenhouse gas emissions according to the energy source based on the calculated predicted power consumption or the detected supplied power consumption. In addition, the control method may further include a step for pre-storing the greenhouse gas index and the corresponding electricity fee table (not shown). Further, the control method may further include a step (not shown) of being connected to an external power device via a wired or wireless communication scheme, such as serial communication, the Internet, power line communication, or wireless LAN, and receiving from the external power device information regarding the type of the energy source and the greenhouse gas index corresponding to the energy source.
- [0118] The step for generating a message 400 generates one or more messages corresponding to the detected internal and external states of the refrigerator, and the step for outputting 600 selectively outputs, together with the message, the consumed power amount and the corresponding estimated greenhouse gas emissions, or outputs all of them simultaneously.
- [0119] In addition, the control method may further include a step for receiving, from the external power device, information regarding the consumed power amount of individual appliances, namely the refrigerator, and calculating the corresponding electricity fee or greenhouse gas emissions based on the received consumed power amount information.
- [0120] In addition, the control method may further include a step (not shown) for transmitting the detected, calculated, or generated data to an external device. That is, the control method transmits to an external device the consumed power amount in the refrigerator, such as the calculated predicted power consumption or the detected supplied power consumption, the usage fee corresponding to the consumed power amount, the estimated greenhouse gas emissions of the energy source corresponding to the consumed power amount, trends or cumulative statistics of the consumed power amount, usage fee, and estimated greenhouse gas emissions, internal and external state values of the refrigerator such as the amount of stored food and energy saving information, operating information, and

messages, and, as necessary, receives various information or control commands from the external device.

- [0121] Referring to Figure 10, a refrigerator control method according to another embodiment of the present invention includes a step for detecting a plurality of internal and external states of the refrigerator S100; a step for calculating predicted power consumption and usage fees based on the detected states S200; a step for calculating an estimated greenhouse gas emission of the energy source supplying power to the refrigerator based on the calculated predicted power consumption S310; a step for generating one or more messages corresponding to the internal and external states S400; and a step for outputting the power consumption and the messages S600. Further, the control method may further include a step for displaying the estimated power consumption and the calculated estimated greenhouse gas emissions of the energy source S360. The configuration of the device is described with reference to FIGS. 1 to 7, and the descriptions provided in the refrigerator control methods according to the above embodiment and other embodiments are incorporated by reference and will not be repeated hereinafter.
- [0122] The estimated greenhouse gas emissions may be calculated by multiplying the predicted power consumption by the greenhouse gas index. Here, the energy sources may include fossil fuels such as oil and gas, alternative energy sources such as solar power, solar heat, wind power, tidal power, hydropower, and geothermal energy, nuclear power, and fuel cells, and a greenhouse gas index for each energy source, for example a carbon dioxide index, can be set through experiments or the like.
- [0123] The refrigerator control method may further include a step for pre-storing the greenhouse gas index and the corresponding electricity fee table (not shown). That is, the carbon dioxide index corresponding to each energy source may be stored, and an electricity fee table based on the estimated carbon dioxide emissions calculated according to the corresponding consumed power amount can be stored. When the amount of carbon dioxide emissions exceeds a predetermined threshold, a sharp increase in electricity fee fees may occur, and such information can be communicated to a user or the like.
- [0124] The refrigerator control method further includes a step (not shown) of receiving information on the energy source supplied to the refrigerator from an external power device. The information on the energy source includes the type of the energy source and a greenhouse gas index, such as a carbon dioxide index, corresponding to the energy source. That is, the refrigerator control method connect to an external power device via a wired or wireless communication scheme, such as serial communication, the Internet, power line communication, or wireless LAN, and receive information from the external power device regarding the type of the energy source and the greenhouse gas index corresponding to the energy source.
- [0125] In addition, the refrigerator control method may further include a step for receiving, from the external power device, information regarding the consumed power amount of individual appliances, specifically the refrigerator, and calculating the corresponding electricity fee or greenhouse gas emissions based on the received consumed power amount information.
- [0126] Additionally, the refrigerator control method may further include a step (not shown) for transmitting the detected, calculated, or generated data to an external device. That is, the control method transmits to an external device the consumed power amount in the refrigerator, such as the calculated predicted power consumption or the detected supplied power consumption, the usage fee corresponding to the consumed power amount, the estimated greenhouse gas emissions of the energy source corresponding to the consumed power amount, trends or cumulative statistics of the consumed power amount, usage fee, and estimated greenhouse gas emissions, internal and external state values of the refrigerator such as the amount of stored food and energy saving information, operating information, and messages, and, as necessary, receives various information or control commands from the external device.
- [0127] Further, in the refrigerator control method, when the calculated estimated greenhouse gas emissions of the energy source exceed a predetermined amount, it is determined whether a user selects another energy source S700, and if another energy source is selected, the refrigerator is connected to the selected energy source S710 to receive energy therefrom. That is, when a refrigerator is operating using fossil fuels as an energy source, and the estimated greenhouse gas emissions exceed or are expected to exceed a predetermined threshold, a user or the like can be prompted to switch to an energy source having a relatively lower greenhouse gas index.
- [0128] The refrigerator control method further includes the step S300 of detecting the power consumption supplied to the refrigerator. The step S300 of detecting the power consumption supplied to the refrigerator detects the power consumption input to the refrigerator main body 100. The step S300 does not use a conventional cumulative power meter that detects the total power consumption supplied to a household, but instead detects the power consumption of the refrigerator itself, which is individually connected to the refrigerator and required based on the internal and external states of the refrigerator or according to state change commands from a user. The step S300 detects the current and voltage applied to the refrigerator main body 100 through a current detection unit and a voltage detection unit, and may detect the power consumption by reflecting the measurement time obtained using a timer or the like. At this time, the step for calculating the estimated greenhouse gas emissions S310 may calculate the estimated greenhouse gas emissions based on the detected supplied power instead of the calculated predicted power

consumption.

[0129] As described above, the refrigerator control device and method according to the present invention individually estimate or measure the consumed power amount resulting from the use of the refrigerator, thereby allowing a user to check the power consumption amount and electricity fees, and can output and display information regarding energy saving based on the internal and external states of the refrigerator and its operating conditions. In addition, the present invention enables active energy saving by detecting the internal and external states of a refrigerator and generating and providing messages such as information on changes in the internal and external states, actual or estimated consumed power amount, type of energy source, greenhouse gas emissions based on the actual or estimated consumed power amount, usage fee, and energy saving tips.

Brief Description of the Drawings

- [0130] FIG. 1 is a front view illustrating a refrigerator equipped with a refrigerator control device according to the present invention;
- [0131] Fig. 2 is a perspective view illustrating the refrigerator of Fig. 1;
- [0132] FIG. 3 is a block diagram schematically illustrating the configuration of a refrigerator control device according to a first embodiment of the present invention;
- [0133] FIG. 4 is a block diagram schematically illustrating the configuration of a refrigerator control device according to a second embodiment of the present invention;
- [0134] FIG. 5 is a block diagram schematically illustrating the input/output unit of FIG. 3 or FIG. 4;
- [0135] FIG. 6 is a view illustrating a screen output through the output unit of FIG. 3 or FIG. 4;
- [0136] FIG. 7 illustrates another example of a screen output through the output unit of FIG. 3 or FIG. 4;
- [0137] FIG. 8 is a flowchart illustrating an example of a refrigerator control method according to the present invention;
- [0138] FIG. 9 is a flowchart illustrating another example of a refrigerator control method according to the present invention;
- [0139] FIG. 10 is a flowchart illustrating still another example of a refrigerator control method according to the present invention.

Drawings

FIG. 1

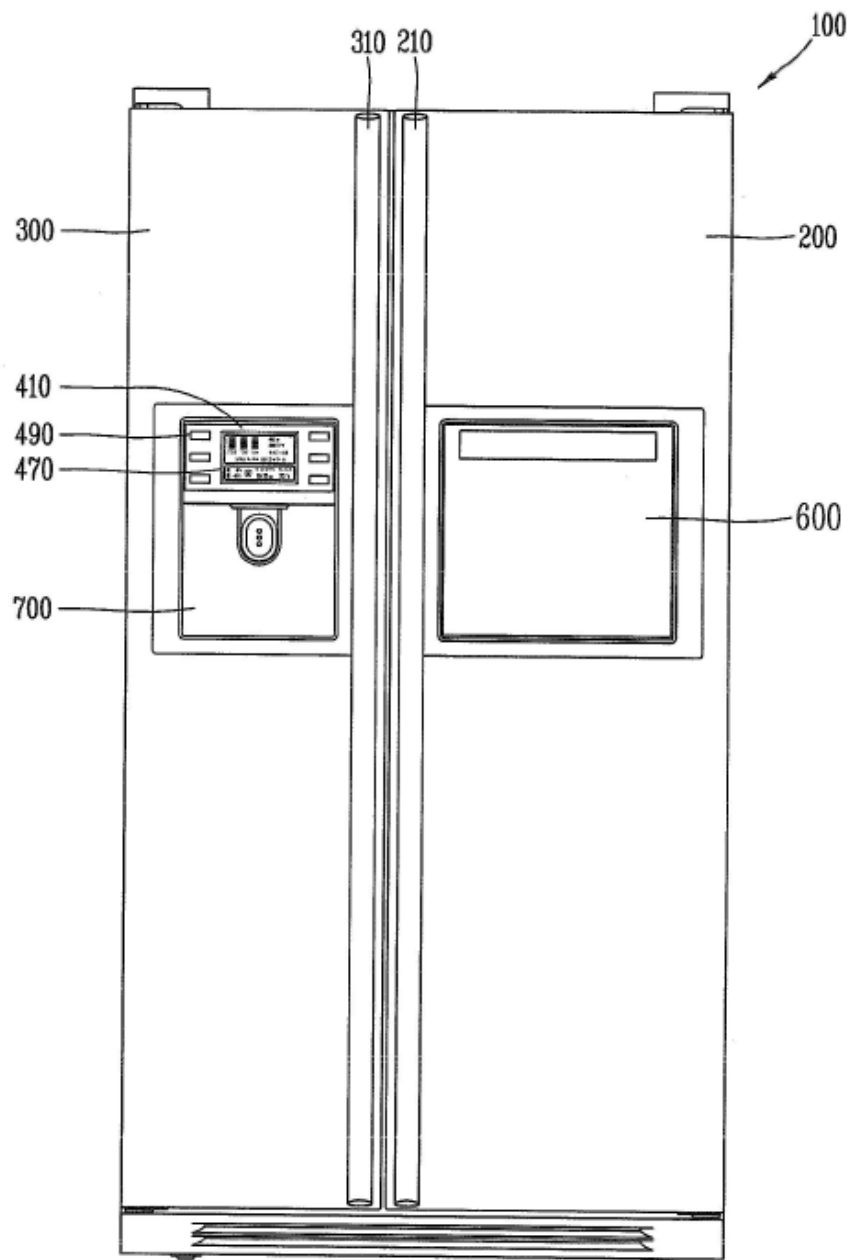


FIG. 2

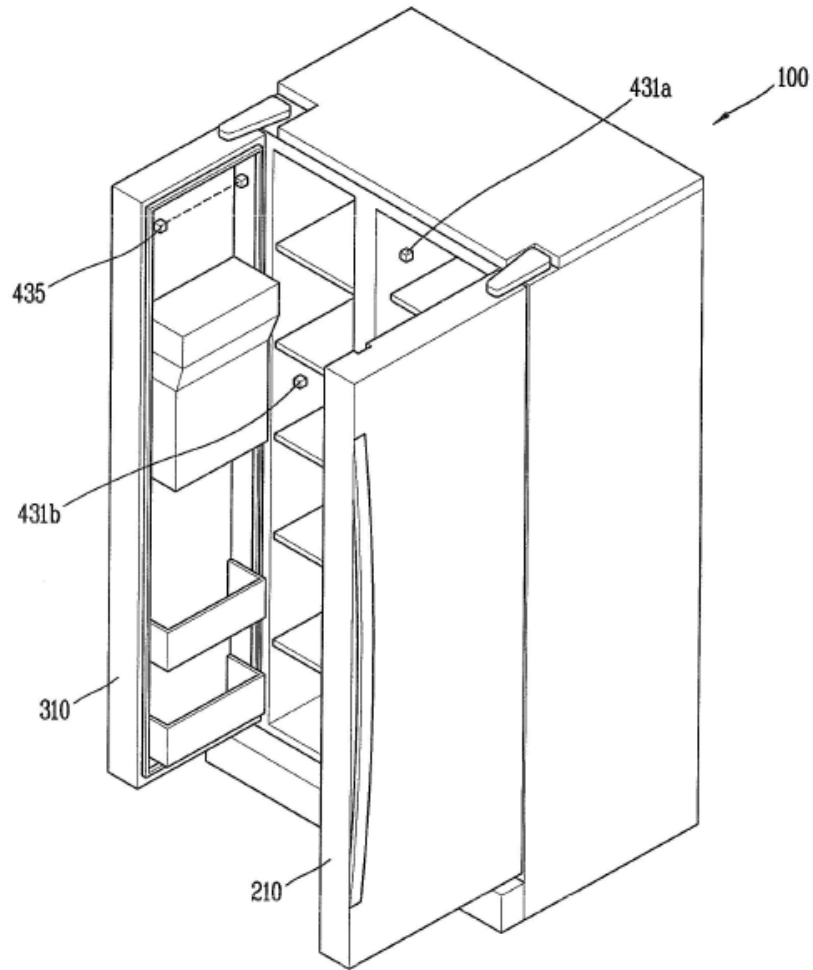


FIG. 3

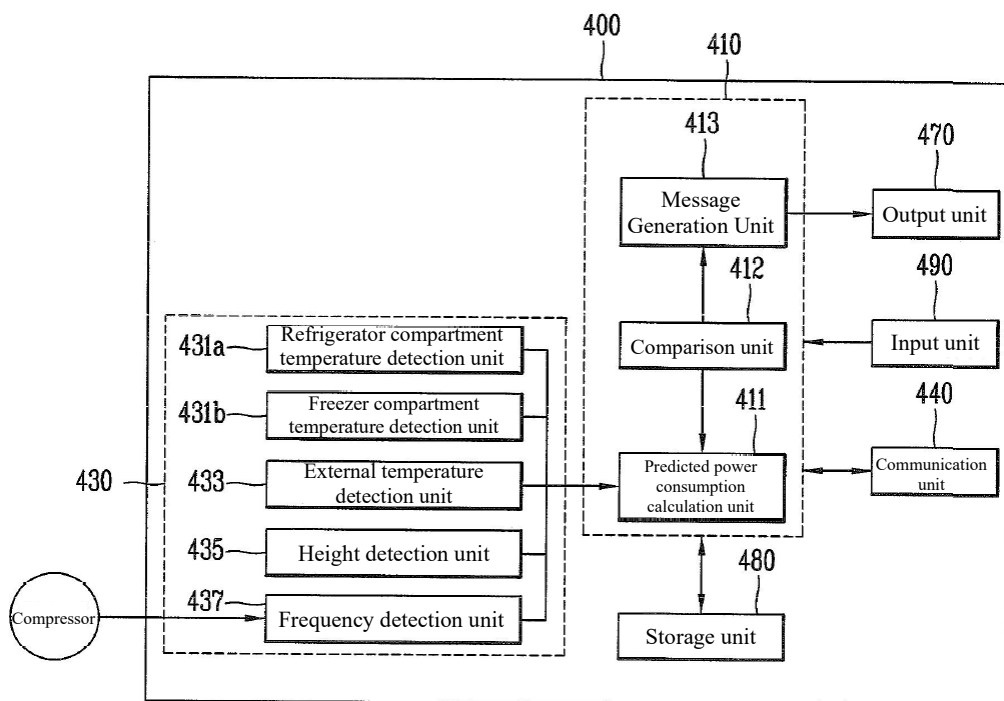


FIG. 4

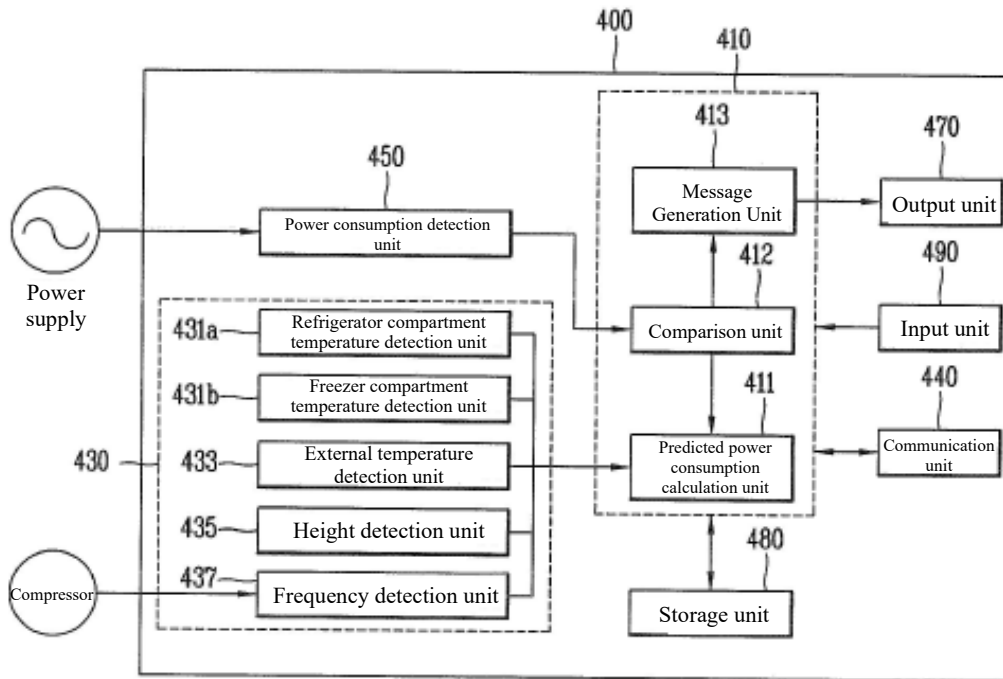


FIG. 5

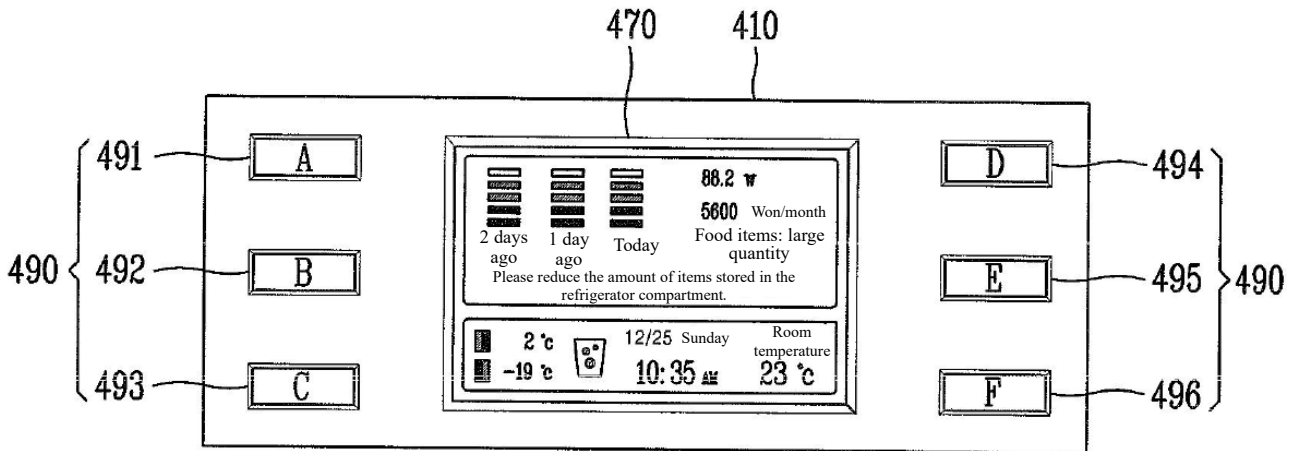


FIG. 6

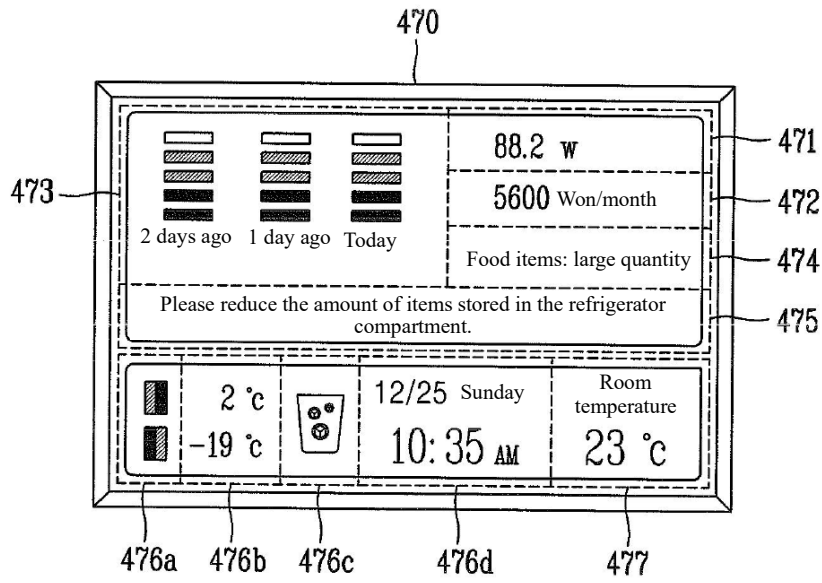


FIG. 7

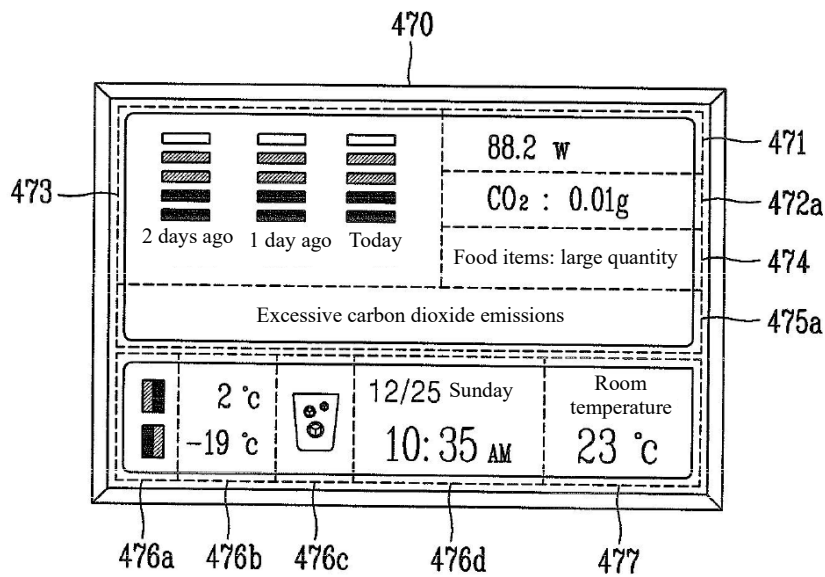


FIG. 8

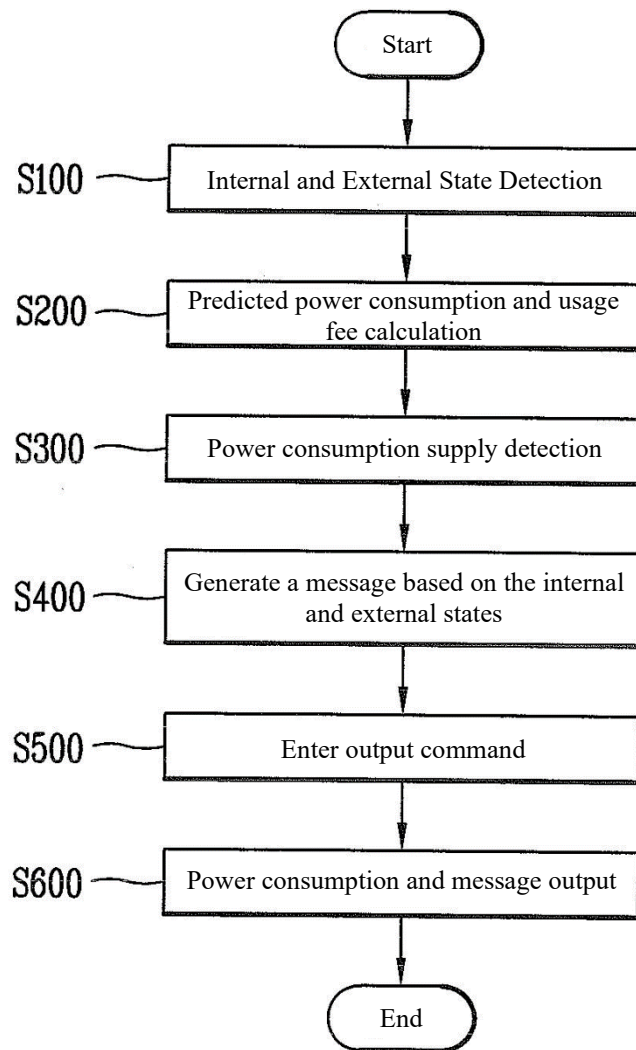


FIG. 9

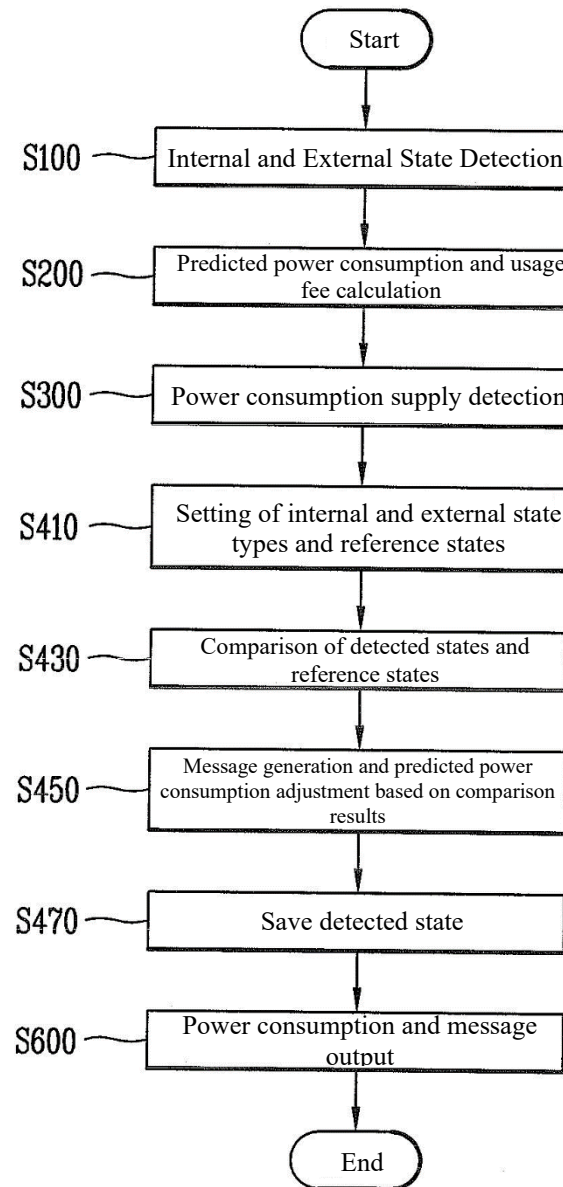


FIG. 10

