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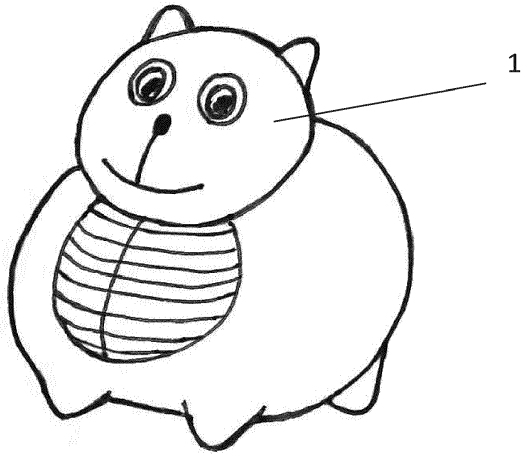
(54) MOVABLE TEMPERATURE ADJUSTING DEVICE AND METHOD FOR OPERATING THE MOVABLE TEMPERATURE ADJUSTING DEVICE

(57) The invention is a movable temperature adjusting device, comprising heating and/or cooling means, identifying means configured to identify a user, and sensing means configured to sense at least one quantity indicative of a heating and/or cooling demand of the user, wherein the movable temperature adjusting device is adapted to operate the heating and/or cooling means based on the heating and/or cooling demand of the user.

Fig. 1



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Description

[0001] The invention concerns a movable temperature adjusting device comprising heating and/or cooling means, identifying means, configured to identify a user and sensing means for sensing at least one quantity indicative of a heating and/or cooling demand of the user, wherein the movable temperature adjusting device is adapted to operate the heating and/or cooling means based on the heating and/or cooling demand of the user.

[0002] Rapid aging is a global social trend in the coming half century. It is particularly significant in developed countries such as Japan or Italy, but even in developing countries, people tend to become older. Along with the aging population, elderly lone households and elderly care facilities are on the rise. Pet type robots targeting elderly people for their mental health care are already on the market. Fundamentally, pet robots provide healing and easing of loneliness to an aged owner.

[0003] In Europe and the US, heating/cooling is normally provided by central systems, either hydronic or air based. On the other hand, stand-alone heating/cooling devices are also introduced for rooms with no central system or for additional heating/cooling close to the user. Some people feel that the central system is not enough and buy such additional localised heater or cooler as an assistant heat source.

[0004] Devices of the prior art provide heating and/or cooling but are not able to react on a user's specific requirements.

[0005] It is the object of the present invention to provide a movable temperature adjusting device, a heating and/or cooling device as well as methods for operating these devices, which are able to adjust the temperature in accordance with the demand of a specific user.

[0006] This object is achieved by the movable temperature adjusting device according to claim 1, the method for operating the movable temperature adjusting device according to claim 9, the heating and/or cooling device according to claim 12 and the method for adjusting a temperature according to claim 13. The respective dependent claims describe advantageous embodiments of the movable temperature adjusting device, the method for operating the movable temperature adjusting device, the heating and/or cooling device and the method for adjusting a temperature.

[0007] The invention concerns a movable temperature adjusting device. Here, the term "temperature adjusting" means that the movable temperature adjusting device can heat and/or cool in order to establish a target temperature in a certain environment of the device. The movable temperature adjusting device according to the invention comprises heating and/or cooling means. Heating means can for example be an electric heater, cooling means can for example be a fan or a peltier element.

[0008] The movable temperature adjusting device according to the invention furthermore comprises identifying means, configured to identify a user. The identifying means can for example employ specific properties of the user or the user can have a separate identification enabling identification by the identifying means. The identifying means can for example comprise face recognition means and/or voice recognition means so that they can identify the user based on his face and/or voice, respectively. In another example the user can carry an RFID chip and the identifying means can comprise a corresponding read-out circuit which is configured to read out the RFID chip and thereby identify the user. It is also possible to employ wearable smart devices as for example a smart watch for identifying the user. Many alternative ways of identifying the user can be employed.

[0009] The movable temperature adjusting device according to dimension furthermore comprises sensing means which are configured to sense at least one quantity which is indicative of a heating and/or cooling demand of the user. Such sensing means can for example be one or more of a temperature sensor, an ambient temperature sensor, a biometric sensor, a body temperature sensor for sensing a body temperature of the user, an infra-red sensor for sensing a skin temperature of the user and/or a heart rate sensor. The sensing means might also comprise input means where the user can enter the heating and/or cooling demand for example by using a keyboard or by speech. Many alternative ways of sensing heating and/or cooling demand of the user can be employed.

[0010] The movable temperature adjusting device is adapted to operate the heating and/or cooling means based on the heating and/or cooling demand of the user which was identified based on the results of the sensing means. Thus, if the at least one quantity sensed by the sensing means indicated that the user demands heating it can operate the heating means. On the other hand, if the at least one quantity sensed by the sensing means indicates that the user demands cooling it can operate the cooling means.

[0011] In a preferred embodiment the movable temperature adjusting device can comprise storage means which are configured to store personal conditions of the user. These personal conditions can then be used to determine the heating and/or cooling demand of the user. Thus, the movable temperature adjusting device can determine the heating and/or cooling demand of the user based on the personal conditions of the user and the at least one quantity sensed by the sensing means. The personal condition can for example comprise one or more out of a preferred temperature, age and/or health condition. If for example the stored personal condition is a preferred temperature, the sensing means can determine an ambient temperature in the surrounding of the user, and the movable temperature adjusting device can determine that the user has a heating demand if the ambient temperature is lower than the preferred temperature, and that the user has a cooling demand if the ambient temperature is higher than the preferred temperature. The movable temperature adjusting device can also for example compare a sensed ambient temperature with a

prestored average ambient temperature which can be weighted by the age of the user and/or the health condition of the user, so that the average ambient temperature is increased if for example the user is very old or ill, and the average temperature is reduced if the user is young and/or healthy. The heating and/or cooling means can then be operated to establish the adjusted average temperature in the user's environment.

[0012] The sensing means can for example comprise one or more of the following: A temperature sensor, an ambient temperature sensor, a biometric sensor, a body temperature sensor for sending a body temperature of the user, an infra-red sensor for sensing a skin temperature of the user, and/or a heart rate sensor. One or more of these sensors can be used to determine a heating and/or cooling demand of the user.

[0013] In a preferred embodiment the movable temperature adjusting device can comprise input means configured such that the user can input information indicative of a heating and/or cooling preference or demand. The movable temperature adjusting device can then be adapted to determine the heating and/or cooling demand of the user based on the information input by the user. Preferably, the heating and/or cooling demand of the user can be determined based on this input preferences in addition to prestored personal conditions of the user. Preferably the heating and/or cooling demand can be determined based on the input preferences in addition to the quantities sensed by the sensing means. It is also preferably possible to determine the heating and/or cooling demand of the user based on the input preferences the prestored personal conditions of the user and the sensed quantities obtained by the sensing means.

[0014] In a preferred embodiment the movable temperature adjusting device can comprise a microphone to record a speech input by the user and can be configured to determine the heating and/or cooling demand additionally based on the speech input by the user.

[0015] Preferably, the movable temperature adjusting device can comprise communication means, configured to communicate with a central heating and/or cooling system. Using such communication means, the heating and/or cooling load of the movable temperature adjusting device can be reduced because the device can indicate a heating and/or cooling demand to the central heating and/or cooling system.

[0016] A central heating and/or cooling system in the context of the present invention can for example be an HVAC system.

[0017] In a preferred embodiment of the invention the movable temperature adjusting device can be self-propelled. By this, the movable temperature adjusting device can be configured to sense a location of the user and to move towards the user and/or to follow the user. The movable temperature adjusting device can for example have wheels which are actuated by an electric motor. In a preferred embodiment the sensing of the location of the user can be done by the identifying means. Thus, if there are multiple persons in a room, the movable temperature adjusting device can move to the user and follow the user.

[0018] In a preferred embodiment, the movable temperature adjusting device can comprise communication means which are configured to communicate with at least one further movable temperature adjusting device. By this, multiple movable temperature adjusting devices can coordinate each other. This is in particular advantageous if the movable temperature adjusting device can communicate with a central heating and/or cooling system because the multiple movable temperature adjusting devices can coordinate whether to incite the central system to heat or to cool.

[0019] Preferably the movable temperature adjusting device can be a pet robot.

[0020] In a preferred embodiment of the invention the movable heating and/or cooling device can determine whether a central heating and/or cooling system is available with which the movable heating and/or cooling device can communicate and/or which contributes to the adjustment of the temperature in the user's environment. Preferably, the movable temperature adjusting device can also determine whether an available central heating and/or cooling system is a water-based heating and/or cooling system or an air-based heating and/or cooling system so it can proactively adjust the device. Preferably, the movable temperature adjusting device can be configured to operate its heating and/or cooling means additionally based on the result of this determination. Preferably, the movable temperature adjusting device can also instruct the central heating and/or cooling system to heat and/or cool based on the result of this determination.

[0021] The present invention also regards a method for operating a movable temperature adjusting device as described above. According to this method, the movable temperature adjusting device identifies the user, senses at least one quantity indicative of heating and/or cooling demand of the user and operates its heating and/or cooling means based on the heating and/or cooling demand of the user.

[0022] In a preferred embodiment the at least one movable temperature adjusting device can be initialized by inputting a normal condition of the user, a normal body temperature, a face photo of the user, and/or a normal heart rate of the user. These quantities can then be used to determine the heating and/or cooling demand of the user.

[0023] In an advantageous embodiment the movable temperature adjusting device can prompt the user to touch the movable temperature adjusting device at a place including a temperature sensor. Such sensor can be arranged on an outer surface of the device. The movable temperature adjusting device can then measure a body temperature of the user as one of the quantities indicative of a heating and/or cooling demand of the user. The measurement is then performed when the user touches the movable temperature adjusting device at the

place including the temperature sensor.

[0024] In a preferred embodiment of the invention the movable temperature adjusting device can send a message to predefined person in a case where the at least one quantity indicative of a heating and/or cooling demand measured by one or more of said sensing means indicates a predefined condition of the user. More specifically, the movable temperature adjusting device can for example send an emergency message to a doctor if a measured heart rate of the user indicates a medical problem.

[0025] In a preferred embodiment of the invention the movable temperature adjusting device can monitor the user's heating/cooling demand continuously also after an operation has started towards the set temperature but while not yet achieving the set temperature. In case the user's satisfaction is detected by sensing latest user data, the device can change the set temperature and operate accordingly so that redundant operation will be reduced. By this it is possible for the device to react on quick changes of the user's demand, for example because the user has fever. In this embodiment the at least one movable temperature adjusting device continuously monitors the heating and/or cooling demand of the user during an operation for meeting a previously determined heating and/or cooling demand of the user and adjusts the heating and/or cooling demand to the thus determined heating and/or cooling demand.

[0026] The present invention furthermore relates to a heating and/or cooling device, including at least one movable temperature adjusting device as described above as well as a central heating and/or cooling system, as for example an HVAC. Here, the movable temperature adjusting device has a communication means which is configured to communicate with the central heating and/or cooling system. The movable temperature adjusting device in this embodiment is configured to instruct the central heating and/or cooling system using the communication means to heat and/or cool based on the heating and/or cooling demand of the user.

[0027] The present invention also concerns a method for adjusting a temperature using such heating and/or cooling device. In this method, a movable temperature adjusting device measures at least one quantity indicative of a heating and/or cooling demand of the user and operates the heating and/or cooling means based on this heating and/or cooling demand of the user. Furthermore, the movable heating and/or cooling device sends a heating and/or cooling instruction to the central heating and/or cooling system, based on the heating and/or cooling demand of the user. Due to this method, the movable heating and/or cooling device can cooperate with the central heating and/or cooling system to establish a target temperature for the user. In particular, the target temperature can be established as quick as possible and/or as energy efficient as possible due to such cooperation.

[0028] In a preferred embodiment the at least one movable temperature adjusting device can operate its heating and/or cooling means such that a determined heating and/or cooling demand of the user is met within a predetermined time if the central heating and/or cooling system is not capable of meeting the heating and/or cooling demand of the user in this predetermined time. Usually central heating and/or cooling systems have greater size and are located further away from the user so that the effect of the operation is delayed. The movable heating and/or cooling device can bridge the heating and/or cooling demand during a time where the operation of the central heating and/or cooling system is not yet fully effective at the user's location.

[0029] Preferably, the movable temperature adjusting device can operate its heating and/or cooling means such that a heating and/or cooling power of the heating and/or cooling means is reduced as a heating and/or cooling effect of the central heating and/or cooling system increases. The heating and/or cooling power can here be determined as the power used by the heating and/or cooling means. The heating and/or cooling effect of the central heating and/or cooling system can be determined as the temperature effected by the central heating and/or cooling system at the location of the user. In particular, the heating and/or cooling effect of the central heating and/or cooling system at the location of the user can be set temperature which can be maintained by the operation of the central heating and/or cooling system alone. Due to the higher inertia of the central heating and/or cooling system, this temperature needs some time to approach the target temperature which would meet the user's heating and/or cooling demand. In that time, where the temperature is still different from the target temperature, the temperature gap can be filled by the movable heating and/or cooling device. As the temperature achieved by the central heating and/or cooling system approaches the target temperature, the movable temperature adjusting device can reduce its heating and/or cooling power.

[0030] In a preferred embodiment the movable temperature adjusting device can prompt the user to speak a speech input. The movable temperature adjusting device can then control the heating and/or cooling means and/or can send a heating and/or cooling instruction to the central heating and/or cooling system based on the speech input spoken by the user. This allows a very convenient control of the movable temperature adjusting devices and/or the central heating and/or cooling system.

[0031] In a preferred embodiment the movable temperature adjusting device can communicate with at least one further of the movable temperature adjusting devices, which can also be configured as described above. In this embodiment, the central heating and/or cooling system can be instructed to establish a temperature which is the minimal temperature demanded by any of the movable temperature adjusting devices in a heating case. By this, the user requiring the lowest temperature can be satisfied by the central heating and/or cooling system alone and the other users requiring higher temperatures

can receive further heat by their respective movable temperature adjusting devices. The central heating and/or cooling system can also be instructed to establish a temperature which is the maximum temperature device demanded by any of the movable temperature adjusting devices in a cooling case. By this, the central system provides the minimum required cooling and those users requiring a lower temperature can receive further cooling by the respective movable temperature adjusting devices.

[0032] In a further advantageous embodiment the central heating and/or cooling system can be instructed to establish a temperature which is an average temperature of all temperatures demanded by the movable temperature adjusting devices. As the movable temperature adjusting devices can communicate with each other, they can determine their average temperature. Users requiring a higher temperature than the average temperature can receive further heat by their respective movable heating and/or cooling device. Users requiring a lower temperature than the average temperature can receive cooling by their respective movable temperature adjusting device.

[0033] It is furthermore possible that the central heating and/or cooling system is instructed to establish a temperature which meets a heating and/or cooling demand of a preselected user of one of the movable temperature adjusting devices. Those users requiring higher temperature can receive heating by their movable temperature adjusting device and users requiring a lower temperature can receive cooling by their movable temperature adjusting device. This configuration makes it possible to take care of specific users which might be particularly sensitive to the ambient temperature as for example old or ill persons.

[0034] The above embodiments in which the central heating and/or cooling system provides a minimal cooling or heating are particularly advantageous because they allow an operation of the system with minimal energy consumption.

[0035] In a preferred embodiment the central heating and/or cooling system can have movable louvers which are configured to direct an air-flow in a predetermined direction. The movable temperature adjusting device can then instruct the central heating and the cooling system to move the louvers such that the air-flow is directed in a direction which meets the heating and/or cooling demand of the user. If, for example, the user demands strong cooling, the central heating and/or cooling system can be instructed to cool and to direct the louvers such that the air-flow is directed directly towards the user. In a configuration where more than one user and more than one movable temperature adjusting device is present in a room, the movable temperature adjusting devices can communicate with each other in order to determine where the central heating and/or cooling system should direct its louvers. The central heating and/or cooling system could for example be instructed to direct its louvers such that the air-flow is directed at none of the users directly or that the air-flow is directed to a specific user.

[0036] Thus, in summary the movable temperature adjusting device of the invention can advantageously be a self-propelled or movable robot. It can have a built-in heating and/or cooling unit for heating and/or cooling. A heating can, for example, be a directly electricity heating, however, it is not limited to such heating. The cooling can, for example, be a fan or a Peltier element, but it not limited to such element. The device can have environmental information sensing means for sensing, for example, the temperature, specifications of a central heating and/or cooling system in the room where the user and the movable device are present and/or an operation status of the central heating and/or cooling system. The movable device can also have user's health and/or heating/cooling demand sensing means as, for example, having a visual information sensing function, for example, a video camera, and a processor. The device can also have biometric sensing function, configured, for example, for sensing a body temperature of, for example, the face by an infra-red sensor or the skin by a thermal sensor and/or a heart rate sensor. The device can preferably also have voice communication functions, as for example a microphone, a speaker and a processor. As described above, the device can have communication means to communicate with other robots and, for example, a central heating and/or cooling system. By this it can understand and negotiate the user's demand on temperature and transmit control commands to a central system. Preferably, the movable device has a power unit for self-propelling or mobility as well as power charging means. Said central heating and/or cooling system can, for example, be hydronic or air-based.

[0037] In the following an advantageous method of determining a user's heating and/or cooling demand shall be described. As described above, visual, biometric and/or verbal data can be obtained from the user and be analyzed. For example, the data can be analyzed by comparing it with registered and/or historical data to conclude whether the user is hot, modest or cool. Then, visual and/or biometric data can be integrated and it can thereby be determined whether the user is hot, modest or cool. Finally, the verbal data analysis result can be integrated using pre-stored information on how to interpret the user's speech input. For example, it can be presumed that as people age, the perception of the temperature becomes less precise. Therefore, for younger people the analysis can put more priority to the verbal data while for older people the analysis can put more priority to biometric and/or visual data. The age threshold can, for example, be set as 60 years. It can also be taken into account as a linear weight factor or based on the analysis of the user's historical data. As a result of the integration of the user data, it can be determined whether cooling, light cooling, no action, light heating or heating is required. Depending on the user's preference, a certain temperature can be set compared to the room temperature and

heating or cooling can be activated.

[0038] In a preferred embodiment the heating and/or cooling means of the movable temperature adjusting device can be employed to provide rapid heating and/or rapid cooling. Rapid heating can, for example, be achieved with a direct electric heat device and rapid cooling can, for example, be achieved with a fan. The heating and/or cooling means of the movable temperature adjusting device can be operated to compensate a temperature between the demanded temperature of the user and the current temperature in the user's environment until the central heating and/or cooling system can maintain the target temperature.

[0039] The heating and/or cooling means of the movable temperature adjusting device can be operated differently depending on the central heating and/or cooling system. If the central heating and/or cooling system is water-based, the heating and/or cooling means of the movable temperature adjusting device can be operated for a longer period because these systems react more slowly and take more time to heat up or cool down a room than an air-based system. Preferably, the temperature demanded by the user should be achieved by the operation as soon as possible and for a long time.

[0040] In a preferred embodiment of the invention the total energy consumption of the heating and/or cooling device can be determined. For this, preferably the total energy consumption of the heating and/or cooling means of the movable temperature adjusting device and of the central heating and/or cooling system can be calculated. Based on the result of this calculation, it can be determined how the demanded temperature can be achieved and maintained with the most energy efficient operation. For example, the temperature set by the heating and/or cooling means of the movable temperature adjusting device can be a little higher in the beginning than the demanded temperature and can be decreased gradually until the central heating and/or cooling system achieves the demanded temperature. However, since initially more than enough heat was provided, the temperature of the central heating and/or cooling system can be set a little lower than the demanded temperature. This results in less energy consumption in the case where heating is provided for more than a certain period. In the case of cooling the system can be operated analogously using, for example, the built-in fan or Peltier element. In this case, the heating and/or cooling means of the movable temperature adjusting device can be set to a little lower temperature than the demanded temperature and as a result the central heating and/or cooling system can be set to a higher temperature than the target temperature.

[0041] In a preferred embodiment the movable temperature adjusting device can be configured to detect or recognize other movable temperature adjusting devices in the same room, which preferably belong to other users or are assigned to other users in the room. In this case, where multiple movable temperature adjusting devices are present, these can be preferably communicate with each other. For example, the movable temperature adjusting devices can share with each other what their respectively demanded temperature is. The different devices can compare these demanded temperatures adopt the lowest temperature setting for heating or the highest temperature setting for cooling. Those of the movable temperature adjusting devices, the temperature of which is different from the temperature set in this way, can operate their heating and/or cooling means to meet the heating and/or cooling demand of their respective user.

[0042] In a further advantageous embodiment the movable temperature adjusting device may comprise a microphone to record a speech input by the user and the movable temperature adjusting device may be configured to determine the heating and/or cooling demand additionally based on the speech input by the user.

[0043] In a further advantageous embodiment the movable temperature adjusting device may be self-propelled, wherein the movable temperature adjusting device may be configured to sense a location of the user and wherein the movable temperature adjusting device may be configured to follow the user.

[0044] In a further embodiment the movable temperature adjusting device may be configured to determine whether a central heating and/or cooling system is available and/or whether an available central heating and/or cooling system is a water based heating and/or cooling system or an air based heating and/or cooling system and may further be configured to operate the heating and/or cooling means additionally based on the result of this determination and/or to instruct the central heating and/or cooling system to heat and/or cool based on the result of this determination.

[0045] In a preferred embodiment the movable temperature adjusting device can send a message to a predefined person in a case where the at least one quantity indicative of a heating and/or cooling demand measured by one or more of said sensing means indicates a predefined condition of the user.

[0046] In another advantageous embodiment the movable temperature adjusting device can prompt the user to speak a speech input and the movable temperature adjusting device can control the heating and/or cooling means and/or send a heating and/or cooling instruction to the central heating and/or cooling system based on the speech input spoken by the user.

[0047] In a preferred embodiment the central heating and/or cooling system can have movable louvers configured to direct an air flow in a predetermined direction, wherein the movable temperature adjusting device instructs the central heating and/or cooling system to move the louvers such that the air flow is directed in a direction which meets the heating and/or cooling demand of the user.

[0048] In the following, the invention shall be described by way of examples with reference to some figures.

Fig. 1 shows a pet robot as an example of a movable

temperature adjusting device,

Fig. 2 shows a scheme of an example embodiment of a movable temperature adjusting device,

Fig. 3 shows an example operation of a movable temperature adjusting device,

Fig. 4 shows the contribution of a heating and/or cooling means of the movable temperature adjusting device, together with a contribution of a central heating and/or cooling system to achieving a target temperature, in a water-based central heating system,

Fig. 5 shows the contribution of heating and/or cooling means of a movable temperature adjusting device and of a central heating and/or cooling system in case of an air-based central heating system,

Fig. 6 shows the temperature setting in case of operating only heating and/or cooling means of a movable temperature adjusting device,

Fig. 7 shows an example of how a user's visual, biometric and speech input data are analyzed,

Fig. 8 shows an example of an operation of a heating and/or cooling means of a movable temperature adjusting device together with a central heating and/or cooling system to achieve a most energyefficient operation,

Fig. 9 shows an example of a negotiation of multiple movable temperature adjusting devices, and

Fig. 10 shows a contribution of the heating and/or cooling means of one of the movable temperature adjusting devices taken into account in Fig. 9, and of a central heating and/or cooling system.

[0049] Fig. 1 shows an example of a pet robot which can be employed as movable temperature adjusting device according to the present invention.

[0050] Fig. 2 shows a schematic sketch of a configuration of such movable temperature adjusting device 1. The device can have identifying means 2 configured to identify a user. The identifying means 2 can preferably also be configured to locate a user, if it is desired that the movable temperature adjusting device 1 can follow the user. The movable temperature adjusting device 1 furthermore comprises heating and/or cooling means 3 which can provide heat and/or cool the environment of the movable temperature adjusting device.

[0051] The device 1 can furthermore comprise an environment sensor which, for example, can detect an environment temperature and/or presence, specification and/or operation status of a central heating and/or cooling system in the room where the movable temperature adjusting device 1 is present. The environment sensor 4 can also be regarded as sensing means 4. The device 1 can further comprise sensing means 5, configured to sense at least one quantity indicative of a heating and/or cooling demand of the user. Such sensing means 5 can, for example, comprise a visual information sensing function, a biometric sensing function and/or voice communication functions.

[0052] The movable temperature adjusting device 1 can furthermore comprise communication means 6, which can communicate with other movable temperature adjusting devices and/or which can communicate with a system controller of a central heating and/or cooling system.

[0053] Preferably, the device 1 comprises a power source 7 to enable the device to move freely. However, also a cable bound solution is possible. The device 1 may comprise movement means 8, as for example propelled wheels, so that the device 1 can move to the user or follow the user.

[0054] Fig. 3 shows an example of a flow chart of an operation which can be carried out by a movable temperature adjusting device 1 of the invention. In this example, it is determined in a first step S1 whether a registered user is recognized. If this is the case, the movable temperature adjusting device 1 approaches the user in step S2. It is then determined in step S3 whether for example visual and/or biometric data and/or environmental data of the user have been obtained. If these data exist, step S4 is carried out in which the obtained data are compared with registered data and the user's heating and/or cooling demand is determined. It can furthermore in step S5 be determined whether the user is in good health. If it is determined that this is not the case, a health care advice can be issued in step S6. If on the other hand the user is in good health, the device 1 may for example ask the user in step S7 whether he is hot or cold. It can then be determined whether an answer has been obtained in step S8 and if so, it can be estimated in step S9 what the user's total heating or cooling demand is, taking into account for example the user's age. In step S10 then adequate heating and/or cooling can be provided by controlling the built-in heating and/or cooling means. It is also possible to, in step S11, monitor the user's condition continuously by sending, for example, visual, biometric and/or verbal data. In a final step S12 it can be determined whether the demand has been achieved. If this is the case, the operation may end or it may start from the beginning to maintain the demanded temperature over a long time.

[0055] Fig. 4 shows the temperature set by the heating and/or cooling means of the movable temperature adjusting device as well as by the central heating and/or cooling system over time. It is assumed here that the central heating and/or cooling system is water-based and

therefore reacts quite slowly. Fig. 4 shows as the upper curve 41 the temperature as set by the heating and/or cooling means of the movable temperature adjusting device and as lower curve 42 the temperature as set by the central heating and/or cooling system. Fig. 4 shows a heating operation. However, a cooling operation would look similar, but with the target temperature being lower than the start temperature. It can be seen here by comparing lines 41 and 42 that the built-in heating and/or cooling means of the movable temperature adjusting device 1 can achieve the target temperature much faster than the central heating system. To achieve the target temperature as soon as possible, the built-in heater can first heat the environment to the target temperature and the heating power of the built-in heating and/or cooling means can be reduced with increasing temperature provided by the central heating system.

[0056] Fig. 5 shows a diagram similar to that shown in Fig. 4, but for an air-based central heating. It can be seen that the temperature set by the central heating system, as shown as line 42, reaches the target temperature much faster than in the case of a water-based central heating system as shown in Fig. 4. The built-in heating and/or cooling means of the movable temperature adjusting device 1 can therefore operate for a shorter time, as can be seen by the smaller hashed area between lines 41 and 42.

[0057] Fig. 6 shows an example where no central heating and/or cooling system is available. Here, the heating and/or cooling means of the movable temperature adjusting device heat the room, starting from the start temperature towards the target temperature. If the internal heating and/or cooling means are turned off, the temperature drops again.

[0058] Fig. 7 shows an example in which visual data and biometric data are obtained of a user and wherein furthermore the user inserts verbal data as speech input. It is assumed here for the sake of simplicity that the biometric data, the visual data and the verbal data indicate either that the user is hot, modest or cold. The left hand table in Fig. 7 can be used to determine whether the user is hot, modest or cold based on just the biometric data analysis and the visual data analysis. The biometric data analysis is shown in the vertical direction and the visual data analysis is shown in the horizontal direction. If both data values indicate the same state of the user, this state is determined as actual state of the user. On the other hand, if the biometric data indicate the opposite state than the visual data, it is assumed that the user is modest. If one type of data indicates that the user is modest and one type of data indicates that the user is not modest, it is assumed that the user is in the non-modest state.

[0059] The right-hand side of Fig. 7 now shows an integration of the result of the left-hand table with an analysis of the verbal input. Here, the result of the left-hand table is indicated in the vertical direction and the result of the speech input is indicated in the horizontal direction. The upper table is for a young user and the lower table is for an older user. It can be seen that for younger users the verbal data, that is the speech input, has priority. Thus, if the user inputs that he is hot, he will receive some cooling while if he inputs that he is cold, he will receive some heating. However, if the biometric and the visual data contradict the user's speech input, the heating and/or the cooling will be light.

[0060] On the other hand, in case of an old person as shown in the lower table on the right-hand side, priority is given to the result of the left-hand table. Thus, if the speech input of the user contradicts the biometric and visual data, a temperature will be adjusted in the direction as indicated by the biometric and visual data in a light manner.

[0061] Fig. 8 shows an example of an operation which is most energy-efficient. As in Figs. 4 and 5 the upper curve 41 indicates the temperature set by the internal heating and/or cooling means 3 of the movable temperature adjusting device 1 while the lower curve 42 indicates the temperature as set by the central heating and/or cooling system. It can be seen that the internal heating and/or cooling means 3 increase the set temperature to a value higher than the actual target value. Due to this, the temperature 42 set by the central heating system can remain lower than the target temperature, as seen on the right-hand side of Fig. 8. The overall energy efficiency of this operation is better than as shown for example in Fig. 4.

[0062] Fig. 9 shows an example of a negotiation of a room temperature if more than one movable temperature adjusting device 1 is present in the room. Here, table 91 shows in columns A, B and C the demanded temperature of three of those devices before the negotiation. Here, the room temperature is 17°C. Lower table 92 shows the temperature actually set by the devices A, B and C after negotiation together with the room temperature which is then 19°C. Before the negotiation device A demands 19°C, device B demands 21°C and device C demands 20°C. The room temperature is 17°C. In this example the devices A, B and C negotiate to determine the lowest temperature as set room temperature, which can, for example, be set by a central heating and/or cooling system. Here, the lowest demanded temperature is 19°C. The room temperature is therefore set to 19°C as shown in table 92. The internal heating and/or cooling means 3 of device A can therefore be turned off. The central heating and/or cooling means 3 of devices B and C operate to heat their environment to their demanded temperatures which are higher than the set room temperature of 19°C.

[0063] Fig. 10 shows a diagram as shown in Figs. 4 and 5 for the device B in Fig. 9. Device B demands a temperature of 21°C which is higher than the set room temperature of 19°C. Therefore, the central heating sets a temperature indicated by line 42, which is lower than the target temperature of device B. Device B therefore uses its internal heating and/or cooling means 3 to achieve the target temperature. This is indicated by line 41.

Claims

1. Movable temperature adjusting device, comprising heating and/or cooling means,
identifying means configured to identify a user, and sensing means configured to sense at least one quantity indicative of a heating and/or cooling demand of the user,
wherein the movable temperature adjusting device is adapted to operate the heating and/or cooling means based on the heating and/or cooling demand of the user.

2. Movable temperature adjusting device according to the preceding claim,
further comprising storage means configured to store personal conditions of the user,
wherein the movable temperature adjusting device is configured to determine the heating and/or cooling demand of the user based on the personal conditions of the user and the at least one quantity sensed by the sensing means.

3. Movable temperature adjusting device according to according to the preceding claims,
wherein the personal conditions comprise one or more out of preferred temperature, age and/or health condition.

4. Movable temperature adjusting device according to one of the preceding claims,
wherein the sensing means comprise one or more of the following: a temperature sensor, an ambient temperature sensor, a biometric sensor, a body temperature sensor for sensing a body temperature of the user, an infrared sensor for sensing a skin temperature of the user, and/or a heart rate sensor.

5. Movable temperature adjusting device according to one of the preceding claims,
further comprising input means configured such that the user can input information indicative of a heating and/or cooling preference, wherein the movable temperature adjusting device is adapted to determine the heating and/or cooling demand of the user based on the information input by the user and preferably in addition based on prestored personal conditions of the user.

6. Movable temperature adjusting device according to one of the preceding claims,
further comprising communication means configured to communicate with a central heating and/or cooling system and/or to communicate with at least one further movable temperature adjusting device.

7. Movable temperature adjusting device according to one of the preceding claims,
wherein the movable temperature adjusting device is a pet robot.

8. Movable temperature adjusting device according to one of the preceding claims,
wherein the heating means comprises an electrical heater and/or wherein the cooling means comprises a fan and/or a Peltier element.

9. Method for operating a movable temperature adjusting device according to one of claims 1 to 8,
wherein the movable temperature adjusting device identifies the user, senses at least one quantity indicative of a heating and/or cooling demand of the user,
and operates the heating and/or cooling means based on the heating and/or cooling demand of the user.

10. Method according to the preceding claim,
wherein the at least one movable temperature adjusting device is initialized by inputting in a normal condition of the user, a normal body temperature and/or a face photo and/or a heart rate of the user.

11. Method according to one of claims 9 or 10,
wherein the movable temperature adjusting device prompts the user to touch the movable temperature adjusting device at a place including a temperature sensor and wherein the movable temperature adjusting device measures a body temperature as one of the quantities indicative of a heating and/or cooling demand of the user when the user touches the movable temperature adjusting device at the place including the temperature sensor.

12. Heating and/or cooling device including at least one movable temperature adjusting device according to one of claims 1 to 8 and a central heating and/or cooling system,
wherein the movable temperature adjusting device has a communication means configured to communicate with the central heating and/or cooling system,
wherein the movable temperature adjusting device is configured to instruct the central heating and/or cooling system by the communication means to heat and/or cool based on the heating and/or cooling demand of the user.

13. Method for adjusting a temperature,
the method being carried out in heating and/or cooling device according to claim 12,
wherein the movable temperature adjusting device measures at least one quantity indicative of a heating and/or cooling demand by a user, and
operates the heating and/or cooling means based on the heating and/or cooling demand of the user and/or sends a heating and/or cooling instruction to

the central heating and/or cooling system based on the heating and/or cooling demand of the user.

14. Method according to the preceding claim, wherein if the central heating and/or cooling system is not capable of meeting the heating and/or cooling demand of the user in a predetermined time the at least one movable temperature adjusting device operates the heating and/or cooling means such that the heating and/or cooling demand of the user is met within the predetermined time.

15. Method according to according to the preceding claim, wherein the movable temperature adjusting device operates the heating and/or cooling means such that a heating and/or cooling power of these heating and/or cooling means is reduced as a heating and/or cooling effect of the central heating and/or cooling system increases.

16. Method according to one of claims 13 to 15, wherein the movable temperature adjusting device communicates with at least one further of the movable temperature adjusting devices and wherein the central heating and/or cooling system is instructed to establish a temperature which is the minimal temperature demanded by any of the movable temperature adjusting devices in a heating case or wherein the central heating and/or cooling system is instructed to establish a temperature which is the maximal temperature demanded by any of the movable temperature adjusting device in a cooling case or wherein the central heating and/or cooling system is instructed to establish a temperature which is an average temperature of all temperatures demanded by the movable temperature adjusting devices or wherein the central heating and/or cooling system is instructed to establish a temperature which meets the heating and/or cooling demand of a preselected user of one of the movable temperature adjusting devices.

Fig. 1

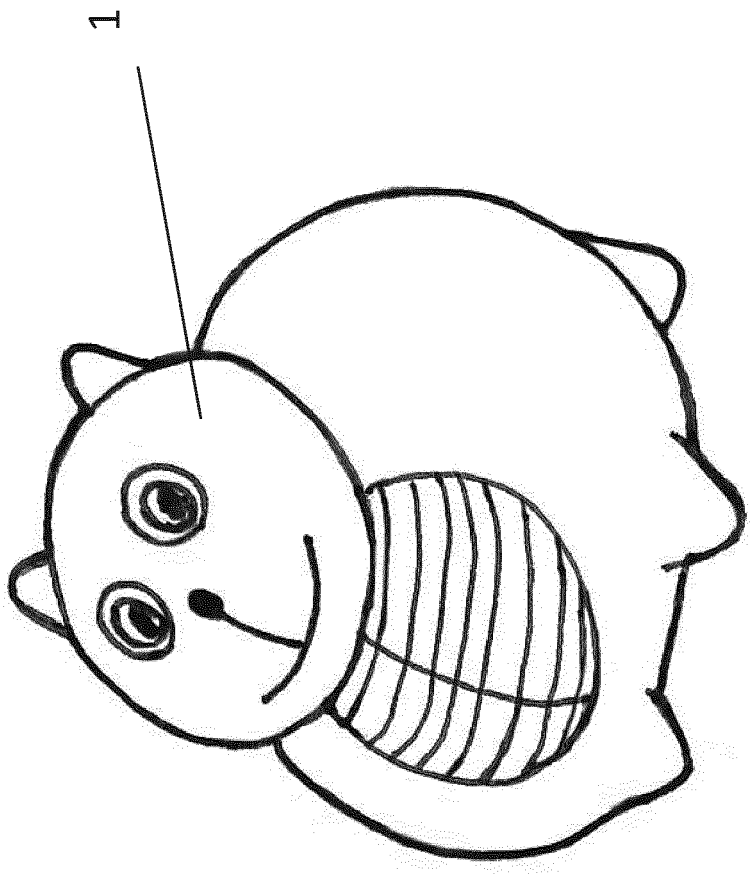


Fig. 2

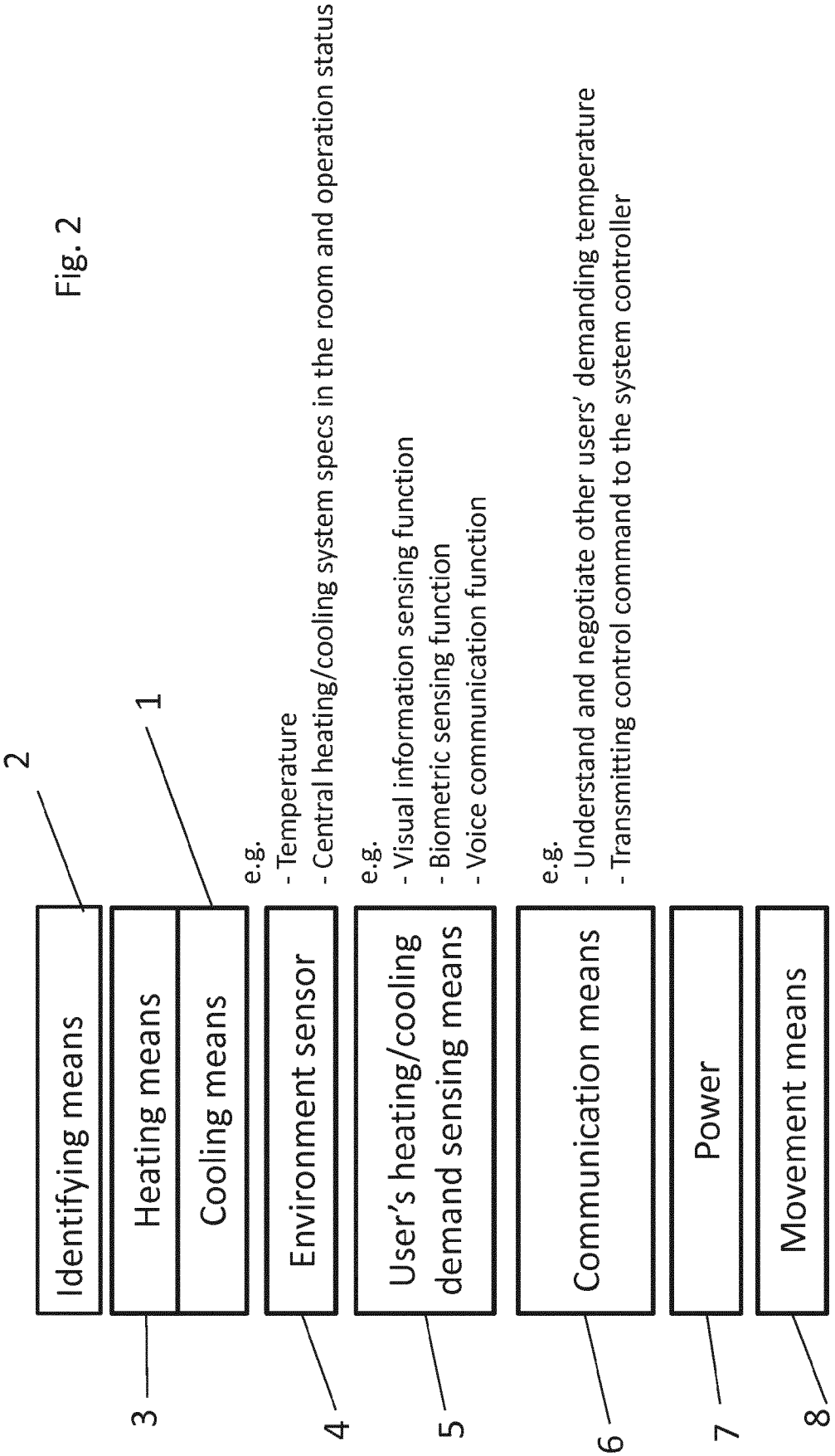

Identifying means
2
Heating means
Cooling means
1
3
Environment sensor
e.g.
- Temperature
- Central heating/cooling system specs in the room and operation status
4
User's heating/cooling demand sensing means
e.g.
- Visual information sensing function
- Biometric sensing function
- Voice communication function
5
Communication means
e.g.
- Understand and negotiate other users' demanding temperature
- Transmitting control command to the system controller
6
Power
7
Movement means
8

Fig. 3

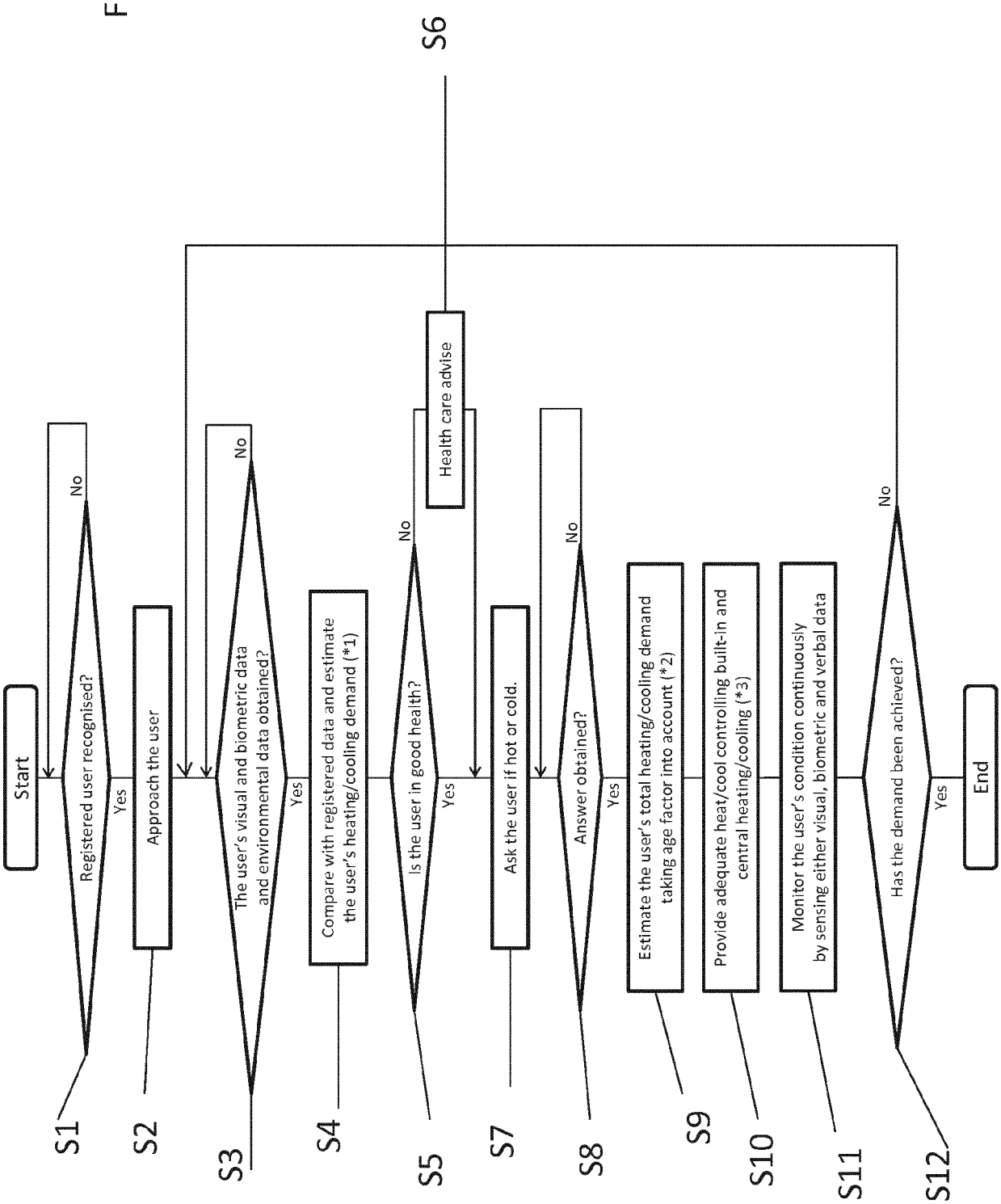

Start
Registered user recognised?
No
Yes
Approach the user
The user's visual and biometric data and environmental data obtained?
No
Yes
Compare with registered data and estimate the user's heating/cooling demand (*1)
Is the user in good health?
No
Yes
Health care advise
Ask the user if hot or cold.
Answer obtained?
No
Yes
Estimate the user's total heating/cooling demand taking age factor into account (*2)
Provide adequate heat/cool controlling built-in and central heating/cooling (*3)
Monitor the user's condition continuously by sensing either visual, biometric and verbal data
Has the demand been achieved?
No
Yes
End
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12

Fig. 4

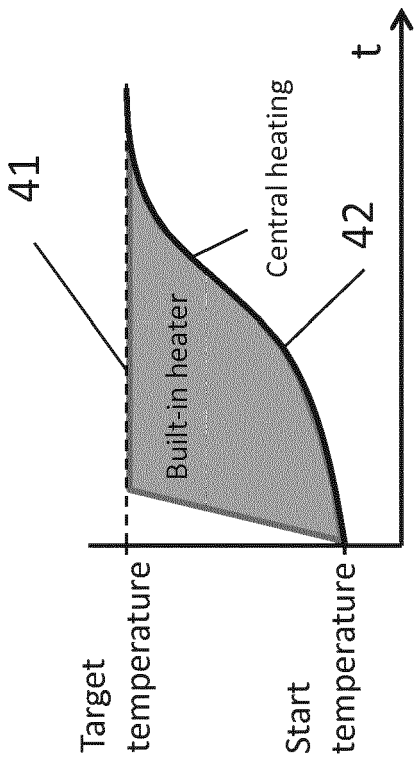


Fig. 5

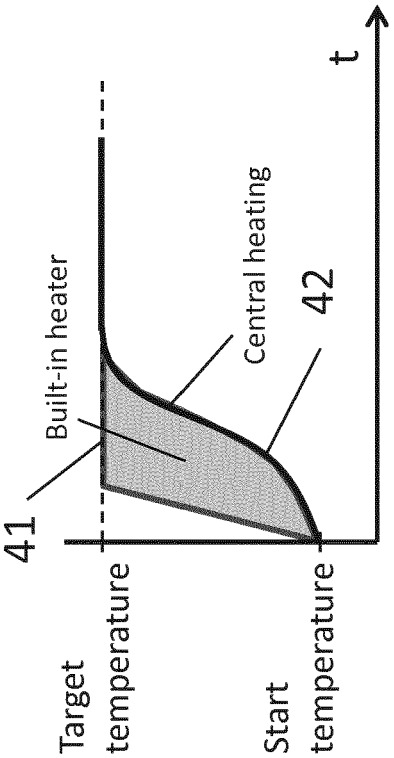


Fig. 6

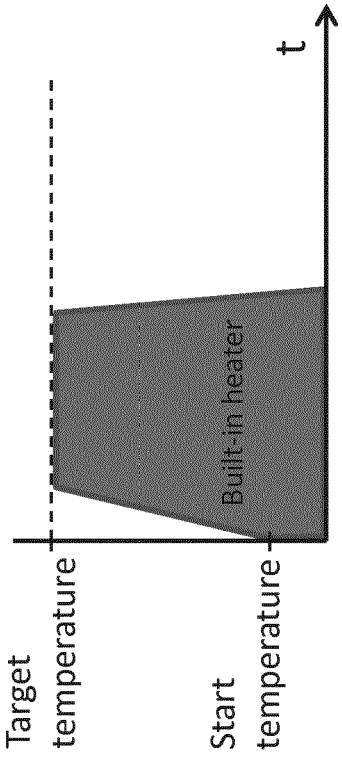


Fig. 7

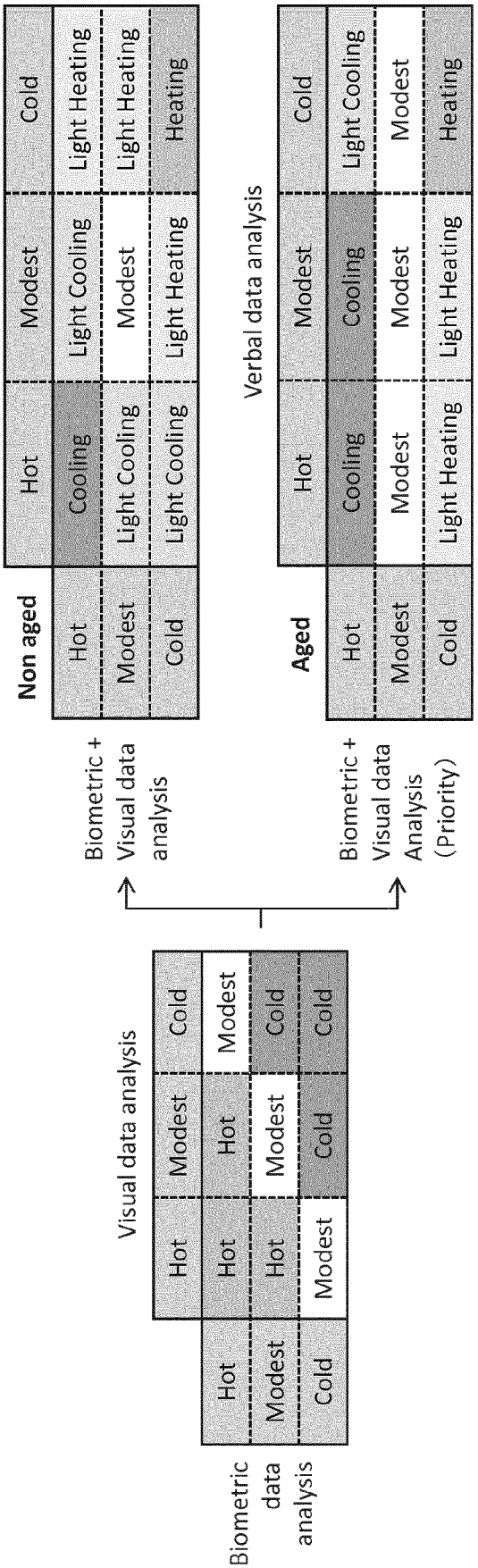

Biometric data analysis
Hot
Modest
Cold
Visual data analysis
Hot
Hot
Hot
Modest
Modest
Hot
Modest
Cold
Cold
Cold
Modest
Cold
Biometric + Visual data analysis
Non aged
Hot
Modest
Cold
Verbal data analysis (Priority)
Hot
Cooling
Light Cooling
Light Cooling
Modest
Light Cooling
Modest
Light Cooling
Cold
Light Heating
Light Heating
Heating
Biometric + Visual data Analysis (Priority)
Aged
Hot
Modest
Cold
Verbal data analysis
Hot
Cooling
Cooling
Modest
Modest
Modest
Modest
Cold
Light Heating
Light Cooling
Modest
Heating

Fig. 8

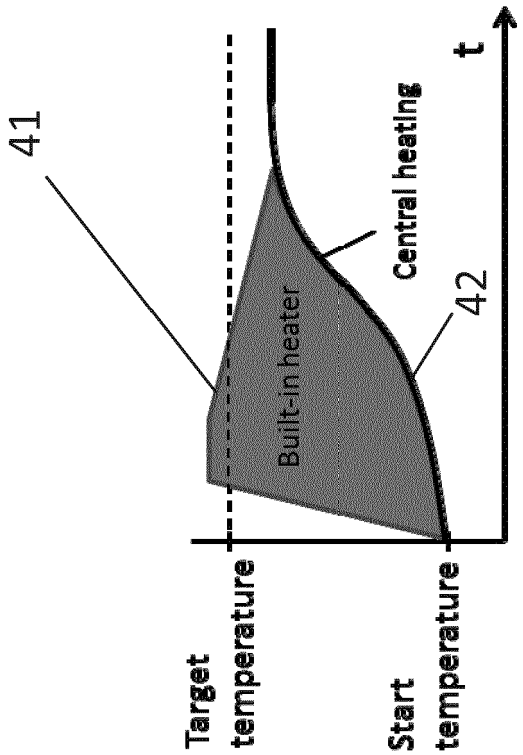

41
Built-in heater
Central heating
42
t
Target temperature
Start temperature

Fig. 9

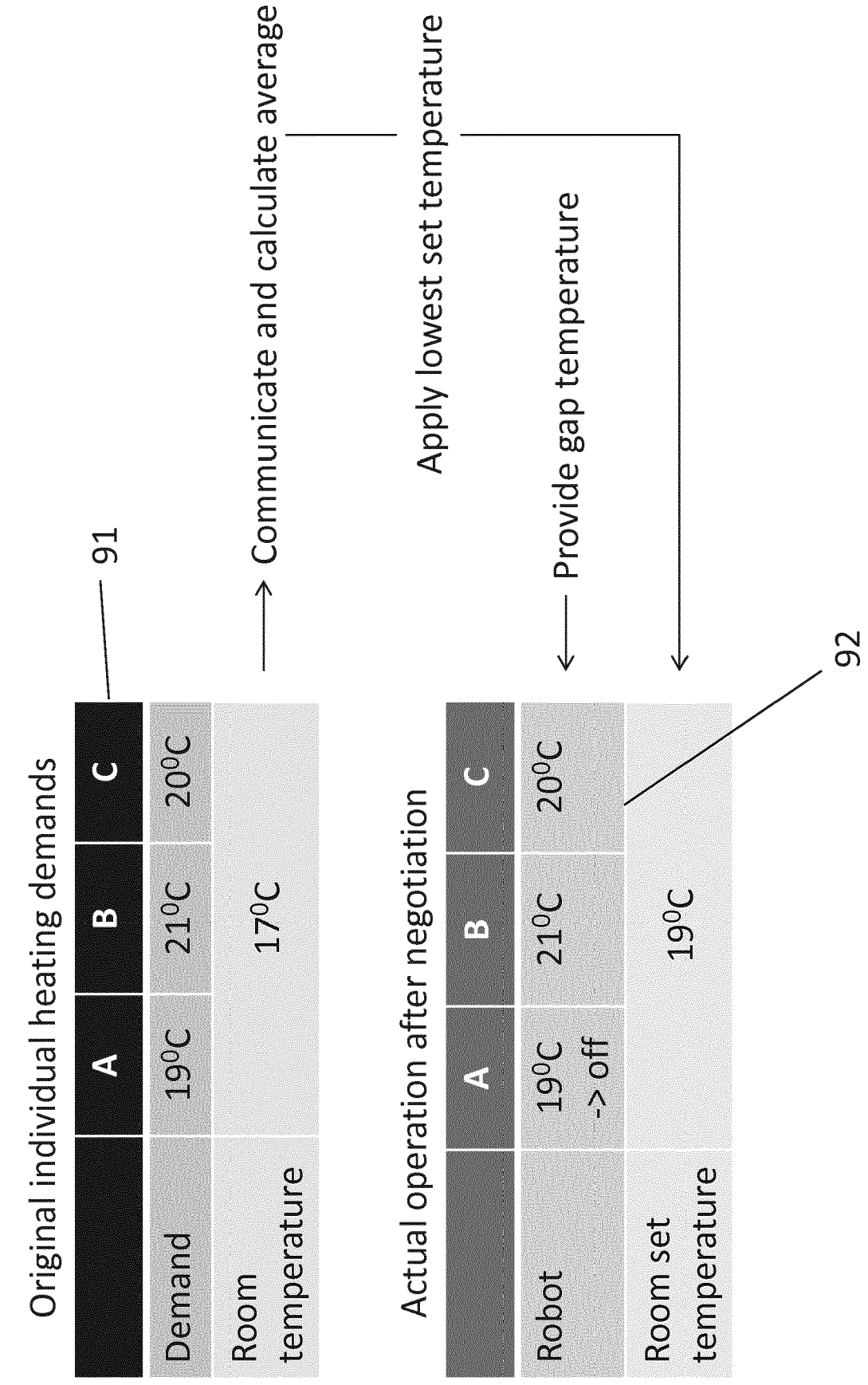
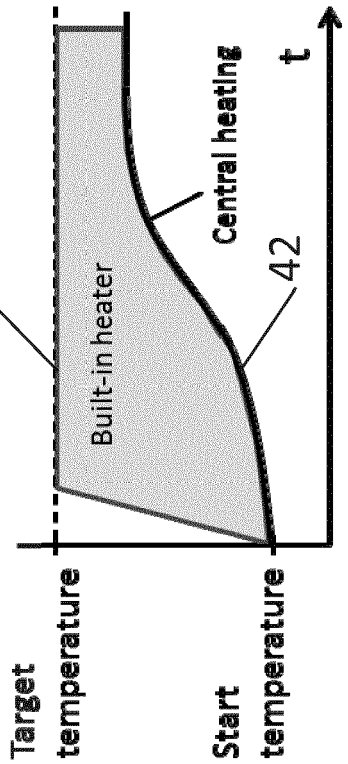

Original individual heating demands
91
A
B
C
Demand
19°C
21°C
20°C
Room temperature
17°C
Communicate and calculate average
Apply lowest set temperature
Provide gap temperature
Actual operation after negotiation
92
A
B
C
Robot
19°C -> off
21°C
20°C
Room set temperature
19°C

Fig. 10


41
Built-in heater
Central heating
42
t
Target temperature
Start temperature

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EUROPEAN SEARCH REPORT

Application Number
EP 17 17 5622

DOCUMENTS CONSIDERED TO BE RELEVANT

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A	* paragraph [0061]; figures 3, 4a *	6,12-16	
Y	US 2006/064204 A1 (KIM JAY-WOO [KR] ET AL) 23 March 2006 (2006-03-23)	1-5,7, 9-11	
A	* paragraphs [0031], [0037], [0038] *	6,12-16	
Y	US 2017/108233 A1 (HOWARD REGINALD BERTRAM [US]) 20 April 2017 (2017-04-20) * abstract *	8	
A	US 2011/271839 A1 (KIM UN KI [KR] ET AL) 10 November 2011 (2011-11-10) * abstract *	1-16	

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F24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 December 2017	Valenza, Davide

CATEGORY OF CITED DOCUMENTS

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05-12-2017

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