US 20250264263A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2025/0264263 A1
(43) Pub. Date: Aug. 21, 2025
SHIM et al.

(54) **REFRIGERATOR AND CONTROL METHOD THEREOF**

(71) Applicant: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR)

(72) Inventors: **Hoon SHIM**, Suwon-si (KR); **Sangyoul CHA**, Suwon-si (KR); **Sungbok Ko**, Suwon-si (KR); **Jaehee BAEK**, Suwon-si (KR); **Dongo YANG**, Suwon-si (KR); **Wonjae YOON**, Suwon-si (KR); **Hyeonsu CHAE**, Suwon-si (KR); **Hansol CHOI**, Suwon-si (KR)

(73) Assignee: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR)

(21) Appl. No.: **19/202,634**

(22) Filed: **May 8, 2025**

Related U.S. Application Data

(63) Continuation of application No. PCT/KR2023/017159, filed on Oct. 31, 2023.

(30) **Foreign Application Priority Data**

Dec. 29, 2022 (KR) 10-2022-0188932

Publication Classification

(51) **Int. Cl.**
F25D 11/02 (2006.01)
F25D 29/00 (2006.01)

(52) **U.S. Cl.**
CPC ***F25D 11/02*** (2013.01); ***F25D 29/005*** (2013.01); *F25D 2500/04* (2013.01); *F25D 2700/12* (2013.01)

(57) **ABSTRACT**

A refrigerator includes a compressor that compresses a refrigerant. The refrigerator identifies whether a temperature change of the inside of the storage compartment after the first time period is greater than or equal to a pre-set value based on the obtained temperature prediction information, and controls, based on the temperature change of the inside of the storage compartment after the first time period being identified as greater than or equal to the pre-set value, the motor to drive the compressor at a pre-set revolutions per minute (RPM).

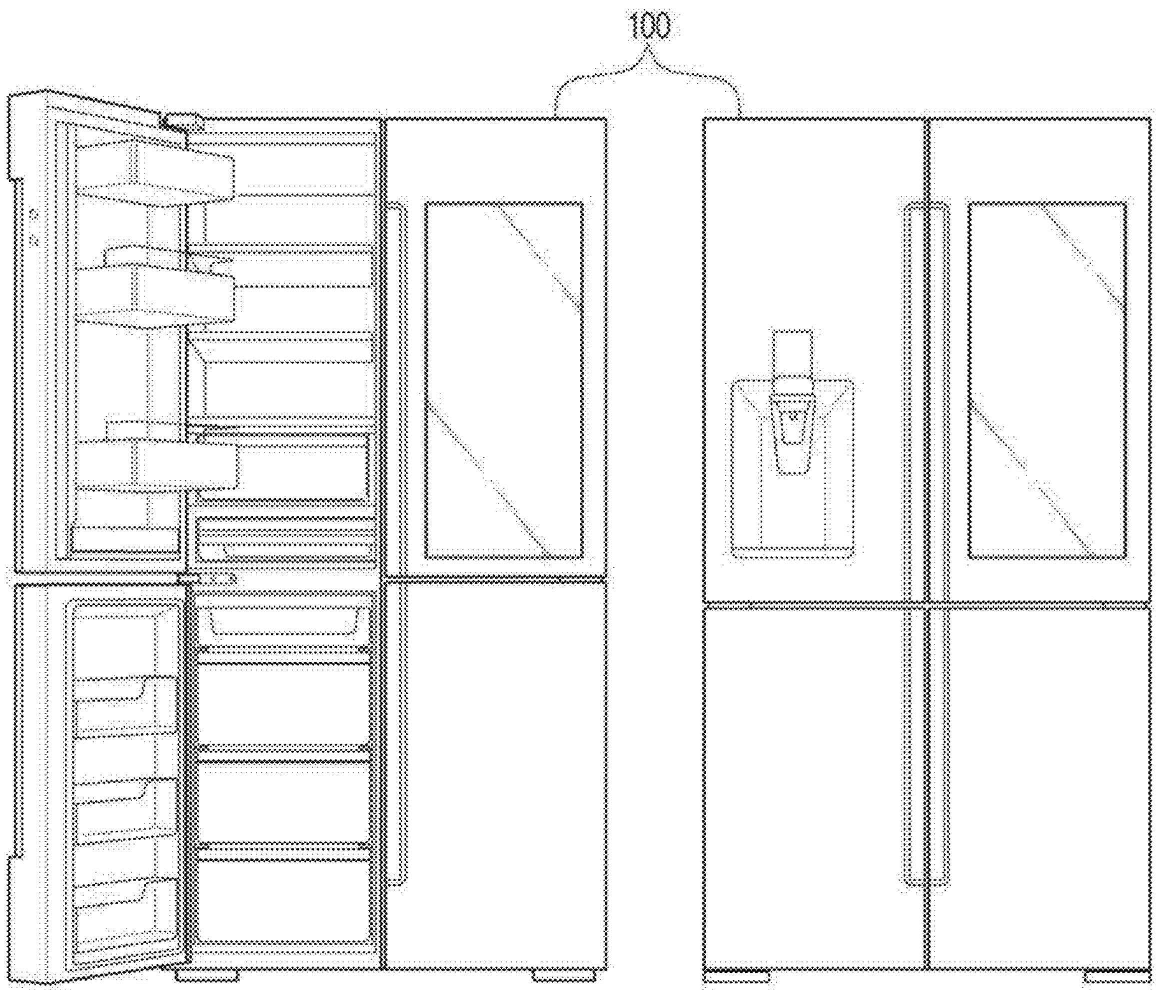


FIG. 1

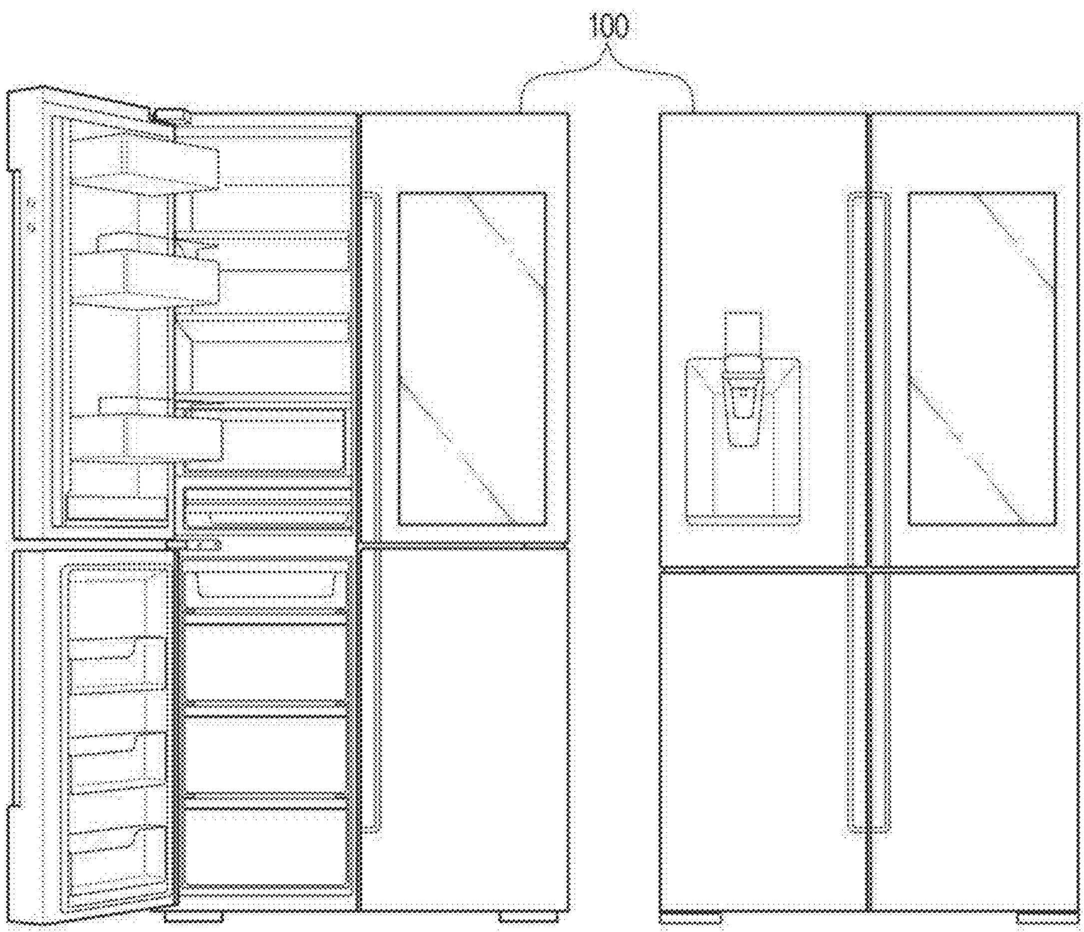


FIG. 2

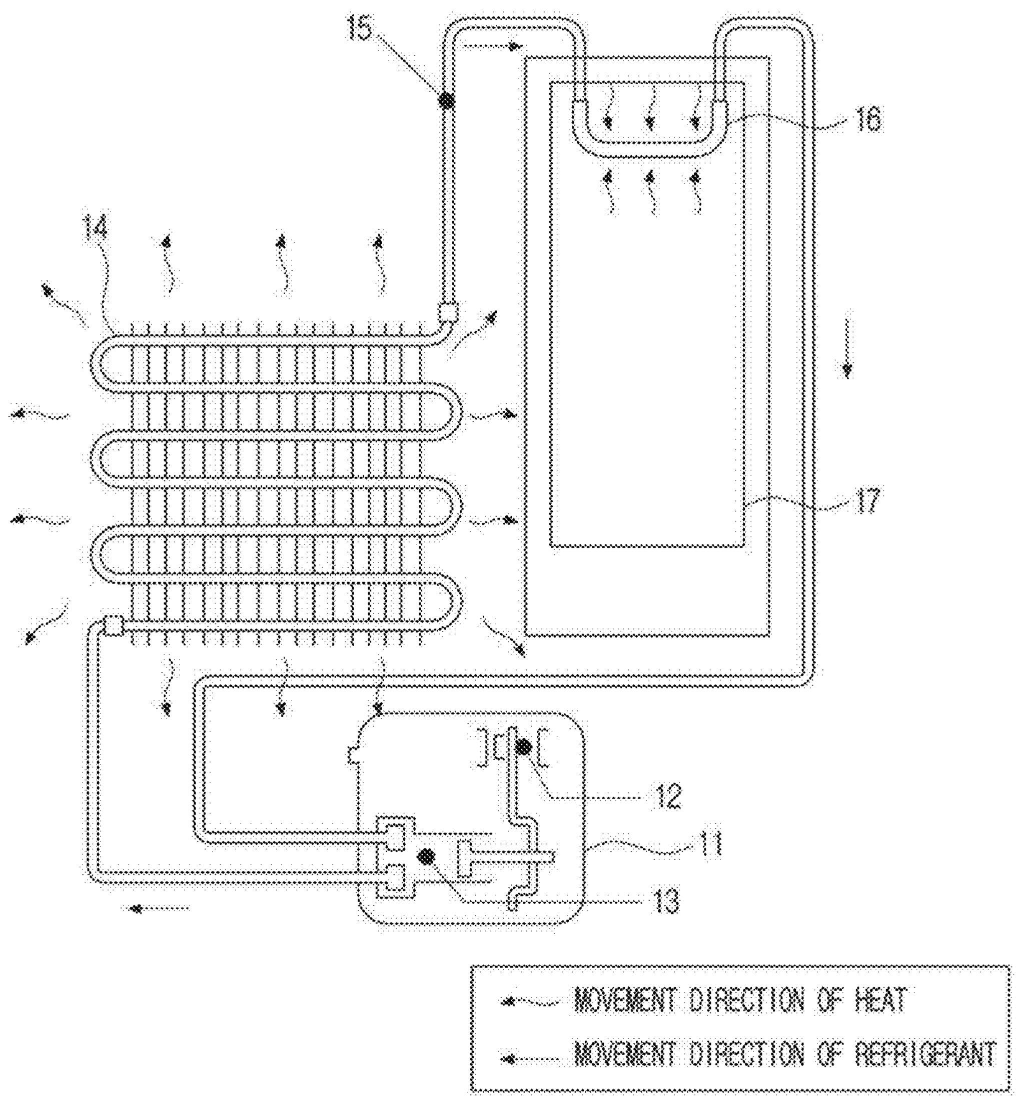

15
16
14
17
12
11
13
MOVEMENT DIRECTION OF HEAT
MOVEMENT DIRECTION OF REFRIGERANT

FIG. 3

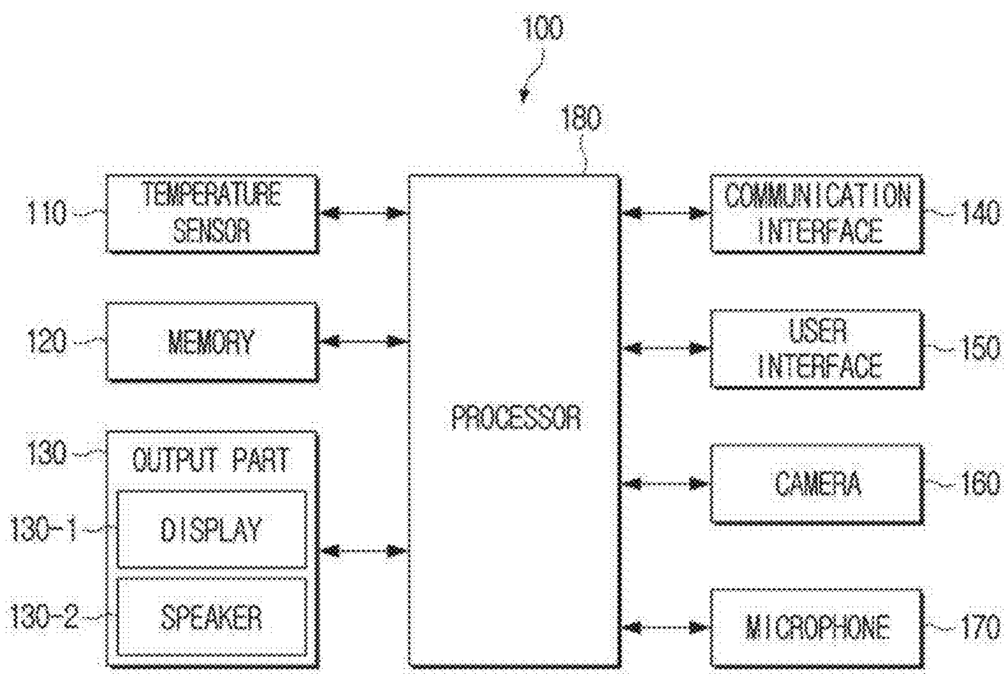

100
180
110
TEMPERATURE SENSOR
120
MEMORY
130
OUTPUT PART
130-1
DISPLAY
130-2
SPEAKER
PROCESSOR
COMMUNICATION INTERFACE
140
USER INTERFACE
150
CAMERA
160
MICROPHONE
170

FIG. 4

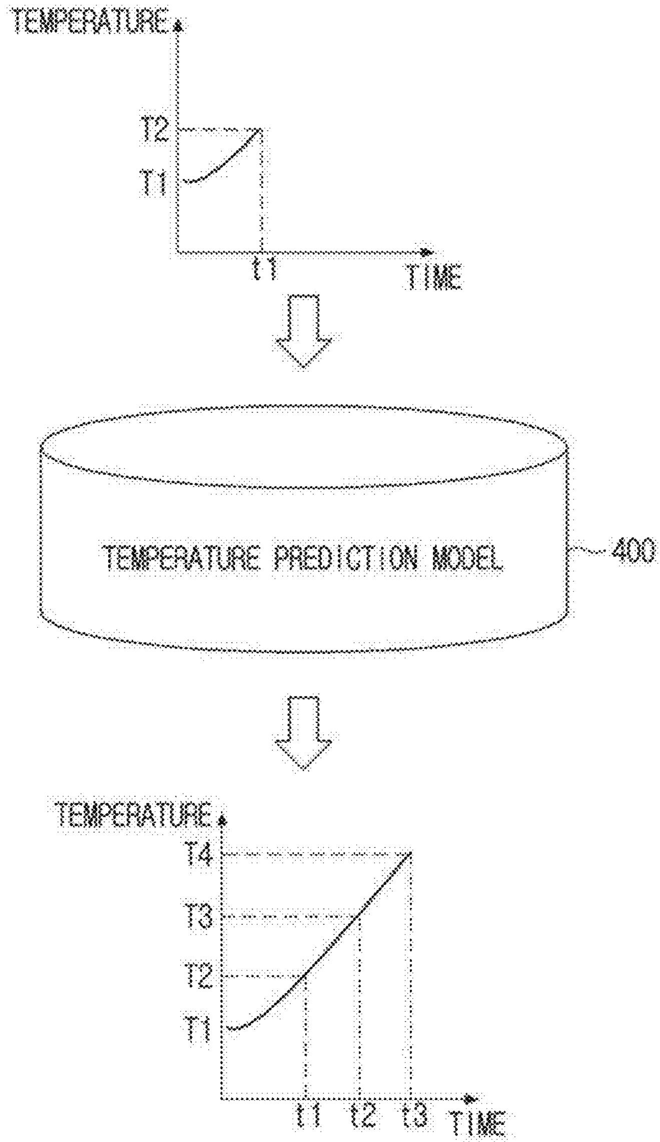

TEMPERATURE
T2
T1
t1
TIME
TEMPERATURE PREDICTION MODEL
400
TEMPERATURE
T4
T3
T2
T1
t1
t2
t3
TIME

FIG. 5

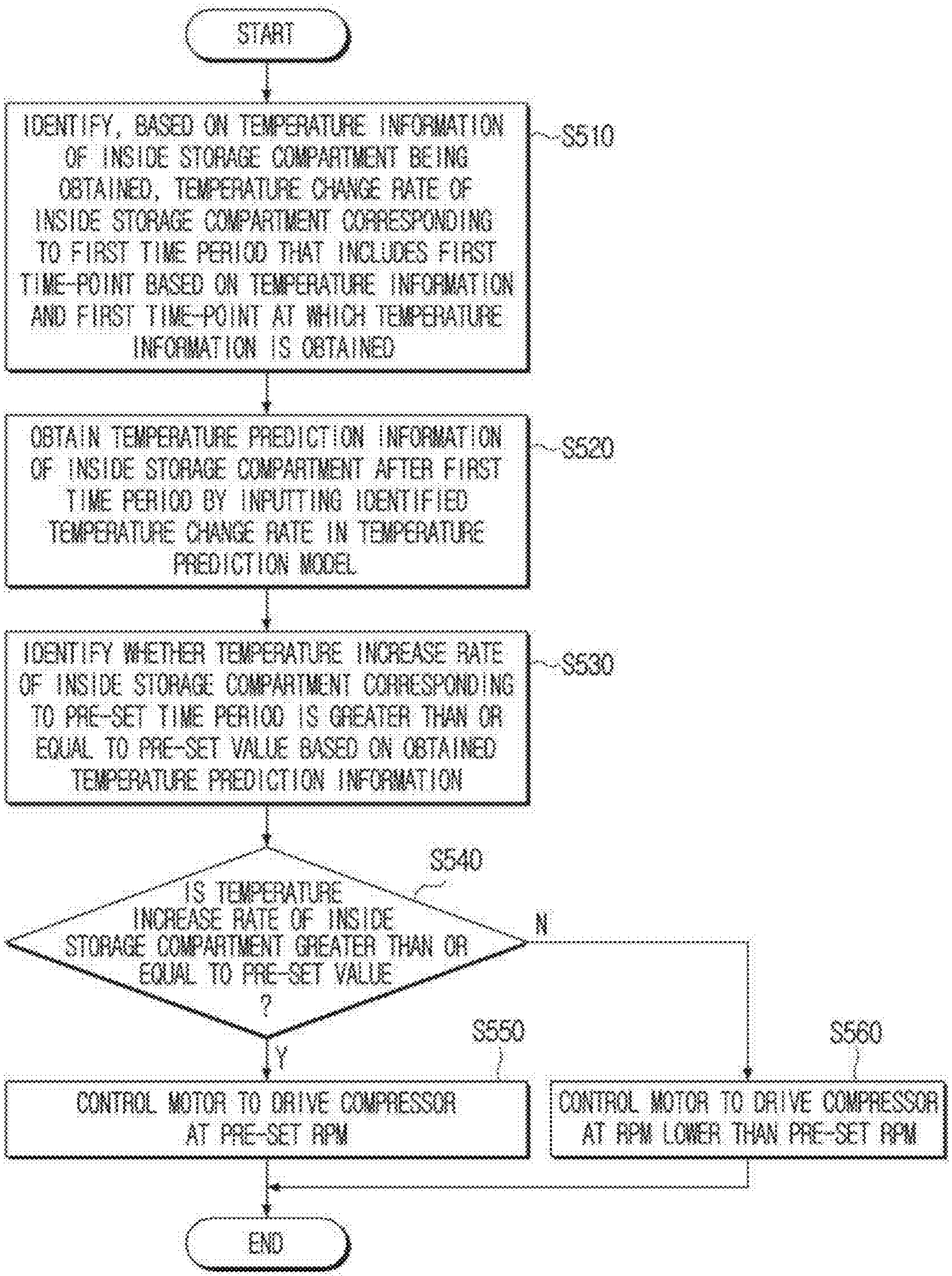

START
IDENTIFY, BASED ON TEMPERATURE INFORMATION OF INSIDE STORAGE COMPARTMENT BEING OBTAINED, TEMPERATURE CHANGE RATE OF INSIDE STORAGE COMPARTMENT CORRESPONDING TO FIRST TIME PERIOD THAT INCLUDES FIRST TIME-POINT BASED ON TEMPERATURE INFORMATION AND FIRST TIME-POINT AT WHICH TEMPERATURE INFORMATION IS OBTAINED
S510
OBTAIN TEMPERATURE PREDICTION INFORMATION OF INSIDE STORAGE COMPARTMENT AFTER FIRST TIME PERIOD BY INPUTTING IDENTIFIED TEMPERATURE CHANGE RATE IN TEMPERATURE PREDICTION MODEL
S520
IDENTIFY WHETHER TEMPERATURE INCREASE RATE OF INSIDE STORAGE COMPARTMENT CORRESPONDING TO PRE-SET TIME PERIOD IS GREATER THAN OR EQUAL TO PRE-SET VALUE BASED ON OBTAINED TEMPERATURE PREDICTION INFORMATION
S530
IS TEMPERATURE INCREASE RATE OF INSIDE STORAGE COMPARTMENT GREATER THAN OR EQUAL TO PRE-SET VALUE ?
S540
N
Y
CONTROL MOTOR TO DRIVE COMPRESSOR AT PRE-SET RPM
S550
CONTROL MOTOR TO DRIVE COMPRESSOR AT RPM LOWER THAN PRE-SET RPM
S560
END

FIG. 6

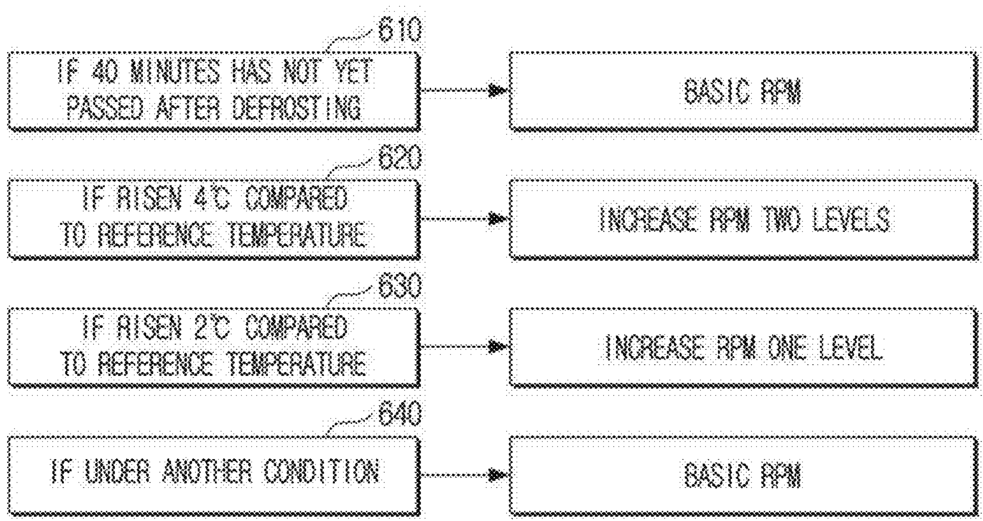

610
IF 40 MINUTES HAS NOT YET PASSED AFTER DEFROSTING
BASIC RPM
620
IF RISEN 4℃ COMPARED TO REFERENCE TEMPERATURE
INCREASE RPM TWO LEVELS
630
IF RISEN 2℃ COMPARED TO REFERENCE TEMPERATURE
INCREASE RPM ONE LEVEL
640
IF UNDER ANOTHER CONDITION
BASIC RPM

FIG. 7

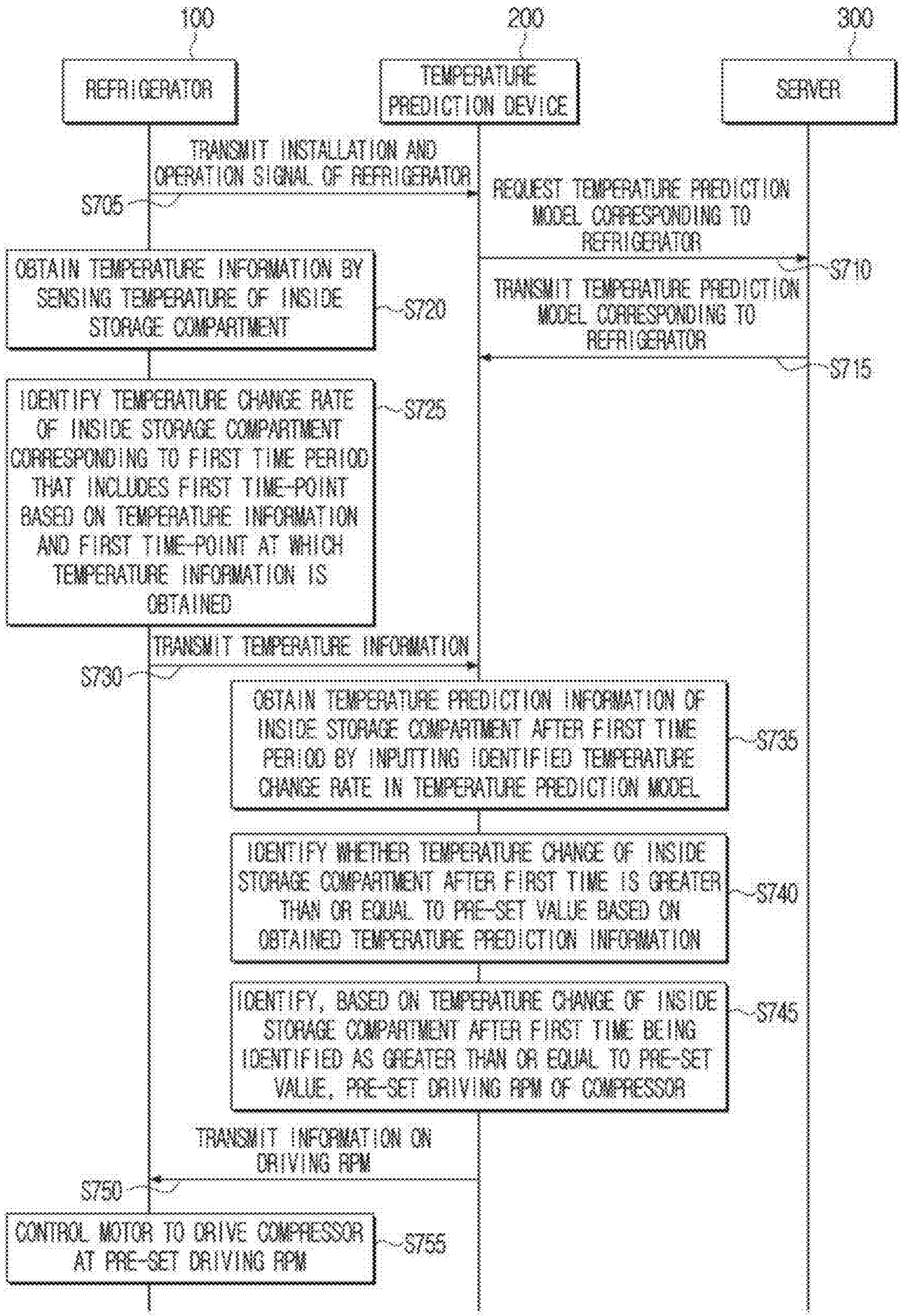
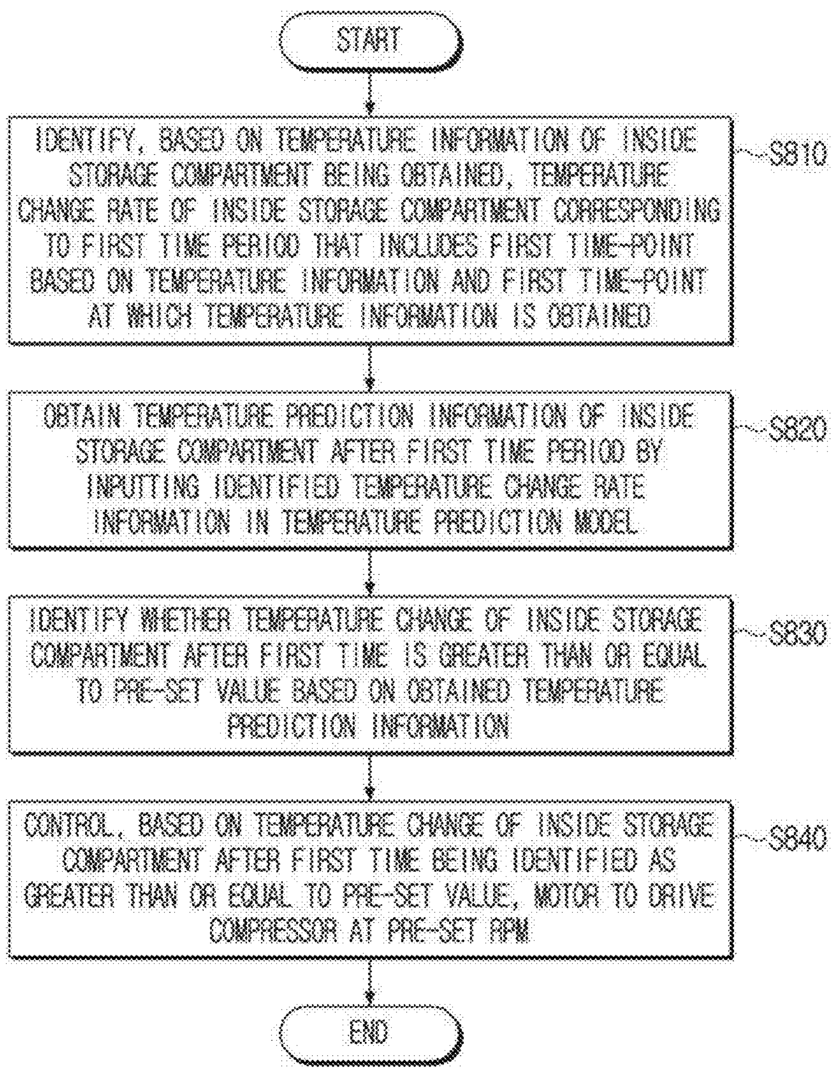

100
200
300
REFRIGERATOR
TEMPERATURE PREDICTION DEVICE
SERVER
TRANSMIT INSTALLATION AND OPERATION SIGNAL OF REFRIGERATOR
S705
REQUEST TEMPERATURE PREDICTION MODEL CORRESPONDING TO REFRIGERATOR
S710
OBTAIN TEMPERATURE INFORMATION BY SENSING TEMPERATURE OF INSIDE STORAGE COMPARTMENT
S720
TRANSMIT TEMPERATURE PREDICTION MODEL CORRESPONDING TO REFRIGERATOR
S715
IDENTIFY TEMPERATURE CHANGE RATE OF INSIDE STORAGE COMPARTMENT CORRESPONDING TO FIRST TIME PERIOD THAT INCLUDES FIRST TIME-POINT BASED ON TEMPERATURE INFORMATION AND FIRST TIME-POINT AT WHICH TEMPERATURE INFORMATION IS OBTAINED
S725
TRANSMIT TEMPERATURE INFORMATION
S730
OBTAIN TEMPERATURE PREDICTION INFORMATION OF INSIDE STORAGE COMPARTMENT AFTER FIRST TIME PERIOD BY INPUTTING IDENTIFIED TEMPERATURE CHANGE RATE IN TEMPERATURE PREDICTION MODEL
S735
IDENTIFY WHETHER TEMPERATURE CHANGE OF INSIDE STORAGE COMPARTMENT AFTER FIRST TIME IS GREATER THAN OR EQUAL TO PRE-SET VALUE BASED ON OBTAINED TEMPERATURE PREDICTION INFORMATION
S740
IDENTIFY, BASED ON TEMPERATURE CHANGE OF INSIDE STORAGE COMPARTMENT AFTER FIRST TIME BEING IDENTIFIED AS GREATER THAN OR EQUAL TO PRE-SET VALUE, PRE-SET DRIVING RPM OF COMPRESSOR
S745
TRANSMIT INFORMATION ON DRIVING RPM
S750
CONTROL MOTOR TO DRIVE COMPRESSOR AT PRE-SET DRIVING RPM
S755

FIG. 8


START
IDENTIFY, BASED ON TEMPERATURE INFORMATION OF INSIDE STORAGE COMPARTMENT BEING OBTAINED, TEMPERATURE CHANGE RATE OF INSIDE STORAGE COMPARTMENT CORRESPONDING TO FIRST TIME PERIOD THAT INCLUDES FIRST TIME-POINT BASED ON TEMPERATURE INFORMATION AND FIRST TIME-POINT AT WHICH TEMPERATURE INFORMATION IS OBTAINED
S810
OBTAIN TEMPERATURE PREDICTION INFORMATION OF INSIDE STORAGE COMPARTMENT AFTER FIRST TIME PERIOD BY INPUTTING IDENTIFIED TEMPERATURE CHANGE RATE INFORMATION IN TEMPERATURE PREDICTION MODEL
S820
IDENTIFY WHETHER TEMPERATURE CHANGE OF INSIDE STORAGE COMPARTMENT AFTER FIRST TIME IS GREATER THAN OR EQUAL TO PRE-SET VALUE BASED ON OBTAINED TEMPERATURE PREDICTION INFORMATION
S830
CONTROL, BASED ON TEMPERATURE CHANGE OF INSIDE STORAGE COMPARTMENT AFTER FIRST TIME BEING IDENTIFIED AS GREATER THAN OR EQUAL TO PRE-SET VALUE, MOTOR TO DRIVE COMPRESSOR AT PRE-SET RPM
S840
END

REFRIGERATOR AND CONTROL METHOD THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation application of International Application No. PCT/KR2023/017159, filed on Oct. 31, 2023, which claims priority to Korean Patent Application No. 10-2022-0188932, filed on Dec. 29, 2022, in the Korean Intellectual Property Office, the disclosures of which are incorporated by reference herein in their entireties.

BACKGROUND

1. Field

[0002] The disclosure relates to a refrigerator and a control method thereof, and more particularly, to a refrigerator that minimizes power consumption for driving a compressor while maintaining an optimal internal temperature by predicting the temperature inside the refrigerator and a control method thereof.

2. Description of Related Art

[0003] A refrigerator may be used to store food, beverages, or the like in a fresh state. The refrigerator may include a cooling part consisting of a compressor, a condenser, an expansion valve, and an evaporator which circulate refrigerant and form a cooling cycle. The refrigerator may maintain temperature of a storage space inside the refrigerator lower than room temperature through the cooling part.

[0004] Here, the compressor may not be always turned-on due to high power consumption, and may maintain the inside of the refrigerator at a setting temperature by being repeatedly turned-on and turned-off based on an external temperature sensed through an external temperature sensor.

[0005] In addition, when an increase in temperature is detected by sensing temperature change inside the refrigerator, the compressor may be driven at a higher revolutions per minute (RPM) than a basic RPM and the temperature inside the refrigerator may be maintained at the setting temperature.

SUMMARY

[0006] According to an aspect of the disclosure, there is provided a refrigerator, including: a compressor configured to compress a refrigerant; a motor configured to transfer power to the compressor; a condenser configured to condense the refrigerant which is compressed in the compressor; a valve configured to reduce pressure of the refrigerant which is condensed in the condenser; an evaporator configured to evaporate the refrigerant which is reduced in pressure in the valve; a storage compartment configured to be adjusted to a pre-set temperature through a heat-exchange process with the evaporator; a memory storing at least one instruction; and one or more processors, wherein the at least one instruction, when executed by the one or more processors individually or collectively, cause the refrigerator to: identify, based on temperature information of an inside of the storage compartment being obtained, a temperature change rate of the inside of the storage compartment corresponding to a first time period that includes the temperature information and a first time-point at which the temperature information is obtained, obtain temperature prediction information of the inside of the storage compartment after the first time period by providing the identified temperature change rate to a temperature prediction model, identify whether a temperature change of the inside of the storage compartment after the first time period is greater than or equal to a pre-set value based on the obtained temperature prediction information, and control, based on the temperature change of the inside of the storage compartment after the first time period being identified as greater than or equal to the pre-set value, the motor to drive the compressor at a pre-set revolutions per minute (RPM).

[0007] The at least one instruction, when executed by the one or more processors individually or collectively, may cause the refrigerator to: obtain the temperature prediction information of the inside of the storage compartment corresponding to a second time-point after the first time period by providing the identified temperature change rate to the temperature prediction model.

[0008] The at least one instruction, when executed by the one or more processors individually or collectively, may cause the refrigerator to: obtain temperature change rate prediction information of the inside of the storage compartment corresponding to a second time period after the first time period by providing the identified temperature change rate to the temperature prediction model.

[0009] The at least one instruction, when executed by the one or more processors individually or collectively, may cause the refrigerator to: identify whether a temperature increase rate of the inside of the storage compartment corresponding to a pre-set time period is greater than or equal to the pre-set value based on the obtained temperature prediction information, and control, based on the temperature increase rate being identified as greater than or equal to the pre-set value, the motor to drive the compressor at the pre-set RPM.

[0010] The at least one instruction, when executed by the one or more processors individually or collectively, may cause the refrigerator to: control the motor to drive the compressor at a higher RPM as the temperature increase rate increases.

[0011] The at least one instruction, when executed by the one or more processors individually or collectively, may cause the refrigerator to identify whether a temperature increase rate of the inside of the storage compartment corresponding to a pre-set time period is less than the pre-set value based on the obtained temperature prediction information, and control, based on the temperature increase rate being identified as less than the pre-set value, the motor to drive the compressor at a lower RPM than the pre-set RPM.

[0012] The temperature prediction model may be trained based on temperature change rate information corresponding to a pre-set time period and the temperature prediction information after the pre-set time period which is output by inputting the temperature change rate information corresponding to the pre-set time period in the temperature prediction model.

[0013] The refrigerator may further include: a temperature sensor, wherein the at least one instruction, when executed by the one or more processors individually or collectively, may cause the refrigerator to: obtain the temperature information of the inside of the storage compartment by sensing temperature of the inside of the storage compartment through the temperature sensor.

[0014] According to an aspect of the disclosure, there is provided a control method of a refrigerator, the control method including: identifying, based on temperature information of an inside of a storage compartment being obtained, a temperature change rate of the inside of the storage compartment corresponding to a first time period that includes the temperature information and a first time-point based on the first time-point at which the temperature information is obtained; obtaining temperature prediction information of the inside of the storage compartment after the first time period by providing the identified temperature change rate to a temperature prediction model; identifying whether a temperature change of the inside of the storage compartment after the first time period is greater than or equal to a pre-set value based on the obtained temperature prediction information; and controlling, based on the temperature change of the inside of the storage compartment after the first time period being identified as greater than or equal to the pre-set value, a motor to drive a compressor at a pre-set revolutions per minute (RPM).

[0015] The obtaining the temperature prediction information may include obtaining the temperature prediction information of the inside of the storage compartment corresponding to a second time-point after the first time period by providing the identified temperature change rate to the temperature prediction model.

[0016] The obtaining temperature prediction information may include obtaining temperature change rate prediction information of the inside of the storage compartment corresponding to a second time period after the first time period by providing the identified temperature change rate to the temperature prediction model.

[0017] The identifying whether the temperature change may be greater than or equal to the pre-set value may include identifying whether a temperature increase rate of the inside of the storage compartment corresponding to a pre-set time period is greater than or equal to the pre-set value based on the obtained temperature prediction information, and wherein the controlling the motor may include controlling, based on the temperature increase rate being identified as greater than or equal to the pre-set value, the motor to drive the compressor at the pre-set RPM.

[0018] The controlling the motor may include controlling the motor to drive the compressor at a higher RPM as the temperature increase rate increases.

[0019] The identifying whether the temperature change may be greater than or equal to the pre-set value may include identifying whether a temperature increase rate of the inside of the storage compartment corresponding to a pre-set time period is less than the pre-set value based on the obtained temperature prediction information, and wherein the controlling the motor may include controlling, based on the temperature increase rate being identified as less than the pre-set value, the motor to drive the compressor at a lower RPM than the pre-set RPM.

[0020] The temperature prediction model may be trained based on temperature change rate information corresponding to a pre-set time period and temperature prediction information after the pre-set time period which is output by providing the temperature change rate information corresponding to the pre-set time period to the temperature prediction model.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The above and other aspects, features, and advantages of certain embodiments of the present disclosure will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

[0022] FIG. **1** is a diagram illustrating a refrigerator according to an embodiment of the disclosure;

[0023] FIG. **2** is a diagram illustrating a compressor, a condenser, an expansion valve, and an evaporator which consist a cooling part of a refrigerator according to an embodiment of the disclosure;

[0024] FIG. **3** is a block diagram illustrating a configuration of a refrigerator according to an embodiment of the disclosure;

[0025] FIG. **4** is a diagram illustrating an operation of a refrigerator obtaining temperature prediction information corresponding to a pre-set time-point or a pre-set time period by inputting temperature change rate information corresponding to the pre-set time period in a temperature prediction model according to an embodiment of the disclosure;

[0026] FIG. **5** is a flowchart illustrating an operation for controlling a motor to drive a compressor according to whether a temperature increase rate inside a storage compartment of a refrigerator is greater than or equal to a pre-set value according to an embodiment of the disclosure;

[0027] FIG. **6** is a diagram illustrating a driving RPM of a compressor corresponding to a temperature change condition of a refrigerator according to an embodiment of the disclosure;

[0028] FIG. **7** is a sequence diagram illustrating operations of a refrigerator, a temperature prediction device, and a server when the temperature prediction device is separated from the refrigerator and implemented as a separate device according to an embodiment of the disclosure; and

[0029] FIG. **8** is a flowchart illustrating an operation of a refrigerator according to an embodiment of the disclosure.

DETAILED DESCRIPTION

[0030] Various modifications may be made to the embodiments of the disclosure, and there may be various types of embodiments. Accordingly, specific embodiments will be illustrated in drawings, and the embodiments will be described in detail in the detailed description. However, it should be noted that the various embodiments are not for limiting the scope of the disclosure to a specific embodiment, but that they should be interpreted to include all modifications, equivalents or alternatives of the embodiments included in the ideas and the technical scopes disclosed herein. With respect to the description of the drawings, like reference numerals may be used to indicate like elements.

[0031] In describing the disclosure, in case it is determined that the detailed description of related known technologies may unnecessarily confuse the gist of the disclosure, the detailed description thereof will be omitted.

[0032] Further, the embodiments below may be modified to various different forms, and it is to be understood that the scope of the technical spirit of the disclosure is not limited to the embodiments below. Rather, the embodiments are provided so that the disclosure will be thorough and complete, and to fully convey the technical spirit of the disclosure to those of ordinary skill in the art.

[0033] Terms used in the disclosure have been merely used to describe a specific embodiment, and is not intended to limit the scope of protection. A singular expression includes a plural expression, unless otherwise specified.

[0034] In the disclosure, expressions such as "have", "may have", "include", and "may include" are used to designate a presence of a corresponding characteristic (e.g., elements such as numerical value, function, operation, or component), and not to preclude a presence or a possibility of additional characteristics.

[0035] In the disclosure, expressions such as "A or B", "at least one of A and/or B", or "one or more of A and/or B" may include all possible combinations of the items listed together. For example, "A or B," "at least one of A and B," or "at least one of A or B" may refer to all cases including (1) only A, (2) only B, or (3) both of A and B.

[0036] Expressions such as "1st", "2nd", "first", or "second" used in the disclosure may limit various elements regardless of order and/or importance, and may be used merely to distinguish one element from another element and not limit the relevant element.

[0037] When a certain element (e.g., a first element) is indicated as being "(operatively or communicatively) coupled with/to" or "connected to" another element (e.g., a second element), it may be understood as the certain element being directly coupled with/to the another element or as being coupled through other element (e.g., a third element).

[0038] Conversely, when a certain element (e.g., first element) is indicated as "directly coupled with/to" or "directly connected to" another element (e.g., second element), it may be understood as the other element (e.g., third element) not being present between the certain element and the another element.

[0039] The expression "configured to . . . (or set up to)" used in the disclosure may be used interchangeably with, for example, "suitable for . . . ", "having the capacity to . . . ", "designed to . . . ", "adapted to . . . ", "made to . . . ", or "capable of . . . " based on circumstance. The term "configured to . . . (or set up to)" may not necessarily mean "specifically designed to" in terms of hardware.

[0040] Rather, in a certain circumstance, the expression "a device configured to . . . " may mean something that the device "may perform . . . " together with another device or components. For example, a phrase "a processor configured to (or set up to) perform A, B, or C" may mean a dedicated processor for performing a relevant operation (e.g., an embedded processor), or a generic-purpose processor (e.g., a central processing unit (CPU) or an application processor) capable of performing the relevant operations by executing one or more software programs stored in a memory device.

[0041] The term 'module' or 'part' used in the embodiments herein perform at least one function or operation, and may be implemented with a hardware or software, or implemented with a combination of hardware and software. In addition, a plurality of 'modules' or a plurality of 'parts', except for a 'module' or a 'part' which needs to be implemented with a specific hardware, may be integrated in at least one module and implemented as at least one processor.

[0042] The various elements and areas of the drawings have been schematically illustrated. Accordingly, embodiments of the disclosure are not limited by relative sizes and distances illustrated in the accompanied drawings.

[0043] Embodiments of the disclosure will be described in detail below with reference to the accompanying drawings to aid in the understanding of those of ordinary skill in the art.

[0044] FIG. **1** is a diagram illustrating a refrigerator according to an embodiment of the disclosure.

[0045] Referring to FIG. **1**, a refrigerator **100** may be provided with a storage space inside thereof and may be a refrigeration storage device that stores food or beverages, and may be, for example, a kimchi refrigerator, a wine refrigerator, a freezer, a maturing (aging) refrigerator, and the like.

[0046] The refrigerator **100** may include a plurality of storage spaces set at different temperatures from one another. Here, the plurality of storage spaces may be a freezing compartment, a refrigeration compartment, an alcohol storage compartment, and the like, but is not limited thereto.

[0047] In addition, the refrigerator **100** may include a nozzle with which purified water may be provided to a user at an external surface of the refrigerator **100**, and a water purifying filter inside the refrigerator **100**. The refrigerator **100** may provide hot water, cold water, ice, and the like through the nozzle according to an input by the user.

[0048] In addition, the refrigerator **100** may include a display **130-1** or a speaker **130-2** at the external surface of the refrigerator **100** and provide information or notifications on food or beverages stored inside the refrigerator **100**, temperature of inside a storage compartment **17**, and the like to the user through the display **130-1** or the speaker **130-2**.

[0049] The refrigerator **100** may include a cooling part which consists of a compressor **11**, a condenser **14**, an expansion valve **15**, and an evaporator **16** through which a refrigerant circulates forming a cooling cycle. The refrigerator **100** may maintain temperature of the storage space inside the refrigerator **100** lower than room temperature through the cooling part that performs heat-exchange with the outside by circulating the refrigerant.

[0050] FIG. **2** is a diagram illustrating the compressor **11**, the condenser **14**, the valve **15**, and the evaporator **16** which consist the cooling part of the refrigerator **100** according to an embodiment of the disclosure.

[0051] Referring to FIG. **2**, the refrigerant inside the cooling part may move in an order of the compressor **11**, the condenser **14**, the valve **15**, and the evaporator **16**, perform heat-exchange with outside air in the condenser **14**, and perform heat-exchange with the storage compartment **17** inside the refrigerator **100** in the evaporator **16**.

[0052] The compressor **11** may perform an operation for compressing the refrigerant in a gaseous state with high-pressure through a cylinder **13**, a piston, and a motor **12**.

[0053] The compressor **11** may not be always turned-on due to high power consumption, and may maintain the inside of the refrigerator **100** at a setting temperature by being repeatedly turned-on and turned-off based on an external temperature sensed through an external temperature sensor **110**. An operation in which the compressor **11** is turned-on and then turned-off one time may be referred to as one driving cycle.

[0054] The compressor **11** may include the cylinder **13**, the piston, and the motor **12** inside of a circular-shaped or a spherical-shaped housing. The compressor **11** may receive power through the motor **12**, and covert a rotational motion of the motor **12** to a linear motion such that the piston is able to perform a reciprocating motion inside the cylinder **13**. The compressor **11** may compress the refrigerant inside the cylinder **13** through the reciprocating motion of the piston.

[0055] However, a refrigerant compression process of the compressor **11** may not be limited to the method of using the cylinder **13** and the piston, and various compression methods may be used.

[0056] In addition, the motor **12** may be provided inside the compressor **11** and may be one element of the compressor **11**, but is not limited thereto, and may be the motor **12** provided separately outside of the compressor **11**.

[0057] The refrigerator **100** may move the refrigerant which is compressed with high- pressure in the compressor **11** to the condenser **14** through a flow path. As the refrigerant compressed in the compressor **11** is condensed in a liquid state in the condenser **14**, heat is dissipated outside.

[0058] The refrigerator **100** may have the condensed refrigerant moved through the flow path passing the valve **15**. As the refrigerant passes the valve **15**, pressure may be significantly decreased.

[0059] Then, the refrigerator **100** may have the pressure deteriorated refrigerant moved to the evaporator **16** through the flow path, and as the refrigerant in a liquid state in the evaporator **16** is evaporated to a gaseous state, surrounding heat may absorbed. The evaporator **16** may be positioned adjacently with the storage compartment **17** inside the refrigerator **100**, and absorb heat from the storage compartment **17** inside the refrigerator **100** evaporating the refrigerant.

[0060] The refrigerator **100** may control the temperature of inside the storage compartment **17** by controlling the cooling part as described above.

[0061] FIG. **3** is a block diagram illustrating a configuration of a refrigerator according to an embodiment of the disclosure.

[0062] Referring to FIG. **3**, the refrigerator **100** may include the temperature sensor **110**, memory **120**, an output part **130** which consists of the display **130-1** or the speaker **130-2**, a communication interface **140**, a user interface **150**, a camera **160**, a microphone **170**, and one or more processors **180** (hereinafter, referred to as a/the processor).

[0063] The temperature sensor **110** may sense the temperature inside the storage compartment **17** of the refrigerator **100**, and generate an electric signal or a data value corresponding to a sensed state.

[0064] The processor may obtain information on the temperature of inside the storage compartment **17** through the temperature sensor **110** inside the refrigerator **100**. The temperature sensor **110** inside the refrigerator **100** may be positioned in each of the insides of the at least one storage compartment **17**, but is not limited thereto, and may be positioned adjacently with the at least one storage compartment **17**.

[0065] The refrigerator **100** may further include a motion sensor or a gesture sensor in addition to the temperature sensor **110**, and a processor **180** may sense movement, a motion, a gesture, and the like of the user through the motion sensor or the gesture sensor and identify a user command corresponding to the sensed information, and perform an operation corresponding to the identified user command.

[0066] The memory **120** may store various programs or data transitorily or non-transitorily, and transfer stored information to the processor according to a call of the processor. In addition, the memory **120** may store various information necessary in a computation, processing, a control operation, or the like of the processor in an electronic format.

[0067] The memory **120** may include at least one from among, for example, a main storing device and an auxiliary storing device. The main storing device may be implemented using a semiconductor storage medium such as a read only memory (ROM) and/or a random access memory (RAM). The ROM may include, for example, a general ROM, an erasable and programmable ROM (EPROM), an electrically erasable and programmable ROM (EEPROM), and/or a mask ROM, and the like. The RAM may include, for example, a dynamic RAM (DRAM), and/or a static RAM (SRAM), and the like. The auxiliary storing device may be implemented using at least one storage medium capable of storing data permanently or semi-permanently such as, for example, and without limitation, an optical media such as a flash memory device, a secure digital (SD) card, a solid state drive (SSD), a hard disc drive (HDD), a magnetic drum, a compact disc (CD), a DVD or laser disc, or the like, a magnetic tape, a magneto-optical disc, and/or a floppy disk, and the like.

[0068] The memory **120** may store overall control information of the refrigerator **100**. The memory **120** may store information on an operation time of the compressor **11**, and a driving RPM of the compressor **11**. In addition, a plurality of setting values of the setting temperature of inside the storage compartment **17** may be stored. In addition thereto, the memory **120** may store information on a driving condition of the compressor **11**.

[0069] The memory **120** may store temperature information of inside the refrigerator and information on a time-point at which the temperature information is obtained.

[0070] The memory **120** may store a temperature change rate (or temperature change information) of inside the storage compartment **17** corresponding to a time period that includes the time-point at which the temperature information is obtained, and information on a temperature increase rate.

[0071] The memory **120** may store information on a temperature prediction model. The memory **120** may store information on a layer included in the temperature prediction model, a node included in the layer, a weight value corresponding to the node, other parameters, and a loss function.

[0072] The memory **120** may store temperature prediction information output from the temperature prediction model. The temperature prediction information may correspond to a vector value positioned in a random real number space.

[0073] The output part **130** may provide various information or notifications to the user, and include the display **130-1** or the speaker **130-2**.

[0074] The display **130-1** may include display panels of various types such as, for example, and without limitation, a liquid crystal display (LCD) panel, an organic light-emitting diode (OLED) panel, an active-matrix organic light-emitting diode (AM-OLED), a liquid crystal on silicon (LcoS), a quantum dot light-emitting diode (QLED) and digital light processor (DLP), a plasma display panel (PDP) panel, an inorganic LED panel, a micro LED panel, and the like, but is not limited thereto. The display **130-1** may form a touch screen together with a touch panel, and may consist of flexible panels.

[0075] The display **130-1** may be implemented in a 2-dimensional (2D) square shape or rectangular shape, but is not limited thereto, and may be implemented in various forms such as a circular form, a polygonal form, a 3-dimensional (3D) form, and the like.

[0076] The display **130-1** may be positioned at the external surface of the refrigerator **100**, an external surface of a door, and the like, but is not limited thereto.

[0077] The processor **180** may control the display **130-1** to display temperature information corresponding to a pre-set time-point of inside the storage compartment **17** of the refrigerator **100**, the temperature prediction information, temperature change rate information corresponding to a pre-set time period, and information on a temperature increase rate corresponding to a pre-set time period in a graphical user interface (GUI) or text form.

[0078] The processor **180** may control the display **130-1** to display information on a driving RPM of the compressor **11**, an operation time of the compressor **11**, and information on the temperatures of inside the one or more storage compartments **17**. In addition, the processor may control the display **130-1** to display various GUIs for control of the refrigerator **100**.

[0079] The speaker **130-2** may consist of a tweeter for playing high-range sound, a midrange for playing mid-range sound, a woofer for playing low-range sound, a sub-woofer for playing ultra-low range sound, an enclosure for controlling resonance, a cross-over network for dividing electric signal frequencies which are input to the speaker **130-2** into bandwidths, and the like.

[0080] The speaker **130-2** may output sound signals to the outside of the refrigerator **100**. The speaker **130-2** may output playing of multi-media, playing of recordings, various notification sounds, voice messages, and the like. The refrigerator **100** may include audio output devices such as the speaker **130-2**, but may include an output device such as an audio output terminal. Specifically, the speaker **130-2** may provide obtained information, information processed and manufactured based on the obtained information, a response result or operation result for a user voice, and the like in a voice form.

[0081] The speaker **130-2** may output sound signals to the outside of the refrigerator **100**. The speaker **130-2** may output playing of multi-media, playing of recordings, various notification sounds, voice messages, and the like. The refrigerator **100** may include audio output devices such as the speaker **130-2**, but may include an output device such as an audio output terminal. Specifically, the speaker **130-2** may provide obtained information, information processed and manufactured based on the obtained information, a response result or operation result for a user voice, and the like in a voice form.

[0082] The processor **180** may control the speaker **130-2** to output the temperature information corresponding to the pre-set time-point of inside the storage compartment **17** of the refrigerator **100**, the temperature prediction information, the temperature change rate information corresponding to the pre-set time period, and information on a temperature increase rate corresponding to the pre-set time period.

[0083] The processor may control the speaker **130-2** to output a voice on the driving RPM of the compressor **11**, the operation time of the compressor **11**, and the temperatures of inside the one or more storage compartments **17**. In addition, the processor may control the speaker **130-2** to output a notification notifying the start and end of driving the compressor **11** of the refrigerator **100**.

[0084] The communication interface **140** may include a wireless communication interface **140**, a wired communication interface **140**, or an input interface. The wireless communication interface **140** may perform communication with various external devices using wireless communication technology or mobile communication technology. The wireless communication technology described above may include, for example, Bluetooth, Bluetooth Low Energy, CAN communication, Wi-Fi, Wi-Fi Direct, ultra-wide band (UWB), ZigBee, Infrared Data Association (IrDA), Near Field Communication (NFC), or the like, and the mobile communication technology may include 3GPP, Wi-Max, Long Term Evolution (LTE), 5G, and the like.

[0085] The wireless communication interface may be implemented using an antenna, a communication chip, a substrate, and the like capable of transmitting electromagnetic waves to the outside or receiving electromagnetic waves transferred from the outside.

[0086] The wired communication interface may perform communication with various external devices based on a wired communication network. Here, the wired communication network may be implemented using a physical cable such as, for example, and without limitation, a pair cable, a coaxial cable, an optical fiber cable, an Ethernet cable, or the like.

[0087] Any one of the wireless communication interface and the wired communication interface may be omitted according to an embodiment. Accordingly, the refrigerator **100** may include only the wireless communication interface **140** or only the wired communication interface. In addition to the above, the refrigerator **100** may include an integrated communication interface **140** which supports both a wireless connection by the wireless communication interface and a wired connection by the wired communication interface.

[0088] The refrigerator **100** may not be limited to including one communication interface **140** for performing one method of communication connection, and may include a plurality of communication interfaces **140** for performing communication connection with a plurality of methods.

[0089] The processor **180** may perform communication connection with an external server or an external device through the communication interface **140**. The processor **180** may perform communication connection with the external server or the external device through the communication interface **140** and transmit or receive information on the operation time of the compressor **11**, the driving RPM of the compressor **11**, and the like.

[0090] In addition, the processor **180** may perform communication connection with a user terminal through the communication interface **140** and receive a signal for controlling the refrigerator **100** from the user terminal.

[0091] The processor **180** may perform communication connection with the external server through the communication interface **140** and transmit the temperature information of inside the storage compartment **17**, the temperature change information, the temperature change rate information corresponding to the pre-set time, and temperature increase rate information corresponding to a pre-set time to the external server or the external device, or receive the same from the external server or the external device.

[0092] The processor **180** may perform communication connection with the external server through the communication interface **140** and transmit or receive information on the temperature prediction model.

[0093] In addition to the above, the processor **180** may perform communication connection with the external server through the communication interface **140** and transmit or receive the temperature information of inside the storage compartment **17**, the temperature change information, the temperature change rate information corresponding to the pre-set time, and information on controlling the cooling part or the compressor corresponding to the temperature increase rate information corresponding to the pre-set time.

[0094] The user interface **150** may include a button, a lever, a switch, a touch type interface, and the like, and the touch type interface may be implemented in a method that receives input by a user touch on the display **130-1**.

[0095] The processor **180** may receive a user input through the user interface **150**. Specifically, the processor may receive an input for the operation and driving RPM of the compressor **11** through the user interface **150**.

[0096] The camera **160** may capture a still image and a moving image. The processor may obtain various images through the camera **160**. Here, the camera **160** may be an infrared camera **160**.

[0097] The processor **180** may determine an operation time of the compressor **11** and a driving RPM of the compressor based on an image obtained through the camera **160**.

[0098] Specifically, the processor **180** may identify a length of time that the door of the refrigerator **100** was opened and an object subject to storing being entered in and taken from the inside of the storage compartment **17** after the door was opened based on an still image or moving image captured through the camera **160**.

[0099] When the door of the refrigerator **100** is identified as opened for greater than or equal to a pre-set time, the processor **180** may control the motor **12** to drive the compressor **11** at a pre-set RPM. Here, the pre-set RPM may be an RPM higher than an RPM of a normal state.

[0100] When an object subject to storing is identified as entering inside the storage compartment **17** after the door of the refrigerator **100** is opened, the processor **180** may control the motor **12** to drive the compressor **11** at a pre-set RPM. Here, the pre-set RPM may be an RPM higher than an RPM of a normal state.

[0101] The microphone **170** may refer to a module that obtains sound and converts to an electric signal, and may be a condenser microphone **170**, a ribbon microphone **170**, a moving-coil microphone **170**, a piezoelectric device microphone **170**, a carbon microphone **170**, or a micro electro mechanical system (MEMS) microphone **170**. In addition, the above may be implemented in an omnidirectional method, a bidirectional method, a unidirectional method, a sub cardioid method, a super cardioid method, or a hyper cardioid method.

[0102] The processor **180** may obtain various voices through the microphone **170**. The processor may identify a user command or inquiry included in the voice obtained through the microphone **170**.

[0103] The processor **180** may identify the operation time and the driving RPM of the compressor **11** based on the identified user command or inquiry. That is, if the user commands to set the setting temperature of inside the refrigerator **100** to a lower temperature, the processor may increase the operation time of the compressor **11**, and raise the driving RPM of the compressor **11**.

[0104] The processor **180** may control the overall operation of the refrigerator **100**. Specifically, the processor may be connected with a configuration of the refrigerator **100** which includes the memory **120** as described above, and by executing the at least one instruction stored in the memory **120** as described above, control the overall operation of the refrigerator **100**. Specifically, the processor **180** may not only be implemented as one processor, but also implemented as a plurality of processors.

[0105] The processor **180** may be implemented in various methods. For example, the one or more processors may include one or more from among a central processing unit (CPU), a graphics processing unit (GPU), an accelerated processing unit (APU), a many integrated core (MIC), a digital signal processor (DSP), a neural processing unit (NPU), a hardware accelerator, or a machine learning accelerator. The one or more processors may control one or a random combination from among other elements of the electronic device, and perform an operation associated with communication or data processing. The one or more processors may execute one or more programs or instructions stored in the memory **120**. For example, the one or more processors may perform, by executing the one or more instructions stored in the memory **120**, a method according to an embodiment of the disclosure.

[0106] When a method according to an embodiment of the disclosure includes a plurality of operations, the plurality of operations may be performed by one processor, or performed by a plurality of processors. For example, when a first operation, a second operation, and a third operation are performed by a method according to an embodiment, the first operation, the second operation, and the third operation may all be performed by a first processor, or the first operation and the second operation may be performed by the first processor (e.g., a generic-purpose processor) and the third operation may be performed by a second processor (e.g., an artificial intelligence dedicated processor).

[0107] The one or more processors may be implemented as a single core processor that includes one core, or as one or more multicore processors that include a plurality of cores (e.g., a homogeneous multicore or a heterogeneous multicore). If the one or more processors are implemented as multicore processors, each of the plurality of cores included in the multicore processors may include the memory **120** inside the processor such as an on-chip memory **120**, and a common cache shared by the plurality of cores may be included in the multicore processors. In addition, each of the plurality of cores (or a portion from among the plurality of cores) included in the multicore processors may independently read and perform a program command for implementing a method according to an embodiment of the disclosure, or read and perform a program command for implementing a method according to an embodiment of the disclosure due to a whole (or a portion) of the plurality of cores being interconnected.

[0108] When a method according to an embodiment of the disclosure includes a plurality of operations, the plurality of operations may be performed by one core from among the plurality of cores or performed by the plurality of cores included in the multicore processors. For example, when a first operation, a second operation, and a third operation are performed by a method according to an embodiment, the first operation, the second operation, and the third operation may all be performed by a first core included in the multicore processors, or the first operation and the second operation may be performed by the first core included in the multicore processors and the third operation may be performed by a second core included in the multicore processors.

[0109] In the embodiments of the disclosure, the processor **180** may refer to a system on chip (SoC), a single core processor, or a multicore processor in which the one or more processors and other electronic components are integrated, or a core included in the single core processor or the multicore processors, and the core herein may be implemented as the CPU, the GPU, the APU, the MIC, the DSP, the NPU, the hardware accelerator, the machine learning accelerator, or the like, but embodiments of the disclosure are not limited thereto.

[0110] The processor **180** may identify, based on the temperature information of inside the storage compartment **17** being obtained, the temperature change rate of inside the storage compartment **17** corresponding to a first time period that includes a first time-point based on the temperature information and the first time-point at which the temperature information is obtained.

[0111] The processor **180** may obtain the temperature prediction information of inside the storage compartment **17** after the first time period by inputting the identified temperature change rate information in the temperature prediction model.

[0112] The processor **180** may identify whether a temperature change of inside the storage compartment **17** after the first time is greater than or equal to the pre-set value based on the obtained temperature prediction information.

[0113] When the temperature change of inside the storage compartment **17** after the first time is identified as greater than or equal to the pre-set value, the processor **180** may control the motor **12** to drive the compressor **11** at the pre-set RPM.

[0114] A more specific control operation of the processor **180** with respect to the refrigerator **100** will be described together with FIG. **4** to FIG. **7**.

[0115] The processor **180** may identify, based on the temperature information of inside the storage compartment **17** being obtained, the temperature change rate of inside the storage compartment **17** corresponding to the first time period that includes the first time-point based on the temperature information and the first time-point at which the temperature information is obtained.

[0116] Here, the processor **180** may sense the temperature of inside the storage compartment **17** through the temperature sensor **110** and obtain the temperature information of inside the storage compartment **17**.

[0117] The processor **180** may obtain the temperature prediction information of inside the storage compartment **17** after the first time period by inputting the identified temperature change rate information in the temperature prediction model.

[0118] FIG. **4** is a diagram illustrating an operation of the refrigerator **100** obtaining temperature prediction information corresponding to a pre-set time-point or a pre-set time period by inputting temperature change rate information corresponding to the pre-set time period in a temperature prediction model according to an embodiment of the disclosure.

[0119] Referring to FIG. **4**, a temperature prediction model **400** may be trained with an error backpropagation method according to a loss function based on temperature change rate information corresponding to a pre-set time period and temperature prediction information after the pre-set time period output by inputting the temperature change rate information corresponding to the pre-set time period in the temperature prediction model, but the model training method is not limited thereto.

[0120] The processor **180** may obtain temperature prediction information of inside the storage compartment **17** corresponding to a second time-point after the first time period by inputting the identified temperature change rate information which consists of the temperature change information corresponding to the first time period in the temperature prediction model **400**.

[0121] Specifically, the processor **180** may input change rate information (e.g., $(T2-T1)/(t1-0)$) indicating that the temperature has changed from T1 to T2 while time is passing from 0 to t1 in the temperature prediction model **400** and obtain temperature prediction information having a value of T3 corresponding to a t2 time-point after the time period from 0 to t1.

[0122] However, unlike the above, a unit time may be a random time period between t0 and t1, and t0 may not necessarily be 0.

[0123] In addition, a difference between t0 and t1 may be close to 0 without limitation, and in this case, a value of $(T2-T1)/(t1-t0)$ may be an instantaneous change rate of the temperature inside the storage compartment **17** corresponding to a specific time-point.

[0124] The processor **180** may input the identified temperature change rate information in the temperature prediction model **400** and obtain temperature change rate prediction information of inside the storage compartment **17** corresponding to a second time period after the first time period.

[0125] Specifically, the processor **180** may input the change rate information (e.g., $(T2-T1)/(t1-0)$) indicating that the temperature has changed from T1 to T2 while time is passing from 0 to t1 in the temperature prediction model **400** and obtain change rate prediction information (e.g., $(T3-T2)/(t2-t1)$) indicating that the temperature change of inside the storage compartment **17** corresponding to a time period between t1 and t2, which is the second time period after the time period from 0 to t1, has changed from T2 to T3.

[0126] Here, as described above, to may not necessarily be 0, and the difference between t0 and t1 may be close to 0 without limitation, and in this case, the value of $(T2-T1)/(t1-t0)$ may be the instantaneous change rate of the temperature inside the storage compartment **17** corresponding to a specific time-point.

[0127] Likewise, a difference between t1 and t2 may be close to 0 without limitation, and in this case, a value of $(T3-T2)/(t2-t1)$ may be the instantaneous change rate of the temperature inside the storage compartment **17** corresponding to a specific time-point.

[0128] The processor **180** may identify whether the temperature change of inside the storage compartment **17** after the first time is greater than or equal to the pre-set value based on the obtained temperature prediction information.

[0129] When the temperature change of inside the storage compartment **17** after the first time is identified as greater than or equal to the pre-set value, the processor **180** may control the motor **12** to drive the compressor **11** at the pre-set RPM.

[0130] FIG. **5** is a flowchart illustrating an operation for controlling the motor **12** to drive the compressor **11** according to whether a temperature increase rate inside the storage compartment **17** of the refrigerator **100** is greater than or equal to a pre-set value according to an embodiment of the disclosure.

[0131] Referring to FIG. **5**, when temperature information of inside the storage compartment **17** is obtained, the processor **180** may identify the temperature change rate of inside the storage compartment **17** corresponding to the first time period that includes the first time-point based on the temperature information and the first time-point at which the temperature information is obtained (S**510**).

[0132] The processor **180** may obtain the temperature prediction information of inside the storage compartment **17** after the first time period by inputting the identified temperature change rate information in the temperature prediction model **400** (S**520**).

[0133] The processor **180** may identify whether the temperature increase rate of inside the storage compartment **17** corresponding to the pre-set time period is greater than or equal to the pre-set value based on the obtained temperature prediction information (S**530**).

[0134] If the temperature increase rate of inside the storage compartment **17** is identified as greater than or equal to the pre-set value (S**540**-Y), the processor **180** may control the motor **12** to drive the compressor **11** at the pre-set RPM (S**550**). Here, the pre-set RPM may be an RPM higher than a basic RPM, or an average RPM, but is not limited thereto.

[0135] Here, the processor **180** may control the motor **12** to drive the compressor **11** at a higher RPM as the temperature increase rate increases.

[0136] If the temperature increase rate of inside the storage compartment **17** is identified as less than the pre-set value (S**540**-N), the processor **180** may control the motor **12** to drive the compressor **11** at a lower RPM than the pre-set RPM (S**560**).

[0137] As described above, it may be possible for the processor **180** to maintain the temperature of inside the storage compartment **17** close to an optimal setting temperature while minimizing power consumption by controlling, based on the temperature increase rate of inside the storage compartment **17** being greater than or equal to the pre-set value, the motor **12** to drive the compressor **11** at a higher RPM as the temperature increase rate of inside the storage compartment **17** increases, and by controlling, based on the temperature increase rate of inside the storage compartment **17** being less than the pre-set value, the motor **12** to drive the compressor **11** at a lower RPM than the pre-set RPM.

[0138] A control operation of the motor **12** according to a temperature condition of inside the storage compartment **17** of the processor **180** may be indicated broken down as in FIG. **6**.

[0139] FIG. **6** is a diagram illustrating a driving RPM of a compressor corresponding to a temperature change condition of a refrigerator according to an embodiment of the disclosure.

[0140] Referring to FIG. **6**, if 40 minutes has not yet passed after defrosting (**610**), the processor **180** may control the motor **12** to drive the compressor **11** at the basic RPM.

[0141] If the temperature of inside the storage compartment **17** has risen 4° C. compared to a reference temperature (**620**), the processor **180** may control the motor **12** to drive the compressor **11** at an RPM two levels higher than the basic RPM.

[0142] If the temperature of inside the storage compartment **17** has risen 2° C. compared to the reference temperature (**630**), the processor **180** may control the motor **12** to drive the compressor **11** at an RPM one level higher than the basic RPM.

[0143] If under another condition (**640**), the processor **180** may control the motor **12** to drive the compressor **11** at the basic RPM.

[0144] In addition to the above-described embodiment, a temperature prediction device implemented as a separate device from the refrigerator **100** may identify the driving RPM of the compressor **11** according to the temperature change of inside the storage compartment **17** of the refrigerator **100**.

[0145] However, the control operation of the motor **12** according to the temperature condition of inside the storage compartment **17** of the processor **180** is not limited to the embodiment described together with FIG. **6**, and driving RPMs of the compressor **11** corresponding to various temperature conditions may be set.

[0146] FIG. **7** is a sequence diagram illustrating operations of a refrigerator, a temperature prediction device, and a server when the temperature prediction device is separated from the refrigerator and implemented as a separate device according to an embodiment of the disclosure.

[0147] Referring to FIG. **7**, the refrigerator **100** may transmit an installation and operation signal of the refrigerator **100** to a temperature prediction device **200** through the communication interface **140** (S**705**).

[0148] When the installation and operation signal of the refrigerator **100** is received, the temperature prediction device **200** may perform communication connection with a server **300** through the communication interface and transmit a signal requesting for the temperature prediction model **400** corresponding to the refrigerator **100** (S**710**).

[0149] The temperature prediction device **200** may receive information on the temperature prediction model **400** corresponding to the refrigerator **100** by performing communication connection with the server **300** through the communication interface (S**715**).

[0150] The refrigerator **100** may obtain the temperature information by sensing the temperature of inside the storage compartment **17** through the temperature sensor **110** (S**720**).

[0151] The refrigerator **100** may identify the temperature change rate of inside the storage compartment **17** corresponding to the first time period that includes the first time-point based on the temperature information and the first time-point at which the temperature information is obtained (S**725**).

[0152] The refrigerator **100** may transmit the temperature information by performing communication connection with the temperature prediction device **200** through the communication interface **140** (S**730**).

[0153] When the temperature information is received from the refrigerator **100**, the temperature prediction device **200** may obtain the temperature prediction information of inside the storage compartment **17** after the first time period by inputting the identified temperature change rate in the temperature prediction model **400** (S**735**).

[0154] The temperature prediction device **200** may identify whether the temperature change of inside the storage compartment **17** after the first time is greater than or equal to the pre-set value based on the obtained temperature prediction information (S**740**).

[0155] If the temperature change of inside the storage compartment **17** after the first time is identified as greater than or equal to the pre-set value, the temperature prediction device **200** may identify a pre-set driving RPM of the compressor **11** based on the temperature change of inside the storage compartment **17** after the first time being identified as greater than or equal to the pre-set value (S**745**).

[0156] The temperature prediction device **200** may transmit the identified information on the driving RPM of the compressor **11** to the refrigerator **100** by performing communication connection with the refrigerator **100** through the communication interface (S**750**).

[0157] The refrigerator **100** may control the motor **12** to drive the compressor **11** at the pre-set driving RPM (S**755**).

[0158] FIG. **8** is a flowchart illustrating an operation of a refrigerator according to an embodiment of the disclosure.

[0159] Referring to FIG. **8**, the refrigerator **100** may identify, based on the temperature information of inside the storage compartment **17** being obtained, the temperature change rate of inside the storage compartment **17** corresponding to the first time period that includes the first time-point based on the temperature information and the first time-point at which the temperature information is obtained (S**810**). Here, the refrigerator **100** may obtain the temperature information of inside the storage compartment **17** by sensing the temperature of inside the storage compartment **17** through the temperature sensor **110**.

[0160] The refrigerator **100** may obtain the temperature prediction information of inside the storage compartment **17** after the first time period by inputting the identified temperature change rate information in the temperature prediction model **400** (S**820**). The temperature prediction model may be trained based on the temperature change rate information corresponding to the pre-set time period and the temperature prediction information after the pre-set time period output by inputting the temperature change rate information corresponding to the pre-set time period in the temperature prediction model.

[0161] The refrigerator **100** may identify whether the temperature change of inside the storage compartment **17** after the first time is greater than or equal to the pre-set value based on the obtained temperature prediction information (S**830**).

[0162] If the temperature change of inside the storage compartment **17** after the first time is identified as greater than or equal to the pre-set value, the refrigerator **100** may control the motor **12** to drive the compressor **11** at the pre-set RPM (S**840**).

[0163] The refrigerator **100** may control the motor **12** to drive the compressor **11** at a higher RPM as the temperature increase rate increases.

[0164] If the temperature change of inside the storage compartment **17** after the first time is identified as less than the pre-set value, the refrigerator **100** may control the motor **12** to drive the compressor **11** at a lower RPM than the pre-set RPM.

[0165] A function associated with artificial intelligence according to the disclosure may be operated through the processor **180** and the memory **120** of the refrigerator **100**.

[0166] The processor **180** may be configured as one or a plurality of processors **180**. At this time, the one or plurality of processors **180** may be a generic-purpose processor **180** such as a central processing unit (CPU) and an application processor (AP), a graphics dedicated processor **180** such as a graphic processing unit (GPU) and a vision processing unit (VPU), or an artificial intelligence dedicated processor **180** such as a neural processing unit (NPU) and a tensor processing unit (TPU).

[0167] In an embodiment of the disclosure, if the plurality of processors **180** is included in the System on Chip (SoC) included in the refrigerator **100**, the refrigerator **100** may perform a computation associated with artificial intelligence (e.g., a computation associated with learning or inference of an artificial intelligence model) using the graphics dedicated processor **180** or the artificial intelligence dedicated processor **180** from among the plurality of processors **180**, and perform a typical computation of the refrigerator **100** by using the generic-purpose processor **180** from among the plurality of processors **180**. For example, the refrigerator **100** may perform a computation associated with artificial intelligence using at least one from among the GPU, the VPU, the NPU, and the TPU specializing in convolution computations from among the plurality of processors **180**, and perform a typical computation of the refrigerator **100** by using at least one from among the CPU and the AP from among the plurality of processors **180**.

[0168] In addition, the refrigerator **100** may perform a computation with respect to a function associated with artificial intelligence by using multicores (e.g., a dual core, a quad core, etc.) included in one processor **180**. Specifically, the refrigerator **100** may perform the convolution computations in parallel using the multicores included in the processor **180**. The one or plurality of processors **180** may control to process input data according to a pre-defined operation rule or an artificial intelligence model stored in the memory **120**. The pre-defined operation rule or the artificial intelligence model may be characterized by being created through learning.

[0169] Here, the being created through learning may mean a pre-defined operation rule or an artificial intelligence model of a desired characteristic being created by applying a learning algorithm to a plurality of training data. The learning may be carried out in a device itself in which the artificial intelligence according to the disclosure is performed, or carried out through a separate server/system.

[0170] The artificial intelligence model may be configured with a plurality of neural network layers. The respective layers may include a plurality of weight values, and perform computation of the layers through the computation results of a previous layer and the computation of the plurality of weight values. Examples of the neural network may include a Convolutional Neural Network (CNN), a Deep Neural Network (DNN), a Recurrent Neural Network (RNN), a Restricted Boltzmann Machine (RBM), a Deep Belief Network (DBN), a Bidirectional Recurrent Deep Neural Network (BRDNN), and a Deep-Q Networks, and the neural network of the disclosure is not limited to the above-described examples, unless otherwise specified.

[0171] The learning algorithm may be a method for training a predetermined target machine (e.g., a robot) to make decisions or predictions on its own using the plurality of training data. Examples of the learning algorithm may include a supervised learning, an unsupervised learning, a semi-supervised learning, or a reinforcement learning, and the learning algorithm of the disclosure is not limited to the above-described examples unless otherwise specified.

[0172] According to an embodiment, a method according to the various embodiments described in the disclosure may be provided included a computer program product. The computer program product may be exchanged between a seller and a purchaser as a commodity. The computer program product may be distributed in a form of a machine-readable storage medium (e.g., a compact disc read only memory (CD-ROM)), or distributed online (e.g., downloaded or uploaded) through an application store (e.g., PLAYSTORE™) or directly between two user devices (e.g., smartphones). In the case of online distribution, at least a portion of the computer program product (e.g., downloadable app) may be stored at least temporarily in the machine-readable storage medium such as a server of a manufacturer, a server of an application store, or a memory of a relay server, or temporarily generated.

[0173] While the disclosure has been illustrated and described with reference to example embodiments thereof, it will be understood that the example embodiments are intended to be illustrative, not limiting. It will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the true spirit and full scope of the disclosure, including the appended claims and their equivalents.

What is claimed is:

1. A refrigerator comprising:

a compressor configured to compress a refrigerant;

a motor configured to transfer power to the compressor;

a condenser configured to condense the refrigerant which is compressed in the compressor;

a valve configured to reduce pressure of the refrigerant which is condensed in the condenser;

an evaporator configured to evaporate the refrigerant which is reduced in pressure in the valve;

a storage compartment configured to be adjusted to a pre-set temperature through a heat-exchange process with the evaporator;

memory storing at least one instruction; and

one or more processors,

wherein the at least one instruction, when executed by the one or more processors individually or collectively, cause the refrigerator to:

identify, based on temperature information of an inside of the storage compartment being obtained, a temperature change rate of the inside of the storage compartment corresponding to a first time period that comprises the temperature information and a first time-point at which the temperature information is obtained,

obtain temperature prediction information of the inside of the storage compartment after the first time period by providing the identified temperature change rate to a temperature prediction model,

identify whether a temperature change of the inside of the storage compartment after the first time period is greater than or equal to a pre-set value based on the obtained temperature prediction information, and

control, based on the temperature change of the inside of the storage compartment after the first time period being identified as greater than or equal to the pre-set value, the motor to drive the compressor at a pre-set revolutions per minute (RPM).

2. The refrigerator of claim **1**, wherein the at least one instruction, when executed by the one or more processors individually or collectively, cause the refrigerator to:

obtain the temperature prediction information of the inside of the storage compartment corresponding to a second time-point after the first time period by providing the identified temperature change rate to the temperature prediction model.

3. The refrigerator of claim **1**, wherein the at least one instruction, when executed by the one or more processors individually or collectively, cause the refrigerator to:

obtain temperature change rate prediction information of the inside of the storage compartment corresponding to a second time period after the first time period by providing the identified temperature change rate to the temperature prediction model.

4. The refrigerator of claim **1**, wherein the at least one instruction, when executed by the one or more processors individually or collectively, cause the refrigerator to:

identify whether a temperature increase rate of the inside of the storage compartment corresponding to a pre-set time period is greater than or equal to the pre-set value based on the obtained temperature prediction information, and

control, based on the temperature increase rate being identified as greater than or equal to the pre-set value, the motor to drive the compressor at the pre-set RPM.

5. The refrigerator of claim **4**, wherein the at least one instruction, when executed by the one or more processors individually or collectively, cause the refrigerator to:

control the motor to drive the compressor at a higher RPM as the temperature increase rate increases.

6. The refrigerator of claim **1**, wherein the at least one instruction, when executed by the one or more processors individually or collectively, cause the refrigerator to:

identify whether a temperature increase rate of the inside of the storage compartment corresponding to a pre-set time period is less than the pre-set value based on the obtained temperature prediction information, and

control, based on the temperature increase rate being identified as less than the pre-set value, the motor to drive the compressor at a lower RPM than the pre-set RPM.

7. The refrigerator of claim **1**, wherein the temperature prediction model is trained based on temperature change rate information corresponding to a pre-set time period and the temperature prediction information after the pre-set time period which is output by inputting the temperature change rate information corresponding to the pre-set time period in the temperature prediction model.

8. The refrigerator of claim **1**, further comprising:

a temperature sensor,

wherein the at least one instruction, when executed by the one or more processors individually or collectively, cause the refrigerator to:

obtain the temperature information of the inside of the storage compartment by sensing temperature of the inside of the storage compartment through the temperature sensor.

9. A control method of a refrigerator, the control method comprising:

identifying, based on temperature information of an inside of a storage compartment being obtained, a temperature change rate of the inside of the storage compartment corresponding to a first time period that comprises the temperature information and a first time-point based on the first time-point at which the temperature information is obtained;

obtaining temperature prediction information of the inside of the storage compartment after the first time period by providing the identified temperature change rate to a temperature prediction model;

identifying whether a temperature change of the inside of the storage compartment after the first time period is greater than or equal to a pre-set value based on the obtained temperature prediction information; and

controlling, based on the temperature change of the inside of the storage compartment after the first time period being identified as greater than or equal to the pre-set value, a motor to drive a compressor at a pre-set revolutions per minute (RPM).

10. The control method of claim **9**, wherein the obtaining the temperature prediction information comprises obtaining the temperature prediction information of the inside of the storage compartment corresponding to a second time-point after the first time period by providing the identified temperature change rate to the temperature prediction model.

11. The control method of claim **9**, wherein the obtaining temperature prediction information comprises obtaining temperature change rate prediction information of the inside of the storage compartment corresponding to a second time period after the first time period by providing the identified temperature change rate to the temperature prediction model.

12. The control method of claim **9**, wherein the identifying whether the temperature change is greater than or equal to the pre-set value comprises identifying whether a temperature increase rate of the inside of the storage compartment corresponding to a pre-set time period is greater than or equal to the pre-set value based on the obtained temperature prediction information, and

wherein the controlling the motor comprises controlling, based on the temperature increase rate being identified as greater than or equal to the pre-set value, the motor to drive the compressor at the pre-set RPM.

13. The control method of claim **12**, wherein the controlling the motor comprises controlling the motor to drive the compressor at a higher RPM as the temperature increase rate increases.

14. The control method of claim **9**, wherein the identifying whether the temperature change is greater than or equal to the pre-set value comprises identifying whether a temperature increase rate of the inside of the storage compartment corresponding to a pre-set time period is less than the pre-set value based on the obtained temperature prediction information, and

wherein the controlling the motor comprises controlling, based on the temperature increase rate being identified as less than the pre-set value, the motor to drive the compressor at a lower RPM than the pre-set RPM.

15. The control method of claim **9**, wherein the temperature prediction model is trained based on temperature change rate information corresponding to a pre-set time period and temperature prediction information after the pre-set time period which is output by providing the temperature change rate information corresponding to the pre-set time period to the temperature prediction model.

16. The control method of claim **9**, wherein identifying a temperature change rate of the inside of the storage compartment comprises obtaining the temperature information of the inside of the storage compartment by sensing temperature of the inside of the storage compartment.

17. One or more non-transitory computer-readable storage medium storing one or more computer programs including computer-executable instructions that, when executed by one or more processors of an electronic device individually or collectively, cause the electronic device to perform operations, the operations comprising:

identifying, based on temperature information of an inside of a storage compartment being obtained, a temperature change rate of the inside of the storage compartment corresponding to a first time period that comprises the temperature information and a first time-point based on the first time-point at which the temperature information is obtained;

obtaining temperature prediction information of the inside of the storage compartment after the first time period by providing the identified temperature change rate to a temperature prediction model;

identifying whether a temperature change of the inside of the storage compartment after the first time period is greater than or equal to a pre-set value based on the obtained temperature prediction information; and

controlling, based on the temperature change of the inside of the storage compartment after the first time period being identified as greater than or equal to the pre-set value, a motor to drive a compressor at a pre-set revolutions per minute (RPM).

18. The medium of claim **17**, wherein the obtaining the temperature prediction information comprises obtaining the temperature prediction information of the inside of the storage compartment corresponding to a second time-point after the first time period by providing the identified temperature change rate to the temperature prediction model.

19. The medium of claim **17**, wherein the obtaining temperature prediction information comprises obtaining temperature change rate prediction information of the inside of the storage compartment corresponding to a second time period after the first time period by providing the identified temperature change rate to the temperature prediction model.

20. The medium of claim **17**, wherein the identifying whether the temperature change is greater than or equal to the pre-set value comprises identifying whether a temperature increase rate of the inside of the storage compartment corresponding to a pre-set time period is greater than or equal to the pre-set value based on the obtained temperature prediction information, and

wherein the controlling the motor comprises controlling, based on the temperature increase rate being identified as greater than or equal to the pre-set value, the motor to drive the compressor at the pre-set RPM.

* * * * *