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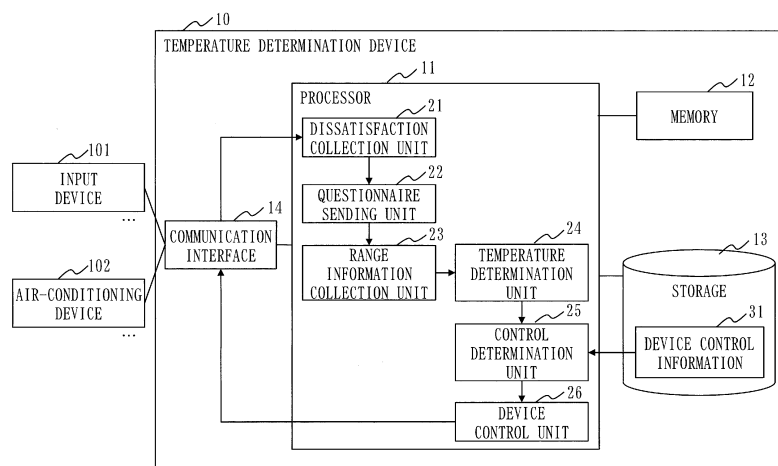
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(54) **TEMPERATURE DETERMINATION DEVICE, AIR CONDITIONING CONTROL SYSTEM, TEMPERATURE DETERMINATION METHOD, AND TEMPERATURE DETERMINATION PROGRAM**

(57) A questionnaire sending unit (22) sends a questionnaire on an allowable temperature range to each of a plurality of users who use an object space. A range information collection unit (23) collects range information indicating the allowable temperature range by collecting a response to the questionnaire from each of the plurality

of users who use the object space. A temperature determination unit (24) determines a set temperature of the object space on a basis of the range information concerning the plurality of users which is collected by the range information collection unit (23).

Fig. 2



Description**Technical Field**

[0001] The present disclosure relates to a technique of determining a set temperature in air-conditioning control.

Background Art

[0002] Different users find different temperatures comfortable. Therefore, in a space used by a plurality of users as in an office, it is not easy to determine an appropriate set temperature for an air conditioner.

[0003] Patent Literature 1 describes obtaining air temperature evaluations indicating "hot" or "cold" from users and changing a comfort zone according to the most frequently received temperature evaluation. In this manner, Patent Literature 1 attempts to realize air-conditioning control that provides a temperature that the users find comfortable.

Citation List**Patent Literature**

[0004] Patent Literature 1: JP 2020-180744 A

Summary of Invention**Technical Problem**

[0005] In Patent Literature 1, the users are asked whether they feel "hot" or "cold" only, and the comfort zone is changed based on the responses. If a comfort zone is determined as in Patent Literature 1, there is a risk that the temperature may be controlled excessively.

[0006] Specifically, if the users are asked whether they feel "hot" or "cold" only, they user respond "hot" if they prefer being much cooler, even if they feel comfortable sufficiently. Therefore, even if all users find the temperature comfortable, if there are many users who wish being cooler, the temperature will be lowered. As a result, some users may find the temperature cold and uncomfortable. In other words, the temperature will be lowered excessively, impairing comfort for some users.

[0007] An objective of the present disclosure is to make it possible to realize air-conditioning control that as many users as possible find comfortable or nearly comfortable.

Solution to Problem

[0008] A temperature determination device according to the present disclosure includes:

a range information collection unit to collect range information indicating an allowable temperature range from each of a plurality of users who use an object space; and

a temperature determination unit to determine a set temperature of the object space on a basis of the range information concerning the plurality of users which is collected by the range information collection unit.

Advantageous Effects of Invention

[0009] In the present disclosure, range information indicating allowable temperature ranges are collected from users, and a set temperature is determined on a basis of the allowable range information. By determining the set temperature on the basis of the allowable temperature range, it becomes possible to perform air-conditioning control that provides a state that many users find comfortable or nearly comfortable.

Brief Description of Drawings

[0010]

Fig. 1 is a configuration diagram of an air-conditioning control system 100 according to Embodiment 1. Fig. 2 is a configuration diagram of a temperature determination device 10 according to Embodiment 1.

Fig. 3 is a flowchart indicating a processing flow of the temperature determination device 10 according to Embodiment 1.

Fig. 4 is an explanatory diagram of a questionnaire according to Embodiment 1.

Fig. 5 is an explanatory diagram of responses to the questionnaire according to Embodiment 1.

Fig. 6 is an explanatory diagram of effects of Embodiment 1.

Fig. 7 is a configuration diagram of an air-conditioning control system 100 according to Modification 1.

Fig. 8 is a configuration diagram of a temperature determination device 10 according to Modification 2.

Fig. 9 is a flowchart illustrating a processing flow of a temperature determination device 10 according to Embodiment 2.

Fig. 10 is an explanatory diagram of responses to a questionnaire according to Embodiment 2.

Fig. 11 is an explanatory diagram of responses to a questionnaire according to Embodiment 3.

Fig. 12 is a configuration diagram of a temperature determination device 10 according to Embodiment 4.

Fig. 13 is a flowchart illustrating a processing flow of the temperature determination device 10 according to Embodiment 4.

Fig. 14 is a configuration diagram of a temperature determination device 10 according to Embodiment 5.

Description of Embodiments

[0011] Embodiment 1.

*** Description of Configuration ***

[0012] A configuration of an air-conditioning control system 100 according to Embodiment 1 will be described with referring to Fig. 1.

[0013] The air-conditioning control system 100 is provided with a temperature determination device 10, not less than one input device 101, and not less than one air-conditioning device 102. The temperature determination device 10 is connected to the input device 101 and the air-conditioning device 102 via a transmission line 103.

[0014] The temperature determination device 10 is a computer that determines a set temperature as a control target of an object space. The input device 101 is a terminal such as a PC used by a user. Note that PC stands for Personal Computer. The air-conditioning device 102 is a device that performs air conditioning of the object space. The object space is a space such as an office used by a plurality of users.

[0015] A configuration of the temperature determination device 10 according to Embodiment 1 will be described with referring to Fig. 2.

[0016] The temperature determination device 10 is provided with hardware devices which are a processor 11, a memory 12, a storage 13, and a communication interface 14. The processor 11 is connected to the other hardware devices via a signal line, and controls the other hardware devices.

[0017] The processor 11 is an IC that performs processing. Note that IC stands for Integrated Circuit. Specific examples of the processor 11 are a CPU, a DSP, and a GPU. Note that CPU stands for Central Processing Unit; DSP for Digital Signal Processor; and GPU for Graphics Processing Unit.

[0018] The memory 12 is a storage device that stores data temporarily. Specific examples of the memory 12 are an SRAM and a DRAM. Note that SRAM stands for Static Random-Access Memory; and DRAM for Dynamic Random-Access Memory.

[0019] The storage 13 is a storage device that keeps data. A specific example of the storage 13 is an HDD. Note that HDD stands for Hard Disk Drive. The storage 13 may be a portable recording medium such as an SD (registered trademark) memory card, a CompactFlash (registered trademark), a NAND flash, a flexible disk, an optical disk, a compact disk, a Blu-ray (registered trademark) disc, and a DVD. Note that SD stands for Secure Digital; and DVD for Digital Versatile Disk.

[0020] The communication interface 14 is an interface to communicate with an external device. Specific examples of the communication interface 14 are an Ethernet (registered trademark) port, a USB port, and an HDMI (registered trademark) port. Note that USB stands for Universal Serial Bus; and HDMI for High-Definition Multi-

media Interface.

[0021] The temperature determination device 10 is connected to the input device 101 and the air-conditioning device 102 via the communication interface 14.

5 [0022] The temperature determination device 10 is provided with a dissatisfaction collection unit 21, a questionnaire sending unit 22, a range information collection unit 23, a temperature determination unit 24, a control determination unit 25, and a device control unit 26, as function constituent elements. Functions of the individual function constituent elements of the temperature determination device 10 are implemented by software.

10 [0023] The storage 13 stores a program that implements the functions of the individual function constituent elements of the temperature determination device 10. This program is read to the memory 12 by the processor 11 and run by the processor 11. The functions of the individual function constituent elements of the temperature determination device 10 are thus implemented.

15 [0024] The storage 13 stores device control information 31.

20 [0025] The number of processors 11 illustrated in Fig. 2 is only one. However, there may be a plurality of processors 11. The plurality of processors 11 may cooperate with each other to run programs that implement the individual functions.

*** Description of Operations ***

30 [0026] Operations of the temperature determination device 10 according to Embodiment 1 will be described with referring to Figs. 3 to 5.

35 [0027] An operation procedure of the temperature determination device 10 according to Embodiment 1 corresponds to a temperature determination method according to Embodiment 1. A program that implements the operations of the temperature determination device 10 according to Embodiment 1 corresponds to a temperature determination program according to Embodiment 1.

40 [0028] A processing flow of the temperature determination device 10 according to Embodiment 1 will be described with referring to Fig. 3.

(Step S11: Dissatisfaction Collection Process)

45 [0029] The dissatisfaction collection unit 21 decides whether or not any one of the plurality of users who use the object space expresses dissatisfaction about a temperature of an object space.

50 [0030] Specifically, if a user feels dissatisfaction with the temperature of the object space, he or she expresses the dissatisfaction with the input device 101. For example, the user expresses dissatisfaction by, for example, depressing a button to express dissatisfaction. If some user expresses dissatisfaction, the dissatisfaction collection unit 21 advances processing to step S12. On the other hand, if no user expresses dissatisfaction, the dissatisfaction collection unit 21 executes a process of

step S11 again at a lapse of a predetermined period of time.

(Step S12: Questionnaire Sending Process)

[0031] The questionnaire sending unit 22 sends a questionnaire concerning an allowable temperature range to each of the plurality of users existing in the object space.

[0032] Specifically, the questionnaire sending unit 22 sends the questionnaire concerning the allowable temperature range to the input device 101 which is used by each of the plurality of users existing in the object space.

[0033] Here, the questionnaire sending unit 22 sends a questionnaire asking a satisfaction level of a case where the temperature is changed by a predetermined temperature from a present temperature as a standard, as illustrated in Fig. 4. Assume that in the questionnaire of Fig. 4, a range of 0 (cannot state clearly) to 3 (very satisfied) represents allowable temperatures.

[0034] For example, assume that a certain user selects: -2 for lowering by 3 degrees; -1 for lowering by 2 degrees; 0 for lowering by 1 degree; 1 for maintaining the present temperature; 2 for raising by 1 degree; 3 for raising by 2 degrees; and 2 for raising by 3 degrees. In this case, lowering by 1 degree to raising by 3 degrees form an allowable temperature range.

[0035] The questionnaire to be sent by the questionnaire sending unit 22 is not limited to one having the format illustrated in Fig. 4. The questionnaire may have another format as far as range information indicating an allowable temperature range can be collected. For example, the questionnaire may have a format for asking a range of from what degree to what degree is allowable.

(Step S13: Range Information Collection Process)

[0036] The range information collection unit 23 collects responses to the questionnaire sent in step S12 from each of the plurality of users who use the object space. By doing this, the range information collection unit 23 collects range information indicating the allowable temperature range from each of the plurality of users who use the object space.

(Step S14: Temperature Determination Process)

[0037] The temperature determination unit 24 determines a set temperature of the object space on a basis of the range information concerning the plurality of users which is collected in step S13.

[0038] In Embodiment 1, the temperature determination unit 24 determines a temperature allowable to many users, as the set temperature. Specifically, the temperature determination unit 24 determines a temperature frequently rated at a satisfaction level not smaller than a standard value (here, 0) among a plurality of temperatures, as the set temperature.

[0039] For example, assume that responses to the questionnaire are obtained as illustrated in Fig. 5. In this case, a maximum number of allowing users is 3 for lowering by 1 degree. Therefore, the temperature determination unit 24 determines a temperature that is 1 degree lower than the present temperature, as the set temperature.

(Step S15: Control Determination Process)

[0040] The control determination unit 25 refers to the device control information 31 to determine a control method that matches the set temperature determined in step S14. The device control information 31 shows control methods that match the set temperatures, heat loads of the object space, operation statuses of the air-conditioning device 102, and so on.

(Step S16: Device Control Process)

[0041] The device control unit 26 controls the air-conditioning device 102 in accordance with the control method determined in step S15. Specifically, the device control unit 26 controls the air-conditioning device 102 by sending to the air-conditioning device 102 a control command according to the control method.

*** Effect of Embodiment 1 ***

[0042] As described above, the temperature determination device 10 according to Embodiment 1 collects range information indicating allowable temperature ranges from the users, and determines a temperature allowable to many users, as the set temperature. As a result, it is possible to perform air-conditioning control with which few users feel dissatisfaction and many users feel comfortable.

[0043] There is a case where the set temperature is determined using PMV being an index expressing comfort. Note that PMV stands for Predicted Mean Vote. It is evaluated that the closer to 0 the value of PMV, the higher the comfort, and the higher the satisfaction level. Hence, in this case, the set temperature is determined such that PMV is close to 0. PMV is essentially a value calculated from a plurality of elements. However, Fig. 6 employs a simplified expression so that only a relationship between PMV and the set temperature is focused. Assume an environment as illustrated by (A) where PMV is 0.08 when the set temperature is 25°C. In this case, based on PMV, since the value of PMV is a value very close to 0, a set temperature of 25°C is allowed as providing a good state. However, even when the set temperature is 25°C, one person out of 5 feels dissatisfaction because for this person the allowable temperature range is 22°C to 24°C.

[0044] In contrast to this, as illustrated by (B) of Fig. 6, with the method according to Embodiment 1, the set temperature is determined at 24°C. Then, this is a state with which all of 5 people feel no dissatisfaction, although

the satisfaction level may be degraded to some people. In fine, it is possible to perform air-conditioning control with which few users feel dissatisfaction and many users feel comfortable.

*** Other Configurations ***

< Modification 1 >

[0045] In Embodiment 1, the temperature determination device 10 is internally provided with a control function for the air-conditioning device 102. The control function for the air-conditioning device 102 consists of functions of the control determination unit 25 and device control unit 26, and the device control information 31. Alternatively, the control function for the air-conditioning device 102 may be provided to a device other than the temperature determination device 10.

[0046] That is, as illustrated in Fig. 7, an air-conditioning control system 100 may be constituted to include: a temperature determination device 10 with a function from which a control function for the air-conditioning device 102 is excluded; a control device 50 with a control function for the air-conditioning device 102; not less than one input device 101; and not less than one air-conditioning device 102.

< Modification 2 >

[0047] In Embodiment 1, the individual function constituent elements are implemented by software. Alternatively, Modification 2 may be possible in which the individual function constituent elements are implemented by hardware. Modification 2 will be described regarding its differences from Embodiment 1.

[0048] A configuration of a temperature determination device 10 according to Modification 2 will be described with referring to Fig. 8.

[0049] In a case where the individual function constituent elements are implemented by hardware, the temperature determination device 10 is provided with an electronic circuit 15 in place of the processor 11, the memory 12, and the storage 13. The electronic circuit 15 is a dedicated circuit that implements the functions of the individual function constituent elements, the function of the memory 12, and the function of the storage 13.

[0050] The electronic circuit 15 may be a single circuit, a composite circuit, a programmed processor, a parallel-programmed processor, a logic IC, a GA, an ASIC, and an FPGA. Note that: GA stands for Gate Array; ASIC for Application Specific Integrated Circuit; and FPGA for Field-Programmable Gate Array.

[0051] The individual function constituent elements may be implemented by one electronic circuit 15. The individual function constituent elements may be implemented by a plurality of electronic circuits 15 by decentralization.

< Modification 3 >

[0052] Modification 3 may be possible in which some of the individual function constituent elements are implemented by hardware and the remaining individual function constituent elements are implemented by software.

[0053] The processor 11, the memory 12, the storage 13, and the electronic circuit 15 are referred to as processing circuitry. That is, the functions of the individual function constituent elements are implemented by processing circuitry.

[0054] Embodiment 2.

[0055] Embodiment 2 is different from Embodiment 1 in a set temperature determination method. In Embodiment 2, this difference will be explained, and explanation on the same point will be omitted.

*** Description of Operations ***

[0056] A processing flow of a temperature determination device 10 according to Embodiment 2 will be described with referring to Fig. 9.

[0057] Processes of step S21 to step S23 are the same as the processes of step S11 to step S13 of Fig. 3. Processes of step S25 to step S26 are the same as the processes of step S15 to step S16 of Fig. 3.

[0058] In Embodiment 2, a questionnaire to be sent in step S22 has a format for asking a satisfaction level with each of a plurality of temperatures, as indicated in Fig. 4.

(Step S24: Temperature Determination Process)

[0059] A temperature determination unit 24 determines a set temperature of an object space on a basis of the range information concerning a plurality of users collected in step S23.

[0060] In Embodiment 2, the temperature determination unit 24 determines a temperature deviating from an allowable temperature range by a small amount, as the set temperature. Specifically, the temperature determination unit 24 determines a temperature providing a high satisfaction level among lowest marks of the plurality of temperatures, as the set temperature.

[0061] For example, assume that responses to the questionnaire are obtained as illustrated in Fig. 10. In this case, a lowest mark of -0.3 obtained when lowering by 1 degree is of the highest level. Therefore, the temperature determination unit 24 determines a temperature that is 1 degree lower than the present temperature, as the set temperature.

*** Effect of Embodiment 2 ***

[0062] As described above, the temperature determination device 10 according to Embodiment 2 collects the range information indicating allowable temperature ranges from the users, and determines a temperature deviating from the allowable temperature range by a

small amount, as the set temperature. As a result, it is possible to perform air-conditioning control that provides a state with which major dissatisfaction is few. In fine, it is possible to perform air-conditioning control that many users find comfortable or nearly comfortable.

Embodiment 3.

[0063] Embodiment 3 is different from Embodiments 1 and 2 in that it employs the set temperature determination methods described in Embodiments 1 and 2 by combination. In Embodiment 3, this difference will be explained, and explanation on the same point will be omitted.

*** Description of Operations ***

[0064] The temperature determination process (step S14 of Fig. 3, step S24 of Fig. 9) is different from its counterpart in Embodiment 1 or 2.

[0065] With the set temperature determination method described in Embodiment 1 or Embodiment 2, there is a possibility that the set temperatures cannot be narrowed down to one temperature.

[0066] For example, assume that the set temperature determination method described in Embodiment 1 is to be employed. At this time, assume that questionnaire responses are obtained as illustrated in Fig. 11. In this case, the maximum number of allowing users is 3 for both lowering the temperature by 1 degree and raising the temperature by 1 degree. Therefore, the set temperatures cannot be narrowed down to one temperature.

[0067] In such a case, according to Embodiment 3, the set temperature determination method described in Embodiment 2 is employed, and the temperatures narrowed down by the set temperature determination method described in Embodiment 1 are narrowed down furthermore. That is, in the above-mentioned example, between two settings of lowering by 1 degree and raising by 1 degree, the choices are narrowed down to a setting where a lowest mark is of a higher satisfaction level. As a result, the choices are narrowed down to the setting of lowering by 1 degree, where a lowest mark is of a higher satisfaction level. Hence, the temperature determination unit 24 determines a temperature that is 1 degree lower than the present temperature, as the set temperature.

[0068] There may be a case where the set temperature cannot be determined to one temperature even when narrowing down is performed with the set temperature determination method described in Embodiment 2. In this case, the temperature determination unit 24 may determine one temperature as the set temperature by an arbitrary method from among a plurality of narrowed-down temperatures.

[0069] So far, the temperatures are narrowed down by the set temperature determination method described in Embodiment 1, and then further narrowed down by the set temperature determination method described in Em-

bodiment 2. Conversely, the temperatures may be narrowed down by the set temperature determination method described in Embodiment 2, and then further narrowed down by the set temperature determination method described in Embodiment 1.

*** Effect of Embodiment 3 ***

[0070] As described above, a temperature determination device 10 according to Embodiment 3 employs the set temperature determination methods described in Embodiments 1 and 2 by combination. Therefore, it is possible to determine a set temperature even in a case where the set temperature cannot be determined with the set temperature determination method described in Embodiment 1 or Embodiment 2.

*** Other Configurations ***

< Modification 4 >

[0071] The set temperature may be determined between two temperatures, that is, the temperature determined by the set temperature determination method described in Embodiment 1 and the temperature determined by the set temperature determination method described in Embodiment 2.

[0072] For example, suppose that one set temperature is determined by the set temperature determination method described in Embodiment 1. Also, one set temperature is determined by the set temperature determination method described in Embodiment 2. In this case, a temperature determination unit 24 may take a temperature between the set temperatures determined by the individual determination methods, or the like, as the set temperature. Specifically, the temperature determination unit 24 may take a mean value of the set temperatures determined by the individual determination methods, as the set temperature.

Embodiment 4.

[0073] Embodiment 4 is different from Embodiments 1 to 3 in that when, for example, sufficient responses to a questionnaire cannot be obtained, a set temperature is determined in accordance with responses obtained in the past. In Embodiment 4, this difference will be explained, and explanation on the same point will be omitted.

[0074] In Embodiment 4, a case wherein a function is added to Embodiment 1 will be explained. It is also possible to add a function to Embodiment 2 or 3.

*** Description of Configuration ***

[0075] A configuration of a temperature determination device 10 according to Embodiment 4 will be described with referring to Fig. 12.

[0076] The temperature determination device 10 is

different from the temperature determination device 10 illustrated in Fig. 2 in that past range information 32 is accumulated in a storage 13. The past range information 32 consists of responses obtained in the past. That is, the past range information 32 is range information collected in the past by a range information collection unit 23.

*** Description of Operations ***

[0077] A processing flow of the temperature determination device 10 according to Embodiment 4 will be described with referring to Fig. 13.

[0078] Processes of step S31 to step S33 are the same as the processes of step S11 to step S12 of Fig. 3. The process of step S35 is the same as the process of step S14 of Fig. 3. Processes of step S37 to step S38 are the same as the processes of step S15 to step S16 of Fig. 3.

[0079] Note that in step S33, the collected range information is accumulated in the storage 13 as the past range information 32.

(Step S34: Response Decision Process)

[0080] A temperature determination unit 24 decides whether not less than a lower limit number of responses are obtained or not in step S33. The lower limit number is a value determined in advance.

[0081] If not less than the lower limit number of responses are obtained, the temperature determination unit 24 advances the processing to step S35. If only less than the lower limit number of responses are obtained, the temperature determination unit 24 advances the processing to step S36.

(Step S36: Second Temperature Determination Process)

[0082] The temperature determination unit 24 determines a set temperature of an object space on a basis of the past range information 32 accumulated in the storage 13.

[0083] Here, the temperature determination unit 24 determines the set temperature by the same method as that in Embodiment 1. Hence, the temperature determination unit 24 determines, from the past range information 32, a temperature allowable to many users, as the set temperature. Specifically, the temperature determination unit 24 determines a temperature frequently providing a satisfaction level not smaller than a standard value (here, 0) among a plurality of temperatures, as the set temperature.

[0084] When a function is to be added to Embodiment 2 or 3, the temperature determination unit 24 employs the set temperature determination method described described in Embodiment 2 or 3 in place of the set temperature determination method described in Embodiment 1.

*** Effect of Embodiment 4 ***

[0085] As described above, when, for example, sufficient responses to the questionnaire cannot be obtained, the temperature determination device 10 according to Embodiment 4 determines the set temperature in accordance with responses obtained in the past. Hence, it is possible to prevent a situation where comfort to only some users having responded to the questionnaire is maintained and comfort to many users not having responded to the questionnaire is impaired.

*** Other Configurations ***

< Modification 5 >

[0086] In a case where a number of users existing in the object space can be grasped, the lower limit number may be a value obtained by multiplying the number of users by a coefficient. The coefficient is a value larger than 0 and not larger than 1. For example, the coefficient is 0.3, and the lower limit value is a value obtained by multiplying the number of users by 0.3.

[0087] The number of users existing in the object space can be identified by cooperation with an entrance and exit management system which manages entrance to and exit from the object space. Also, the number of users existing in the object space can be identified from image data obtained by photographing the object space with a camera. The number of users existing in the object space may be identified by any other method.

Embodiment 5.

[0088] Embodiment 5 is different from Embodiment 4 in that an attribute of a user existing in the object space is taken into consideration. In Embodiment 5, this difference will be explained, and explanation on the same point will be omitted.

*** Description of Configuration ***

[0089] A configuration of a temperature determination device 10 according to Embodiment 5 will be described with referring to Fig. 14.

[0090] The temperature determination device 10 is different from the temperature determination device 10 illustrated in Fig. 12 in that it is provided with a user management unit 27 and an attribute information acquisition unit 28 as function constituent elements.

*** Description of Operations ***

[0091] An operation flow of the temperature determination device 10 according to Embodiment 5 will be described with referring to Fig. 13.

[0092] Embodiment 5 is the same as Embodiment 4 except processes of step S33 and step S36.

(Step S33: Range Information Collection Process)

[0093] A range information collection unit 23 collects range information from each of a plurality of users who use the object space. The range information collection unit 23 accumulates the collected range information in a storage 13 as past range information 32.

[0094] At this time, the user management unit 27 identifies a user existing in the object space. For example, the user management unit 27 identifies the user existing in the object space by cooperation with an entrance and exist management system which manages entrance to and exit from the object space. The attribute information acquisition unit 28 acquires an attribute of the user identified by the user management unit 27. For example, the attribute information acquisition unit 28 acquires the attribute of the user existing in the object space from a system such as a personnel system which manages user attributes. The user attributes are, for example, sex, age, and so on. The attribute information acquisition unit 28 may identify user closing as an attribute from image data obtained by photographing the object space with a camera.

[0095] The range information collection unit 23 stores the past range information 32 by associating it with the attribute information of each user. The range information collection unit 23 may also store other information such as date and time by associating it with the past range information 32.

(Step S36: Second Temperature Determination Process)

[0096] A temperature determination unit 24 determines the set temperature of the object space on a basis of the past range information 32 accumulated in the storage 13. At this time, the temperature determination unit 24 determines the set temperature of the object space by utilizing the attribute acquired in step S33 of the user currently existing in the object space.

[0097] Specifically, the temperature determination unit 24 identifies past range information 32 associated with a user attribute similar to the attribute of the user currently existing in the object space. The temperature determination unit 24 determines the set temperature of the object space on a basis of the identified past range information 32. For example, the temperature determination unit 24 calculates a similarity level between the attribute of the user currently existing in the object space and the user attribute associated with individual past range information 32. The temperature determination unit 24 determines the set temperature of the object space on a basis of the past range information 32 having a similarity level not less than a threshold value. At this time, the temperature determination unit 24 may also take into consideration a similarity level of other information such as date and time, in addition to the user attribute.

[0098] The temperature determination unit 24 may

acquire range information corresponding to the attribute of the user currently existing in the object space, with using an inference model that takes the user attribute as input and outputs range information. Then, the temperature determination unit 24 may determine the set temperature of the object space on a basis of the acquired range information.

[0099] The inference model is generated by machine learning of a set of the past range information 32 accumulated in the storage 13 and the user attribute, as learning data. The inference model is a model formed by using, for example, a neural network.

*** Effect of Embodiment 5 ***

[0100] As described above, when, for example, sufficient responses to the questionnaire cannot be obtained, the temperature determination device 10 according to Embodiment 5 determines the set temperature with taking into consideration the attribute of the user existing in the object space. Hence, it is possible to determine an appropriate set temperature even when responses to the questionnaire cannot be obtained.

[0101] For example, a set temperature in an initial state before the questionnaire is sent may be determined by the method of the second temperature determination process described in Embodiment 5.

[0102] The word "unit" in the above description may be replaced with "circuit", "stage", "procedure", "process", or "processing circuitry".

[0103] The embodiments and modifications of the present disclosure have been described so far. Of these embodiments and modifications, several ones may be practiced in combination. One or several ones of these embodiments and modifications may be practiced partly. The present disclosure is not limited to the above embodiments and modifications and can be changed in various manners as necessary.

Reference Signs List

[0104] 10: temperature determination device; 11: processor; 12: memory; 13: storage; 14: communication interface; 15: electronic circuit; 21: dissatisfaction collection unit; 22: questionnaire sending unit; 23: range information collection unit; 24: temperature determination unit; 25: control determination unit; 26: device control unit; 27: user management unit; 28: attribute information acquisition unit; 31: device control information; 32: past range information; 50: control device; 100: air-conditioning control system; 101: input device; 102: air-conditioning device; 103: transmission line.

Claims

1. A temperature determination device comprising:

- a range information collection unit to collect range information indicating an allowable temperature range from each of a plurality of users who use an object space; and
a temperature determination unit to determine a set temperature of the object space on a basis of the range information concerning the plurality of users which is collected by the range information collection unit.
2. The temperature determination device according to claim 1,
wherein the temperature determination unit determines a temperature allowable to many users, as the set temperature.
 3. The temperature determination device according to claim 2,

wherein the range information indicates a satisfaction level with each of a plurality of temperatures, and
wherein the temperature determination unit determines a temperature frequently providing a satisfaction level not smaller than a standard value among the plurality of temperatures, as the set temperature.
 4. The temperature determination device according to claim 1,
wherein the temperature determination unit determines a temperature deviating from an allowable temperature range by a small amount, as the set temperature.
 5. The temperature determination device according to claim 4,

wherein the range information indicates a satisfaction level with each of a plurality of temperatures, and
wherein the temperature determination unit determines a temperature providing a high satisfaction level among lowest marks of the plurality of temperatures, as the set temperature.
 6. The temperature determination device according to claim 1,
wherein the temperature determination unit determines a temperature deviating from the allowable temperature range by a small amount among a plurality of temperatures allowable to many users, as the set temperature.
 7. The temperature determination device according to claim 1,
wherein the temperature determination unit determines a temperature allowable to many users
- among a plurality of temperatures deviating from the allowable temperature range by a small amount, as the set temperature.
8. The temperature determination device according to any one of claims 1 to 7,
wherein if a number of pieces of range information collected by the range information collection unit is less than a lower limit number, the temperature determination unit determines the set temperature on a basis of the range information collected in the past.
 9. The temperature determination device according to any one of claims 1 to 8,
wherein if a number of pieces of range information collected by the range information collection unit is less than a lower limit number, the temperature determination unit determines the set temperature on a basis of an attribute of a user existing in the object space.
 10. The temperature determination device according to any one of claims 1 to 9, further comprising
a device control unit to control an air-conditioning device which air-conditions the object space on a basis of the set temperature determined by the temperature determination unit.
 11. An air-conditioning control system comprising a temperature determination device and an air-conditioning device which air-conditions an object space, the temperature determination device comprising:

a range information collection unit to collect range information indicating an allowable temperature range from each of a plurality of users who use an object space; and
a temperature determination unit to determine a set temperature of the object space on a basis of the range information concerning the plurality of users which is collected by the range information collection unit,
wherein the air-conditioning device is controlled on a basis of the set temperature determined by the temperature determination unit.
 12. A temperature determination method comprising:

by a computer, collecting range information indicating an allowable temperature range from each of a plurality of users who use an object space; and
by the computer, determining a set temperature of the object space on a basis of the range information concerning the plurality of users.
 13. A temperature determination program which causes

a computer to function as a temperature determination device that performs:

a range information collection process of collecting range information indicating an allowable temperature range from each of a plurality of users who use an object space; and
a temperature determination process of determining a set temperature of the object space on a basis of the range information concerning the plurality of users which is collected by the range information collection process.

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Fig. 1

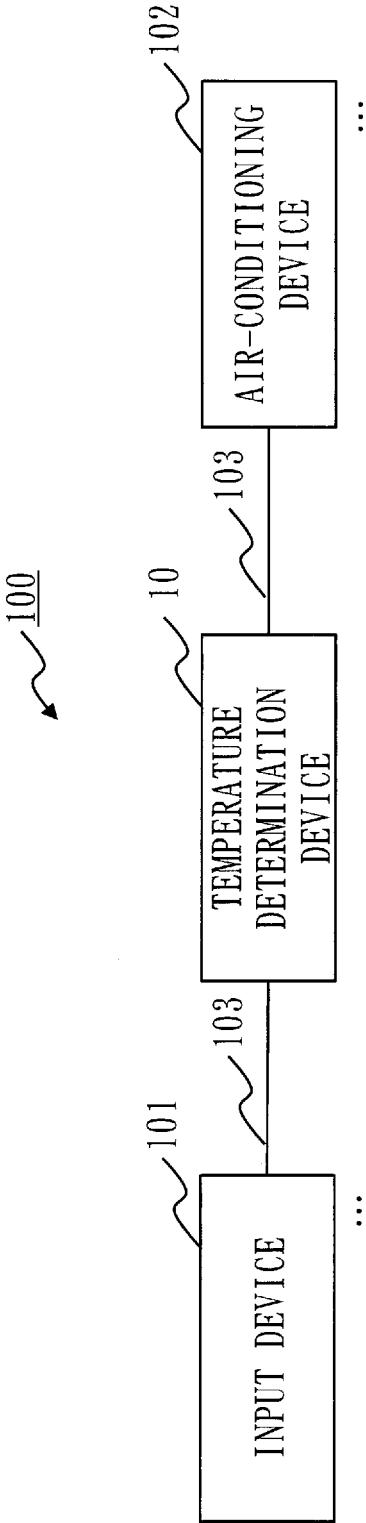


Fig. 2

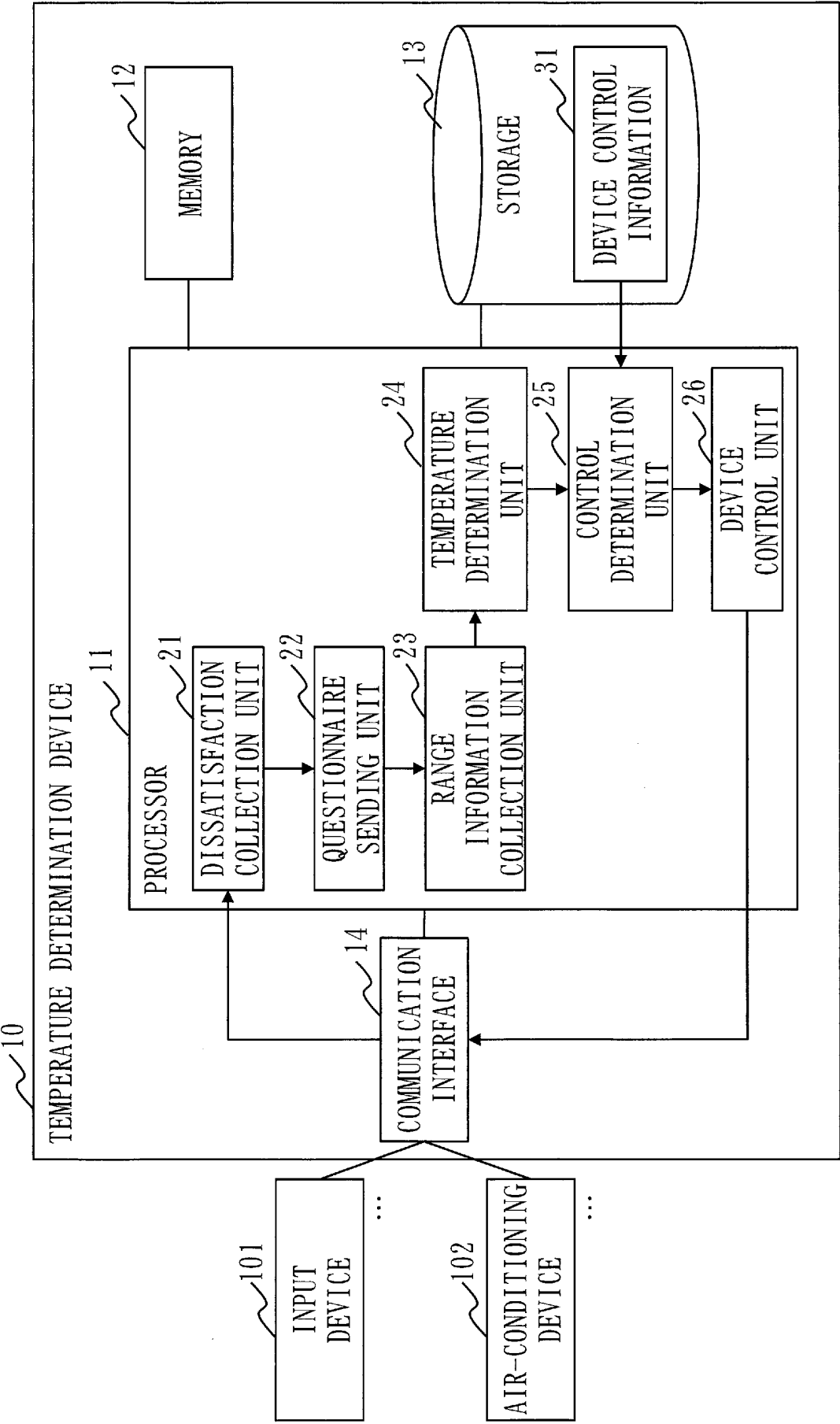


Fig. 3

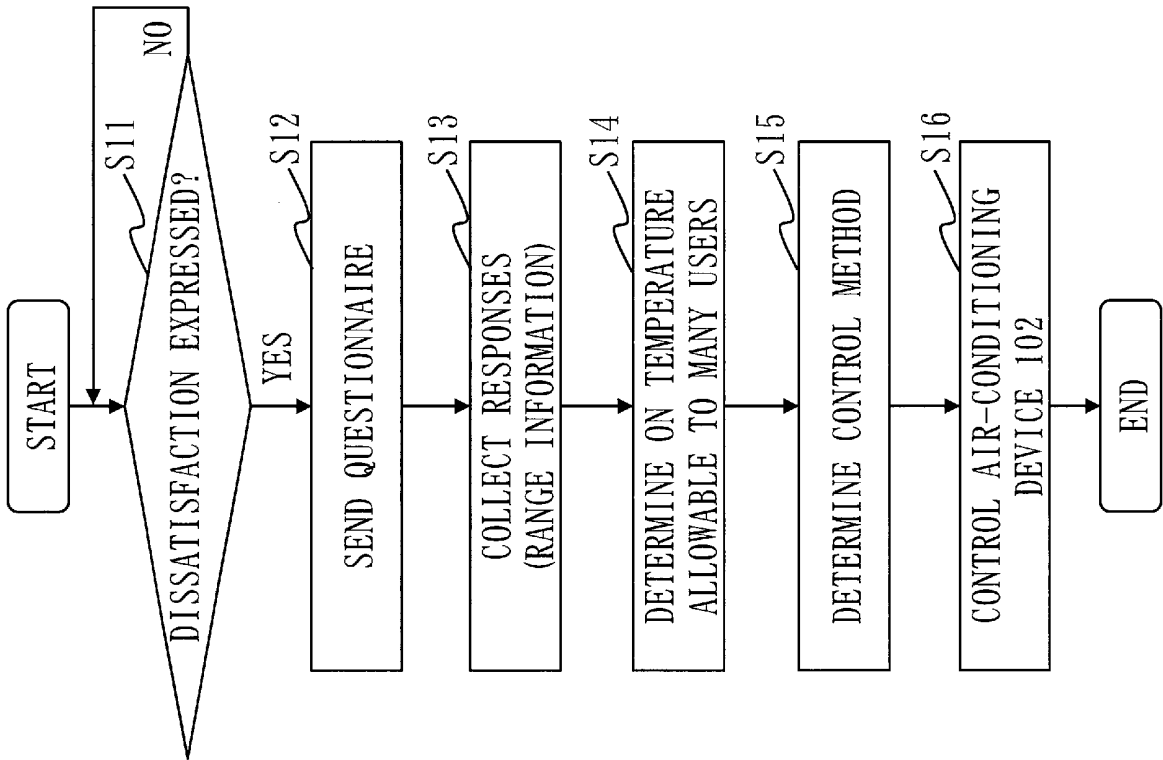


Fig. 4

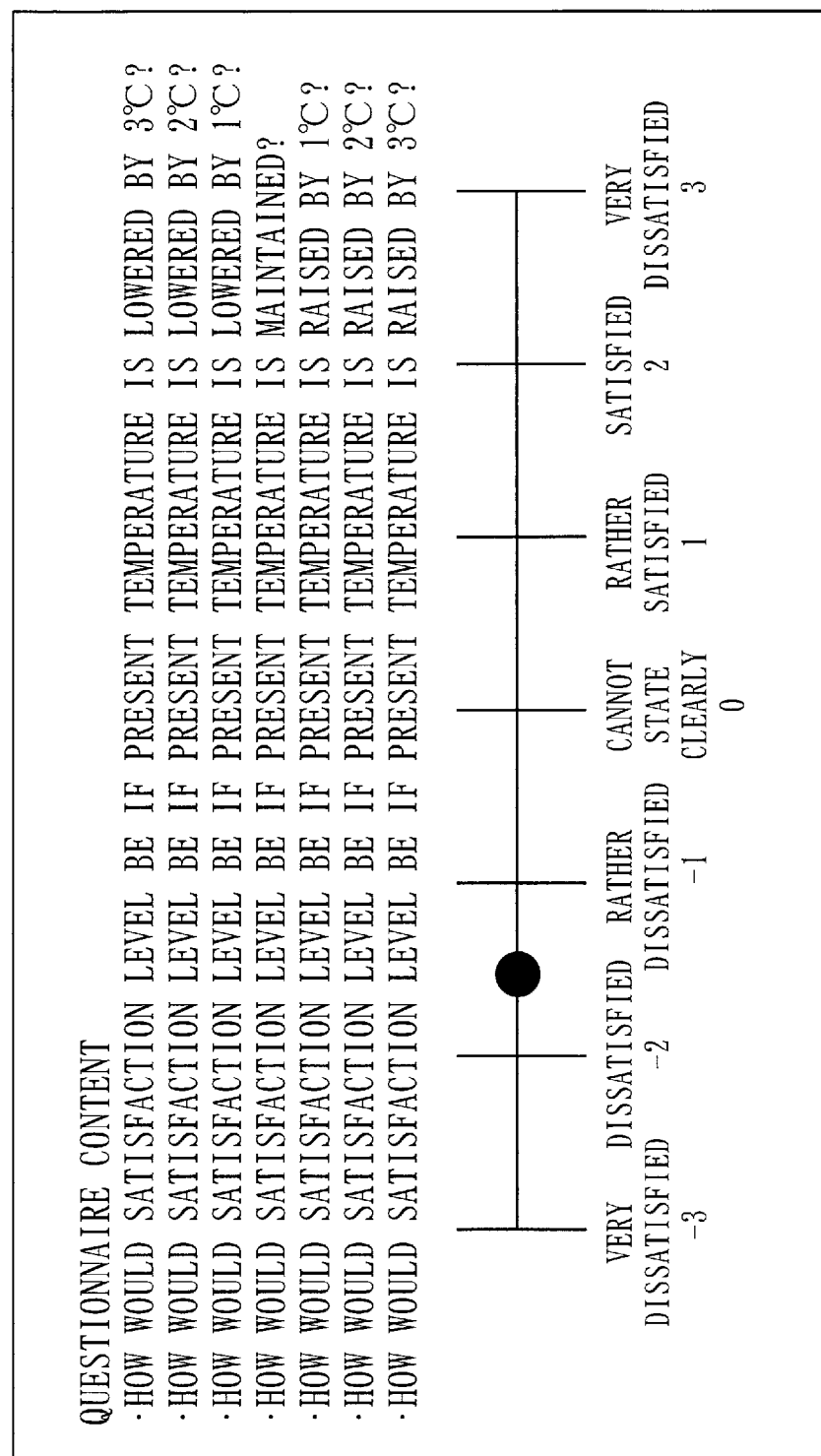


Fig. 5

	• • •	LOWER BY 1°C	NO CHANGE	RAISE BY 1°C	• • •
USER A	• • •	2.6	0.8	-3	• • •
USER B	• • •	1.2	-0.8	2	• • •
USER C	• • •	-0.3	-0.5	-2.7	• • •
USER D	• • •	1.5	0.7	-2.4	• • •
NUMBER OF ALLOWING USERS	• • •	3	2	1	• • •

Fig. 6

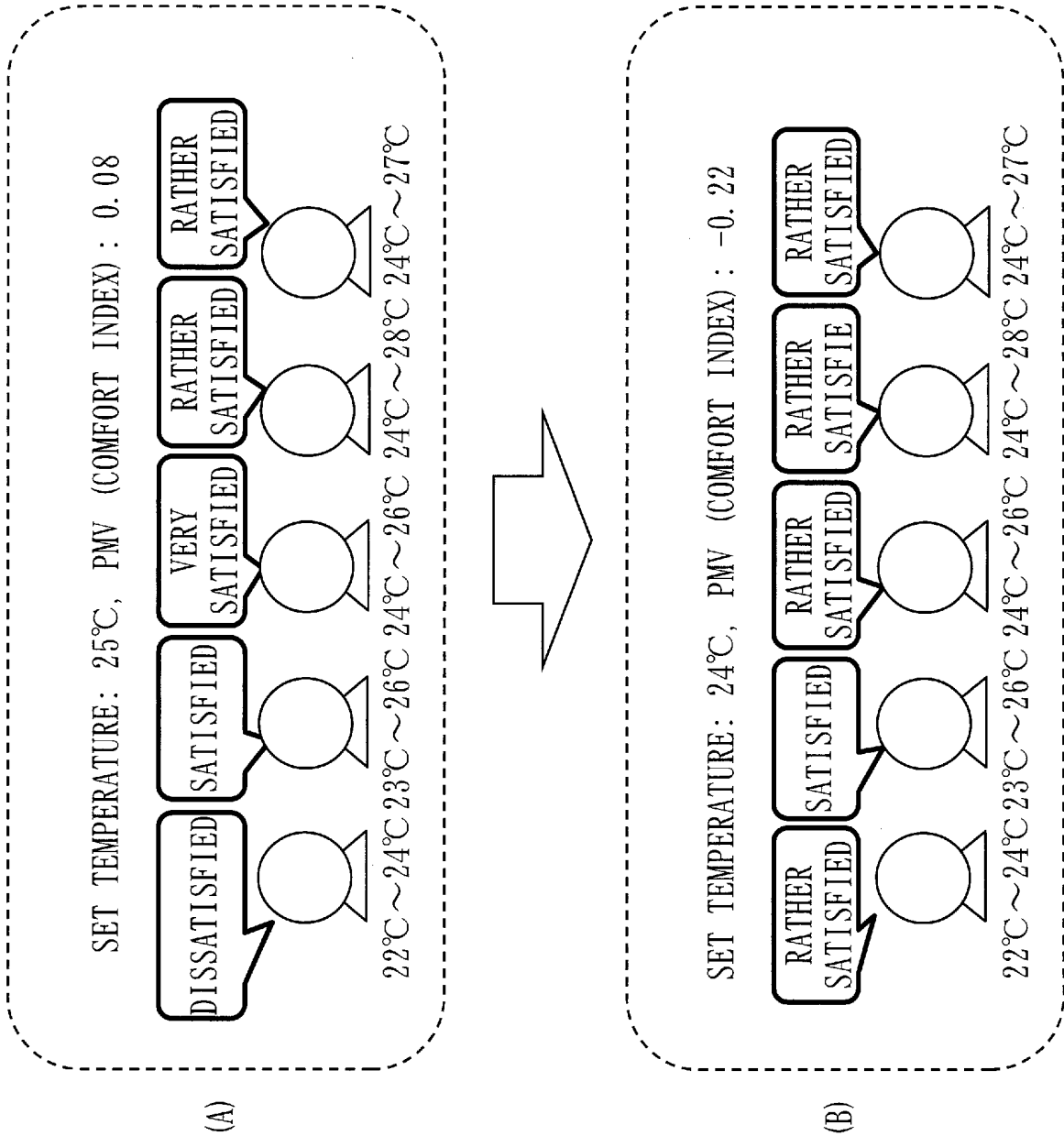


Fig. 7

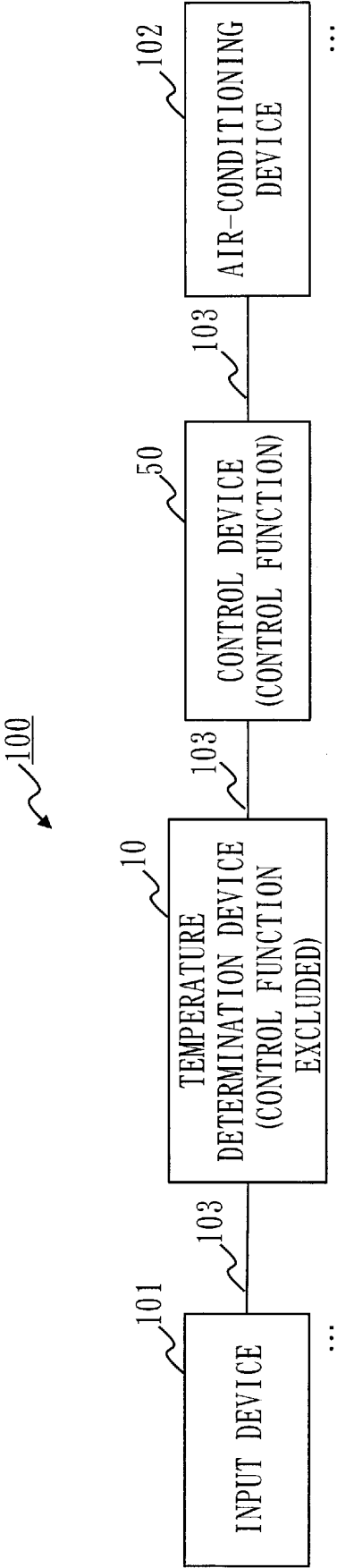


Fig. 8

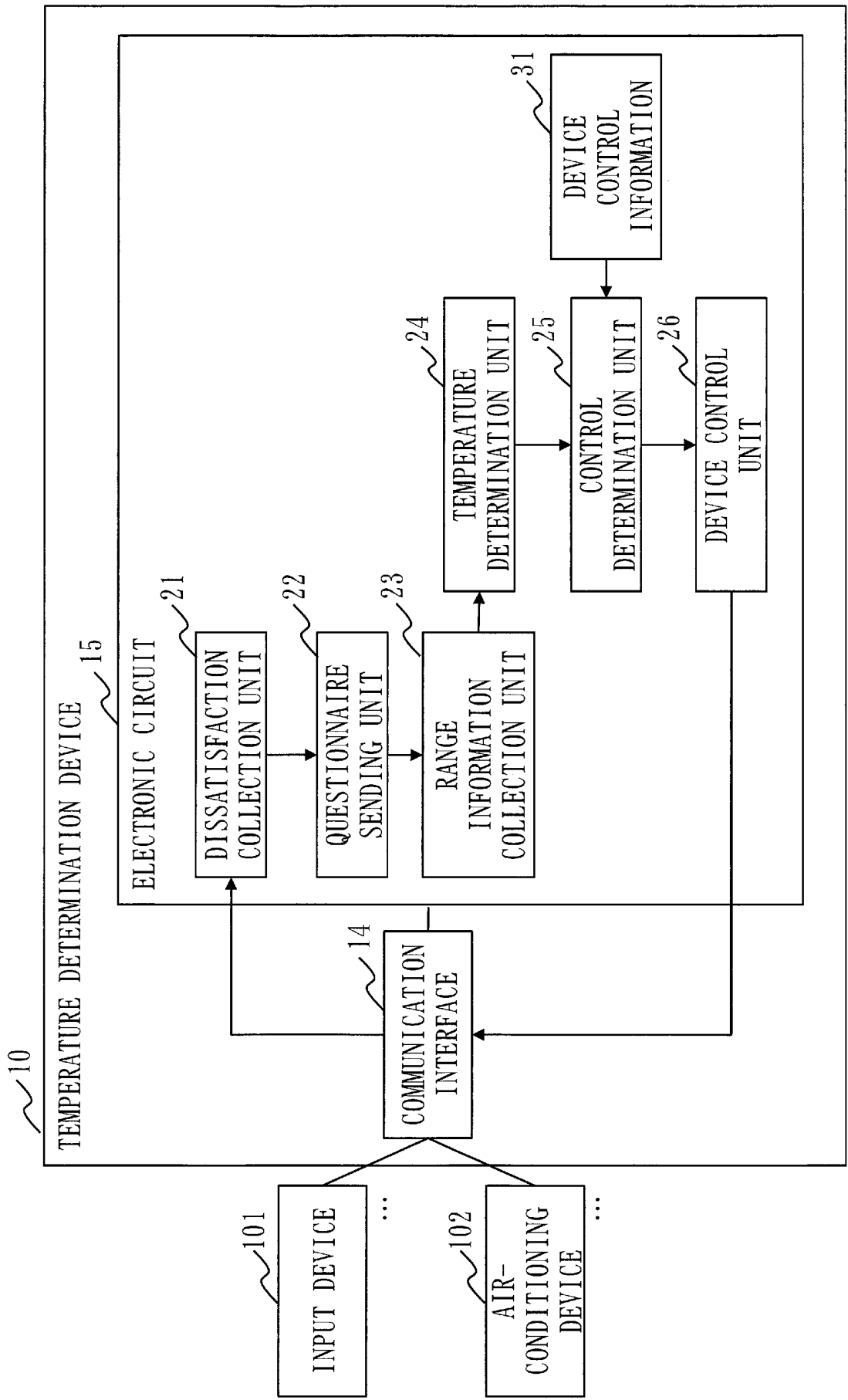


Fig. 9

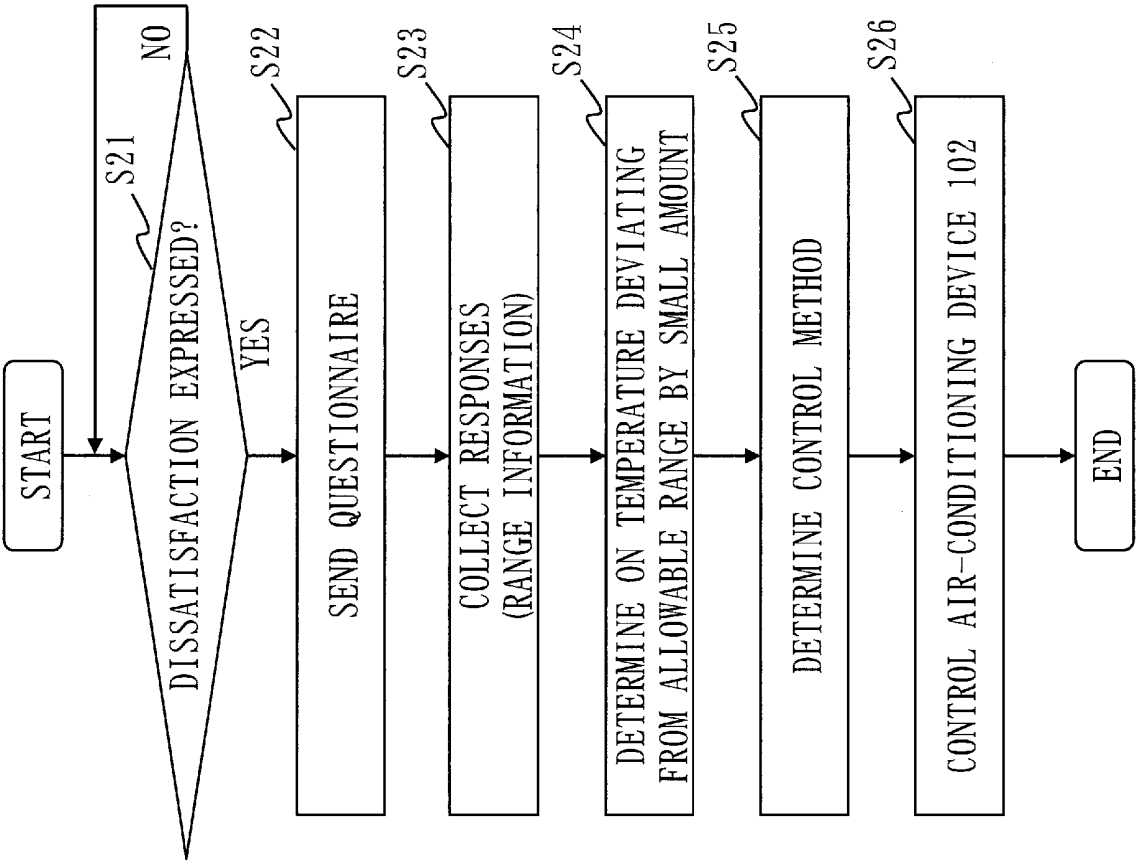


Fig. 10

	• • •	LOWER BY 1°C	NO CHANGE	RAISE BY 1°C	• • •
USER A	• • •	2.6	0.8	-3	• • •
USER B	• • •	1.2	-0.8	2	• • •
USER C	• • •	-0.3	-0.5	-2.7	• • •
USER D	• • •	1.5	0.7	-2.4	• • •
LOWEST MARK	• • •	-0.3	-0.8	-3	• • •

Fig. 11

	• • •	LOWER BY 1°C	NO CHANGE	RAISE BY 1°C	• • •
USER A	• • •	2.6	0.8	0.2	• • •
USER B	• • •	1.2	-0.8	2	• • •
USER C	• • •	-0.3	-0.5	-1.7	• • •
USER D	• • •	1.5	0.7	0	• • •
NUMBER OF ALLOWING USERS	• • •	3	2	3	• • •
LOWEST MARK	• • •	-0.3	-0.8	-1.7	• • •

Fig. 12

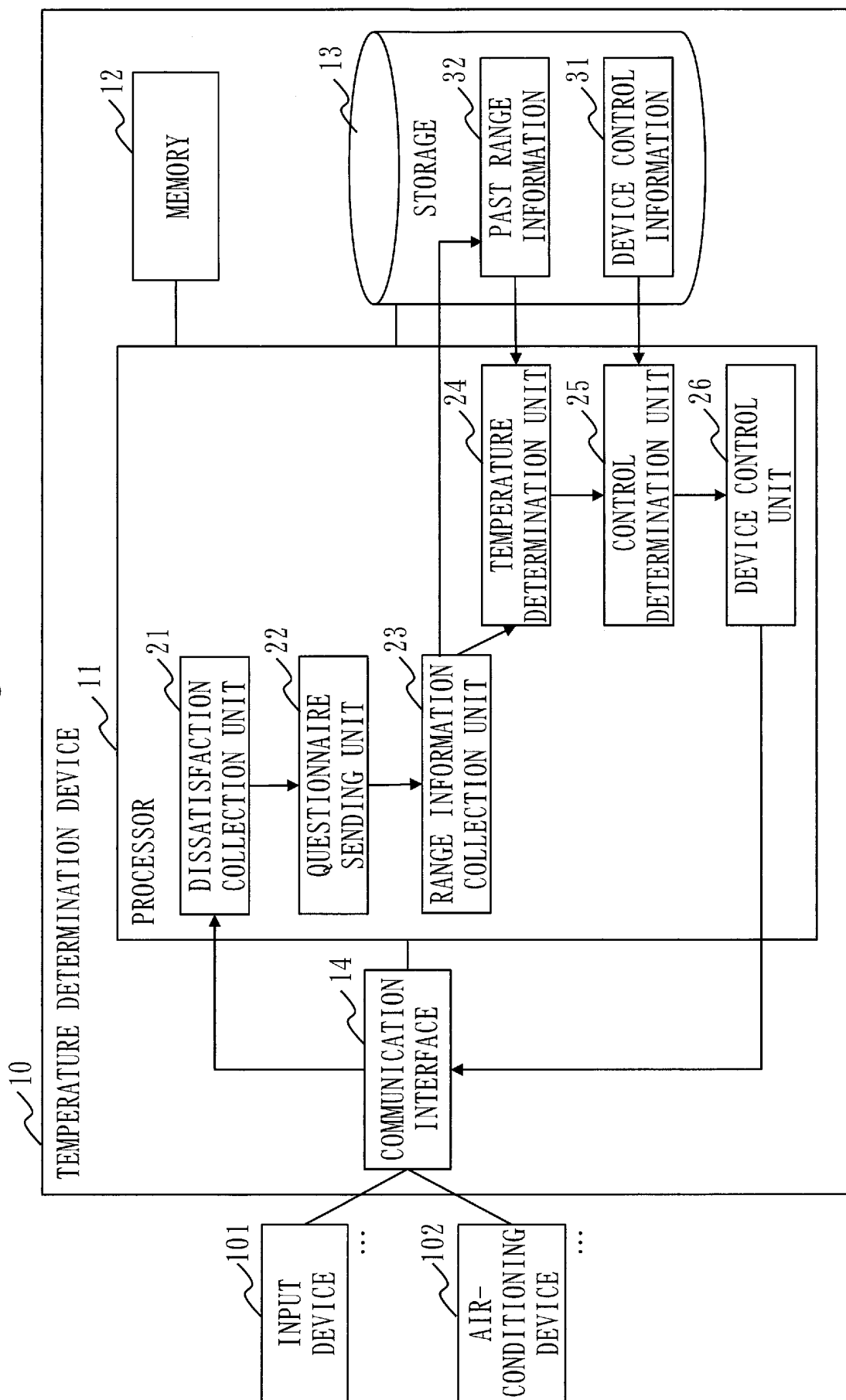


Fig. 13

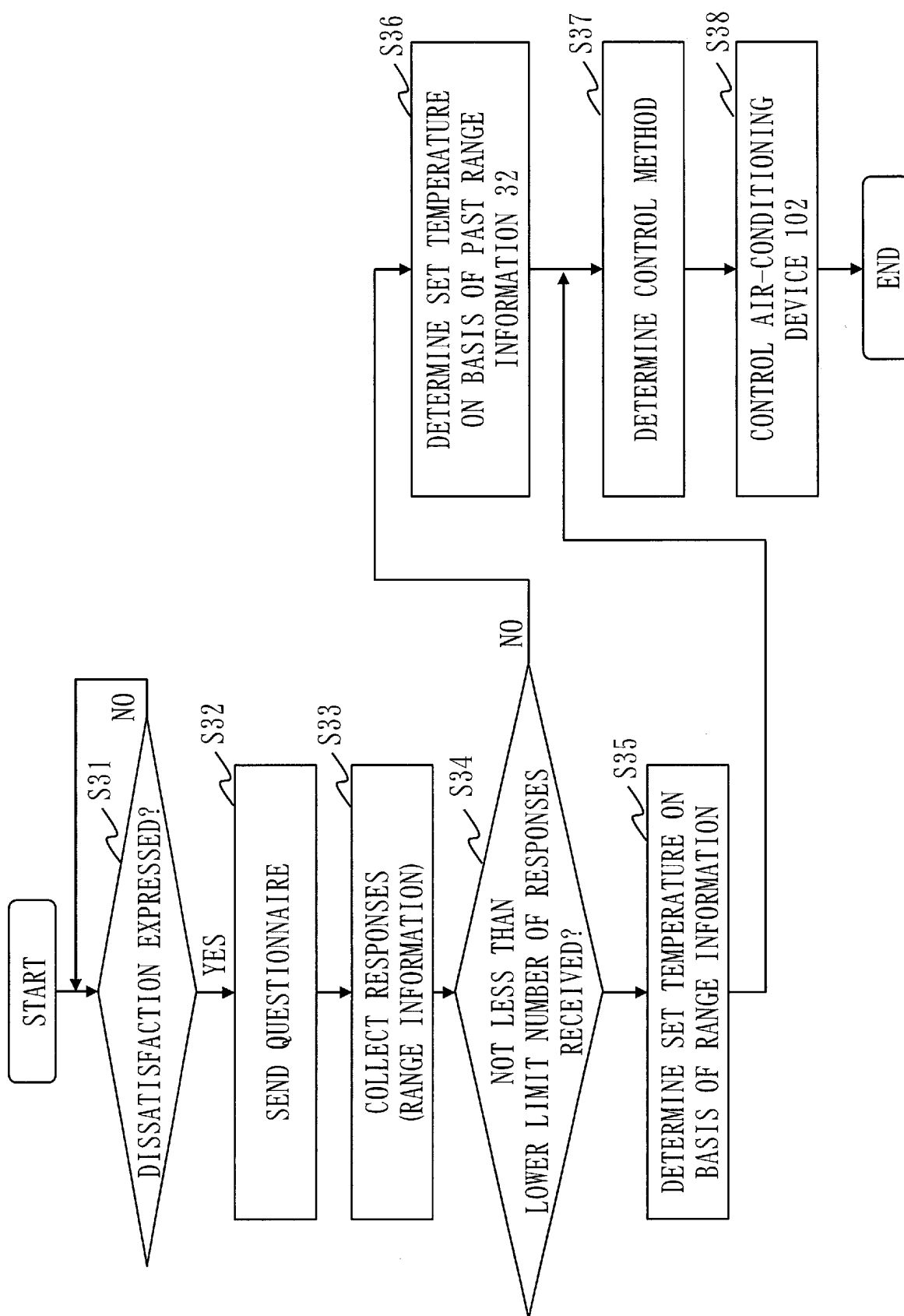
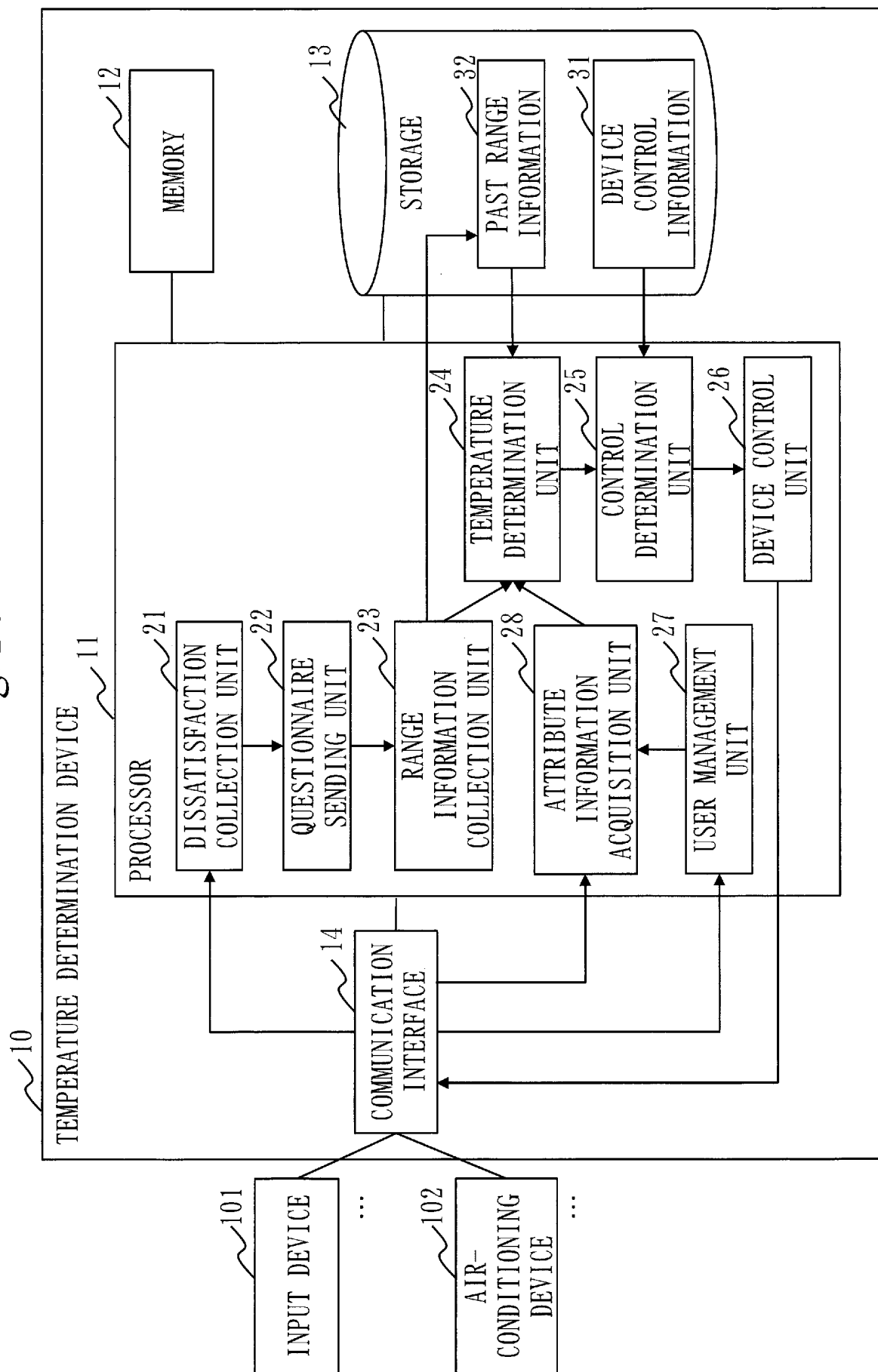


Fig. 14



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2022/028927

A. CLASSIFICATION OF SUBJECT MATTER

F24F 11/80(2018.01)i

FI: F24F11/80

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F11/80

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2022

Registered utility model specifications of Japan 1996-2022

Published registered utility model applications of Japan 1994-2022

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2018/163272 A1 (MITSUBISHI ELECTRIC CORP) 13 September 2018 (2018-09-13) paragraphs [0002]-[0009], [0035]-[0038], [0048], fig. 4	1-2, 4, 6-8, 10-13
Y	paragraphs [0002]-[0009], [0035]-[0038], [0048], fig. 4	9
A	paragraphs [0002]-[0009], [0035]-[0038], [0048], fig. 4	3, 5
Y	JP 2014-74560 A (MITSUBISHI ELECTRIC CORP) 24 April 2014 (2014-04-24) paragraphs [0042]-[0044]	9
Y	JP 2010-25359 A (FUJITSU GENERAL LTD) 04 February 2010 (2010-02-04) paragraph [0042]	9

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

29 September 2022

Date of mailing of the international search report

11 October 2022

Name and mailing address of the ISA/JP

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Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2022/028927

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO 2018/163272 A1	13 September 2018	(Family: none)	
JP 2014-74560 A	24 April 2014	US 2014/0100700 A1 paragraphs [0057]-[0059] EP 2716988 A2 paragraphs [0041]-[0043] CN 103712313 A paragraphs [0066]-[0068]	
JP 2010-25359 A	04 February 2010	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2020180744 A [0004]