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(54) **CONTROL DEVICE AND CONTROL METHOD FOR AN AIR MODIFICATION DEVICE**

(57) A controller is provided for controlling an air modification device, comprising a microphone which picks up sounds from the air modification device. These sounds are analyzed to determine information relating to the space between the controller and the air modification

device. The air modification device is controlled based at least in part on this information in order to ensure suitable air treatment at the location of the controller and hence the user.

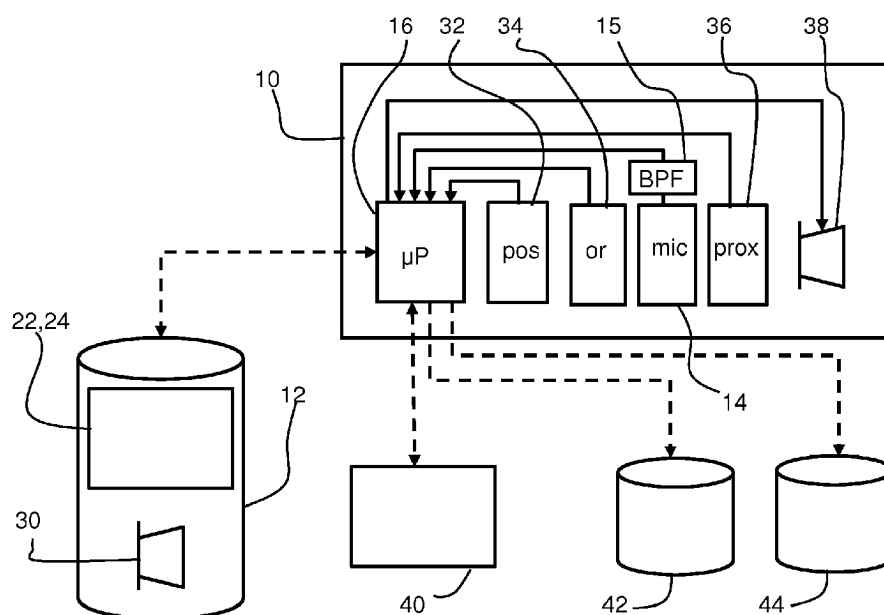


FIG. 2

Description

FIELD OF THE INVENTION

[0001] This invention relates to the control of air modification devices, such as personal air purifiers, humidifiers and/or dehumidifiers, air conditioners or a combination thereof.

BACKGROUND OF THE INVENTION

[0002] Personal air purifiers are designed to filter contaminants such as particles and gasses out of the environment to create healthier air.

[0003] Personal air purifiers have a smaller form factor than devices used to filter rooms, floors or building, with the advantages that (i) they can very locally improve the air quality in the direct environment of the user, (ii) they are portable and (iii) they are more energy efficient, as they modify smaller volumes of air. However, the flexibility to control air quality parameters more locally and in a portable manner requires increased control over adjusting and pre-programming the drive settings since the local conditions are likely to be subject to significant change.

[0004] It is known to test an air purification device in a laboratory setting to characterize the effect which different drive settings have on various air quality parameters around the device. These drive settings are for example different power levels and air flow directions. This knowledge is then used to estimate suitable device settings for the operation desired by the user. Airflow sensors can be used as part of this test procedure to derive capabilities of a system at different locations in a room or building.

[0005] A problem for portable devices in particular is that real life situations are more complex than test settings and can result in an air purification device having quite different capabilities than tested. This can result from an unknown room geometry and layout (e.g. close proximity to walls or furniture, objects that share a surface with the portable air purifier etc.). It can also result from unknown natural airflows within a room, possibly changing over time due to people moving, and doors or windows opening. There may also be interaction with other air modification devices such as a heating ventilation and air conditioning (HVAC) system or other personal air purifiers.

[0006] There is also an issue that degradation of the device or the presence of dirty filters results in increased air resistance and hence different device performance. One option is to perform dedicated air monitoring to provide feedback control. However, such monitoring devices are not widely used and are costly. For a portable personal air purifier, it is not desirable to carry a monitoring system as well and it is desired to maintain a cost as low as possible.

[0007] There is no current solution providing effective

control of a personal air modification device which can be implemented at low cost and with limited testing or calibration burden to the user.

[0008] Further, the problems formulated above also relate to air modification devices that have a fixed position in the room, e.g. hanging on a wall. Traditionally, these devices are configured to modify all the air in a room. However, power consumption or noise can be reduced by modifying only the air in the room that affects the users present in the room, by e.g. determining the location of the users and modify the air in the vicinity of the users only. This disclosure formulates a solution to these problems.

SUMMARY OF THE INVENTION

[0009] The invention is defined by the claims.

[0010] According to examples in accordance with an aspect of the invention, there is provided a controller for controlling an air modification device, e.g. a portable air modification device, comprising:

a microphone; and

a processor,

wherein the processor is adapted to identify and analyze sound from the air modification device thereby to determine information relating to the space between the controller and the air modification device, and to control the air modification device based on the determined information.

[0011] The controller is able to take measurements to test the operation of the air modification device using sound analysis. This is of particular interest because microphone sensors are readily available in a variety of low cost forms. The sound analysis may be performed automatically, for example with test measurements performed in the background as the user is using their device in a normal fashion. The testing may also be dynamic in that test measurements may be performed whenever it is sensed that the possible conditions that influence the air quality or air flow in the environment have changed.

[0012] The air modification device is controlled taking into account the space between the controller (which is where the user is assumed to be) and the air modification device, so that desired functionality (such as air purification) is achieved at the location of the user. The information may relate to the distance and/or other information about the space such as obstacles in the path.

[0013] The controller may further comprise:

a position sensor for determining a position of the controller; and/or

an orientation sensor for determining an orientation of the controller.

[0014] The position of the controller (in particular relative to the air modification device) may for example be

used to control an airflow direction of the air modification device.

[0015] The orientation of the controller may for example be used to interpret more accurately the sound information in that the microphone may have different sensitivity as a function of angle between the sound source (the air modification device) and the microphone.

[0016] The sound information may for example provide a first indication of range, and this may be made more accurate with other sensor information.

[0017] The orientation sensor (when used) may comprise:

- an inertial sensor for determining the absolute orientation; and/or
- a set of microphones for determining an orientation relative to the air modification device.

[0018] The processor may be further adapted to determine changes in the sound in response to changes in settings of the air modification device.

[0019] By providing sound analysis for different settings of the air modification device, a more accurate estimation of the range may be obtained. In particular, different sound outputs may be provided so that additional sound data is captured, giving additional information to be used in the subsequent calculations.

[0020] The processor may be further adapted to determine information relating to the boundaries of the space in which the air modification function is effective.

[0021] The controller may comprise a proximity sensor. This may be used as an additional distance measurement to enhance the information about the space between the controller and the air modification device which has been determined based on sound.

[0022] The processor is for example adapted to determine a range from the controller to the air modification device. This range is determined at least using the sound analysis, but possibly enhanced with the other sensor modalities discussed above.

[0023] The processor may be adapted to implement control of the air modification device based on one or more of fan speed, flow rate, air flow direction and humidification or dehumidification rate. These are parameters which may be adjusted to provide a desired air quality at a particular distance to the user, and possibly also depending on the nature of the space in which the user and the air modification device reside.

[0024] The controller may comprise an audio filter for extracting sounds relating to the air modification device. This filtering enables interference from other sound sources to be removed.

[0025] The controller may comprise a mobile telephone, a tablet or a wearable device.

[0026] There is widespread use of smartphones and tablets to provide remote control of other devices. They are equipped with various sensors, such as one or several microphones, inertia sensors to measure device ori-

entation and movement, a magnetic compass, proximity sensors, as well as the necessary software to analyze the data obtained by such sensors. Similar sensing capabilities can also be integrated into wearable devices such as smartwatches and active earbuds.

[0027] The invention also provides an air modification system comprising:

- a controller as defined above; and
- an air modification device, e.g. a portable air modification device, which is controlled by the controller.

[0028] This provides the combined system of the controller and the portable air modification device. The air modification device for example comprises an air purifier, a humidifier, or a dehumidifier. It may also comprise a sound generating unit so that sound with known characteristics may be processed by the controller. However, the sound of the existing fan of the device may be used as the sound source.

[0029] The invention also provides a method of controlling an air modification device, e.g. a portable air modification device, comprising:

- using a microphone of a controller to detect sound emitted by the air modification device;
- identifying and analyzing the sound from the air modification device to determine information relating to the space between the controller and the air modification device; and
- controlling the air modification device based on the determined information.

[0030] The method may be implemented by a computer program, which is for example in the form of an application to be run on a mobile phone, tablet or wearable sensor device.

[0031] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] Examples of the invention will now be described in detail with reference to the accompanying drawings, in which:

Fig. 1 shows in schematic form an air modification system comprising a controller and a portable air modification device which is controlled by the controller;

Fig. 2 shows the system of Fig. 1 in more detail; and

Fig. 3 shows a method for controlling an air modification device.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0033] Throughout the description reference is made

to a "portable air modification device", this may relate to a device that treats air (purifies and/or conditions air) and which is moveable. The term "portable air modification device" may also be interchangeable by the term "air modification device" or "air treatment device" which relates to a device that treats air (purifies and/or conditions air) and which has a fixed position in a space/room.

[0034] The invention will be described with reference to the Figs.

[0035] It should be understood that the detailed description and specific examples, while indicating exemplary embodiments of the apparatus, systems and methods, are intended for purposes of illustration only and are not intended to limit the scope of the invention. These and other features, aspects, and advantages of the apparatus, systems and methods of the present invention will become better understood from the following description, appended claims, and accompanying drawings. It should be understood that the Figs are merely schematic and are not drawn to scale. It should also be understood that the same reference numerals are used throughout the Figs to indicate the same or similar parts.

[0036] The invention provides a controller for controlling an air modification device, e.g. a portable air modification device, comprising a microphone which picks up sounds from the air modification device. These sounds are analyzed to determine information relating to the space between the controller and the air modification device. The air modification device is controlled based at least in part on this information in order to ensure suitable air treatment at the location of the controller and hence the user.

[0037] Fig. 1 shows an air modification system comprising a controller 10 and a portable air modification device 12 which is controlled by the controller. The air modification device 12 for example comprises an air purifier, a humidifier, or a dehumidifier (or a device which implements a combination of these functions). The air modification device for example comprises a personal air purifier, i.e. a small, typically portable, device that filters a volume of air that is smaller than the total room volume to create a clean or filtered air environment for the user to breathe. The air modification device may also be a traditional air purifier having a fixed position in the room of which the parameters may be controlled by the controller, e.g. increasing fan speed depending on the distance of the user from the air modification device.

[0038] The controller is for example implemented as a mobile telephone, smart watch, tablet, earbud system or other dedicated wireless communications device. It is used to control the air modification device 12 remotely and wirelessly. The controller is intended to be carried by or worn by a user of the system so that the position of the controller is representative of the position of the user.

[0039] The controller 10 has a microphone 14 and a processor 16. The processor is adapted to identify and

analyze sound 18 from the portable air modification device 12 thereby to determine information relating to the space between the controller and the portable air modification device, and to control the portable air modification device based on the determined information. There may be a plurality of microphones to provide additional directionality information.

[0040] The controller 10 is able to take measurements to determine the operation of the air modification device using sound analysis.

[0041] The air modification device 12 comprises an air outlet 20, a fan 22 for controlling an air flow rate from the air outlet and a direction controller 24 for controlling an output flow direction. Thus, the control of the air modification device may involve control of the air flow rate and the air flow direction, and the humidification or dehumidification rate.

[0042] The sound analysis may be performed with reference to a "standard sound" which is a sound or tone with known characteristics such as volume, frequency or spectral characteristics (i.e. relating to an audio signature). The sound may be generated by the fan or other components of the air modification device 12, or there may be a dedicated speaker for this purpose.

[0043] Fig. 1 shows only the most basic set of features which may be present in the controller and air modification device.

[0044] Fig. 2 shows a more complete system diagram showing additional optional elements which are discussed further below.

[0045] It shows that the air modification device 12 additionally may comprise a speaker 30 for generating the "standard sound" recognized by the controller 10.

[0046] The microphone 14 is used to measure the volume of the standard tone produced by the air modification device, which can be used to calculate the absolute distance between the air modification device and the controller. A band pass filter 15 enables noise or background sounds to be removed, and pass the known frequency of the sounds to be analyzed.

[0047] In addition to the microphone 14, the controller is shown with another set of sensors which may generally be described as location sensors. They include an absolute position sensor 32 such as a GPS system as is common in smart phones, an orientation sensor 34 for example in the form of inertia sensors and a proximity sensor 36 for measuring a distance to a remote object (i.e. the air modification device). The location sensors for example enable calculation of one or more of:

- the absolute distance between the controller and the air modification device;
- the direction of the microphone with respect to the air modification device or direction of the airflow created by the air modification device with respect to the microphone;
- the location of the controller and/or air modification device with respect to objects, such as walls, furni-

ture, etc.

[0048] The controller also optionally has a speaker 38 which may be used to send a sound command to the air modification device, which may then return with the generation of a sound at a known time.

[0049] The processor 16 uses an algorithm to process the sensor data and generate suitable control commands for the air modification device. This algorithm may be hosted locally, or it may be remote as shown by unit 40.

[0050] The algorithm 40 for example comprises an airflow characterization algorithm that is able to receive as input the airflow settings of the air modification device, and the sensor data (i.e. the combination of the audio sensor data and the location sensor data) and based on this calculate the range between the controller and the air modification device, as well as making additional assessments about the space between them, as discussed further below.

[0051] The algorithm 40 may also receive as input an indication of the range of operation of the air modification device (for example taking into account all external influences such as externally induced airflows, objects in the environment or degradation of the air modification device). Based on the desired range or other factors such as tolerable noise levels, energy usage etc., the optimal air modification device settings are calculated to meet the requirements as best possible.

[0052] A lookup table 42 stores audio signatures which provide a mapping between airflow characteristics and the resulting audio characteristics. These audio signatures describe the expected audio sensor data for combinations of airflow settings and location sensor data based on an undisturbed airspace, such as an empty room. This data is derived from a test setting by the manufacturer.

[0053] A further lookup table 44 stores further audio signatures that give for certain audio sensor data a value or description of possible user location information. For example, detected breathing or detected voice volume may be associated with the user being very close (e.g. < 0.5 m) or reasonably close (e.g. < 2 m) respectively. The settings of an air purifier may for example be adapted to specific environmental sounds, such as the user being close or far away, more people being in the room, a window being open. If several microphones are used (at the controller or even distributed in the general space) this may be used to give more information than distance alone, e.g. relative direction and/or orientation of the user.

[0054] The way the system may be operated will now be described.

[0055] Initially, the air modification device is operated with selected airflow settings, as set by the user or automatically determined by the device (e.g. based on air quality sensor readings).

(i) Audio data

[0056] The microphone of the controller then captures the audio data. This may take place as part of a calibration procedure that is started manually by the user, e.g. using a smartphone app during setup of the air modification device or when changing its placement or environment or airflow settings.

[0057] A test may instead be performed automatically, either as a regular check of the workings of the air modification device, or when it initiates its operation or is given a new setting, or when a change in the environment is detected such as different air quality readings, changed airflows, changed location of the user, changed number of users within range of the air modification device.

[0058] The distance is for example determined based on capturing the standard sound and, based on the measured volume, the distance is estimated, e.g. using a known relation between volume and distance.

[0059] The audio measurement may not only be used to measure the distance between the controller and the air modification device. Examples of other functions of the audio analysis are gathering environmental audio signatures (walls, objects, airflow obstructions), obtaining information about user location or orientation (e.g. close to the purifier, facing the purifier) and characterizing the air purifier status (moving parts working correctly, change of air filter needed).

(ii) Location data

[0060] The location sensors of the controller also capture the location sensor data. This data for example may include a further non-audio based estimation of the distance between the controller and the air modification device. The distance may for example be determined using the proximity sensor which is for example an infrared laser or ultrasound based time-of-flight depth sensor.

[0061] A proximity sensor is a more accurate alternative for measuring distance between the controller and the air modification device, but is not always desired, because it requires line of sight and also may require effort from the user to make sure the right distance is being measured. Even if the distance is measured with a different method than a sound measurement, acoustic analysis may give other useful information about the workings of the air purifier or the space between the controller and the air modification device, for instance if the air purifier is within line of sight, but still surrounded by objects or walls that obstruct the free flow of air currents.

[0062] The distance measurement may be made using location sensors based on time-of-flight methods. In that case, one of the following three approaches may be adopted:

- (i) synchronization between the two devices to calculate the time between the audio signal being generated and being received.

(ii) in response to a first audio signal from the controller (using speaker 38), the air modification device generating a second audio signal (using speaker 30) with a precisely known time interval after the first signal was received. This is then detected by the microphone 14. The total time difference corresponds to the time-of-flight plus all necessary processing time and can be used to calculate the distance.

(iii) generating a directed ultrasound signal and measuring the time it takes for the signal to travel back after being reflected.

[0063] The orientation of the microphone with respect to the air output of the air modification device may be also determined, for example using inertia sensors (for example indicating if the microphone is pointing upwards/downwards). Orientation may also be determined by changing the airflow settings to change the airflow direction created by the air modification device and, based on the direction with the highest volume, perform the processing when the airflow is directed at the controller. The relative recorded volumes at multiple microphones may also be used to infer from which direction the sound is coming.

[0064] Note that orientation is only of relevance in some cases. For example, for a humidifier or dehumidifier or when the airflow is not directional, orientation may not be needed. In such cases the location sensor data is based on the measured distance and optionally the direction of the microphone.

[0065] The distance and orientation with respect to other objects might be captured as additional location sensor data. For example, the specific x,y,z-coordinates of both the controller and the air modification device within a local room map or 3D environment scan might be determined using a 3D-scanning module contained within the controller.

[0066] The location of the air purifier within a room may influence its performance, for instance when the air purifier is placed within a confined space where the created air currents are obstructed (close to a wall or next to big objects such as furniture). The sound measurement may provide information about the environment, which may be used to adjust the settings of the air purifier.

[0067] One option is the acoustic analysis of a generated signal to obtain environmental knowledge. For example, a sharp reflection may indicate the presence of a wall, muffling of a sound may indicate objects or persons in between the air purifier and controller.

[0068] Another option involves acoustic signatures. If the preferred settings of the air purifier in a certain location have previously been acquired (e.g. using a testing or calibration method), acoustic signatures may indicate if the air purifier is placed in the same or perhaps a similar location, and the preferred settings can be automatically taken from a database.

(iii) Range calculation

[0069] The algorithm 40 estimates the actual range of the controller. For example, the audio sensor data, the airflow settings and the location sensor data are input into the algorithm. These inputs are compared to the stored audio signatures, i.e. the expected audio sensor data that would be associated with the selected airflow settings and location sensor data in a standard setting are compared to actually measured audio sensor data.

[0070] Based on this, the actual range is calculated. For example, a correction function is applied to the standard calibration data to obtain the actual range to the controller. Using this correction factor, the dimensions of the airspace within which the air modification device operation is effective may be calculated.

[0071] The correction function may be a multiplication factor. For example, if the air modification device is in a confined space, it might have a larger actual range. The correction may be a translation of the airspace volume, for example if strong external air currents are present, the airspace volume might be shifted. For given air flow settings (e.g. power) the range will decrease when creating airflows against the external air current, but will increase when creating airflows in the direction of the external air current.

[0072] The correction function may be a more complex location specific correction function such as a function that changes when measured at various coordinates. This might be the case if objects, walls, etc. within the airspace have a varying influence on the local air currents and thus the actual range. Optionally, the actual range may be extrapolated for different airflow settings, for example by applying a standard, power dependent scaling factor, or by using information obtaining measurements at different airflow settings.

(iv) Control of the air modification device

[0073] If the desired characteristics in the airspace within range of the air modification device are not met, the algorithm 40 changes the airflow settings and the air modification device is controlled accordingly. This may be done in such a way as to correct for the measured differences between the air modification device range from the calibration settings and its actual range. This may involve dynamically changing the power until the audio data matches the expected data for the desired airspace characteristics. The measured actual range, the desired airspace characteristics and the data from the lookup tables may be used to determine the most suitable change to the airflow settings.

[0074] As mentioned above, the signal analysis may follow a dynamic routine or it may be triggered manually by the user.

[0075] In one possible approach, the air modification device changes its settings (such as airflow speed and direction) with the purpose of improving the audio meas-

urement and thus the estimation of the range to the air modification device and/or other information relating to the space between the controller and the air modification device.

[0076] These settings are for example incorporated into a program which aims to create settings such that the desired airspace characteristics are obtained, whilst maximizing the quality of the obtained audio sensor data. For example, test settings may be imperceptible to (or ignored by) the user when activated but have a specific pattern associated with them that can be detected by the controller.

[0077] The settings may be activated at times that minimize inconvenience for the user, e.g. when the user is detected to be away, or expected to be minimally disturbed by temporary fluctuations in the output of the air modification device (e.g. when listening to loud music).

[0078] The settings may also be activated at moments that are dependent on the location of the controller, so that dynamic testing can be automatically performed to obtain several measurements at a set of selected locations of the controller. The changing of the controller location can be done either intentionally (as part of a testing routine) or as the user uses their device for other purposes (e.g. smartphone usage).

[0079] The dynamic testing for example involves one of more of:

- increasing the fan speed to lift the noise level above a detectable threshold;
- changing the direction of the air flow to optimize the audio signal quality that is detected by the microphone, or to obtain a sense of in which direction certain obstructions might be present; and
- executing a pre-determined sequence of standard settings which may give acoustic information about the state of the air purifier, e.g. if the fan and/or stepper motor are working correctly, or if the filter needs to be replaced. The accuracy of this scenario depends on how well the acoustic properties of the air purifier are acoustically characterized by the manufacturer.

[0080] In another possible approach, the position and/or orientation of the user influences the desired settings of the air modification device. The controller is for example a wearable device such as a smartwatch, active earbuds or headphones, that thus can infer not only the boundary within which the air modification device function is effective, but also the spatial position and optionally also orientation of the user within the modified airspace. This can be used to dynamically adapt the airspace in which the air modification device function is effective to the user's location. For example, the range of the air modification device may be altered to match the actual location of the user.

[0081] By way of example, the controller may be implemented as active earbuds which perform a measure-

ment automatically when the user is close to the air modification device and when the user is further away. When performing a measurement at a later time, the controller can wait for the user to be at the same location with the same head orientation, for optimal calibration of the airflow settings.

[0082] The captured audio sensor data may be used to detect user location signatures, in order to estimate the user's location with respect to the controller and the air modification device. This may also be used to adapt dynamically the airflow settings as the user is detected to move into or out of the airspace within which the air modification is effective or change their location within the airspace.

[0083] The audio analysis may be used to determine other characteristics of the environment that have a consequence on the working of the air purification, device by picking up additional sounds from the environment.

[0084] Fig. 3 shows a method of controlling a portable air modification device.

[0085] In step 50, the air modification device is operated with previously determined settings. These will initially be default settings or else user-input settings.

[0086] In step 52, a microphone of a controller is used to detect sound emitted by the portable air modification device.

[0087] In step 54, optionally, the controller location is determined using location sensors.

[0088] In step 56, the sound from the portable air modification device is identified and analyzed to determine information relating to the space between the controller and the portable air modification device. This is for example based on an airflow characterization algorithm.

[0089] In step 58, the settings of portable air modification device are altered based on the determined information. This changes the settings to be used in step 50.

[0090] As discussed above, embodiments make use of a processor. The processor can be implemented in numerous ways, with software and/or hardware, to perform the various functions required. The processor employs one or more microprocessors that may be programmed using software (e.g., microcode) to perform the required functions. The processor function may be implemented as a combination of dedicated hardware to perform some functions and a processor (e.g., one or more programmed microprocessors and associated circuitry) to perform other functions.

[0091] Examples of components that may be employed in various embodiments of the present disclosure include, but are not limited to, conventional microprocessors, application specific integrated circuits (ASICs), and field-programmable gate arrays (FPGAs).

[0092] In various implementations, a processor or controller may be associated with one or more storage media such as volatile and non-volatile computer memory such as RAM, PROM, EPROM, and EEPROM. The storage media may be encoded with one or more programs that, when executed on one or more processors and/or con-

trollers, perform the required functions. Various storage media may be fixed within a processor or controller or may be transportable, such that the one or more programs stored thereon can be loaded into a processor or controller.

[0093] The invention is of particular interest when a user wants to measure or calibrate the functioning of their personal air purifier using a personal device such as a smartphone or computer. The personal air purifier may then dynamically adapt its settings to a changing environment, such as the creation of air currents by opening/closing of doors and windows, the relocation of objects that block air flows, relocation of the air purifier itself, of people within the personal airspace, changes in the user's average head location/orientation, etc.

[0094] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. A controller (10) for controlling an air modification device, comprising:
 - a microphone (14); and
 - a processor (16),
 - wherein the processor is adapted to identify and analyze sound from the air modification device thereby to determine information relating to the space between the controller and the air modification device, and to control the air modification device based on the determined information.
2. A controller as claimed in claim 1, further comprising:
 - a position sensor (32) for determining a position of the controller; and/or
 - an orientation sensor (34) for determining an orientation of the controller.
3. A controller as claimed in claim 2, wherein the orientation sensor (34) comprises:
 - an inertial sensor for determining the absolute orientation; and/or
 - a set of microphones for determining an orientation relative to the air modification device.
4. A controller as claimed in any preceding claim, wherein the processor is further adapted to determine changes in the sound in response to changes in settings of the air modification device.
5. A controller as claimed in any preceding claim, wherein the processor is further adapted to determine information relating to the boundaries of the space in which the air modification device is effective.
6. A controller as claimed in any preceding claim, comprising a proximity sensor (36).
7. A controller as claimed in any preceding claim, wherein the processor is adapted to determine a range from the controller to the air modification device.
8. A controller as claimed in any preceding claim, wherein the processor is adapted to implement control of the air modification device based on one or more of fan speed, flow rate, air flow direction, humidification rate and heating/cooling of air.
9. A controller as claimed in any preceding claim, comprising an audio filter (15) for extracting sounds relating to the air modification device.
10. A controller as claimed in any preceding claim, comprising a mobile telephone, a tablet or a wearable device.
11. An air modification system comprising:
 - a controller (10) as claimed in any preceding claim; and
 - an air modification device (12) which is controlled by the controller.
12. A system as claimed in claim 11, wherein the air modification device comprises at least one of: an air purifier, a humidifier, a dehumidifier, an air conditioner.
13. A system as claimed in claim 11 or 12, wherein the air modification device comprises a sound generating unit.
14. A method of controlling an air modification device, comprising:
 - using a microphone of a controller to detect sound emitted by the air modification device;
 - identifying and analyzing the sound from the air modification device to determine information relating to the space between the controller and the air modification device; and

controlling the air modification device based on the determined information.

15. A computer program comprising computer program code means which is adapted, when said program is run on a computer, to implement the method of claim 14.

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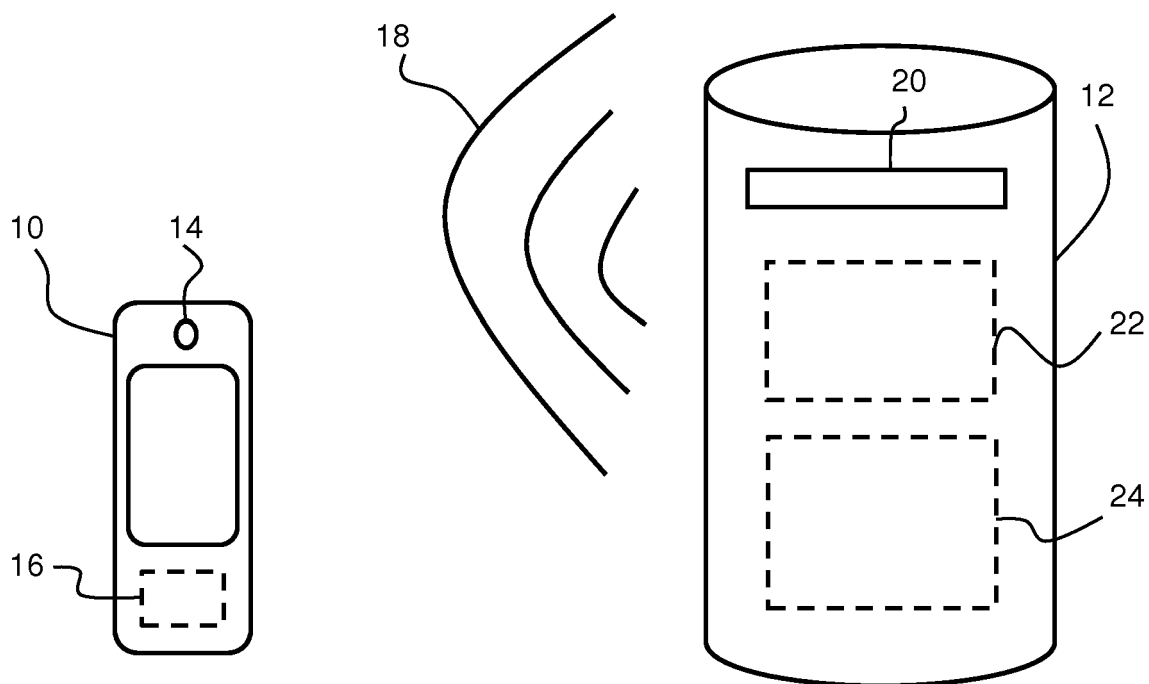


FIG. 1

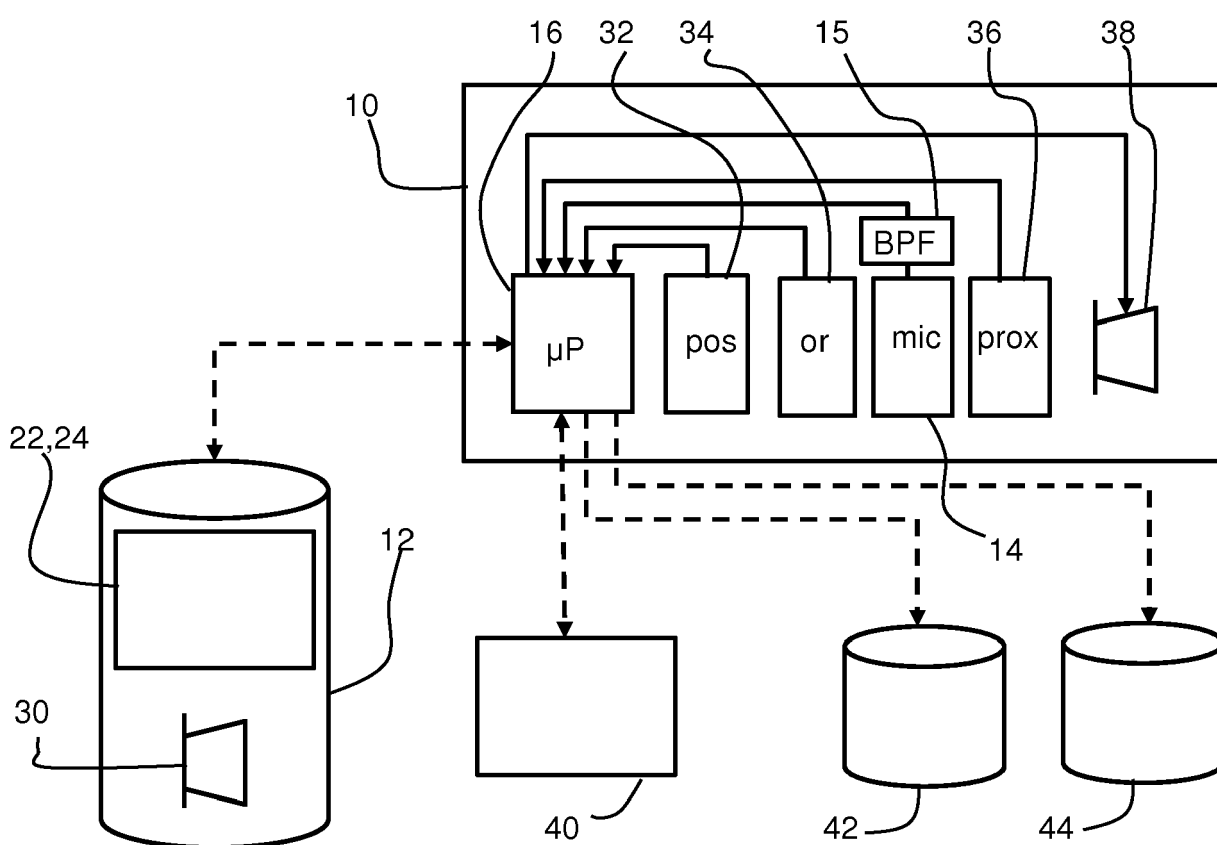


FIG. 2

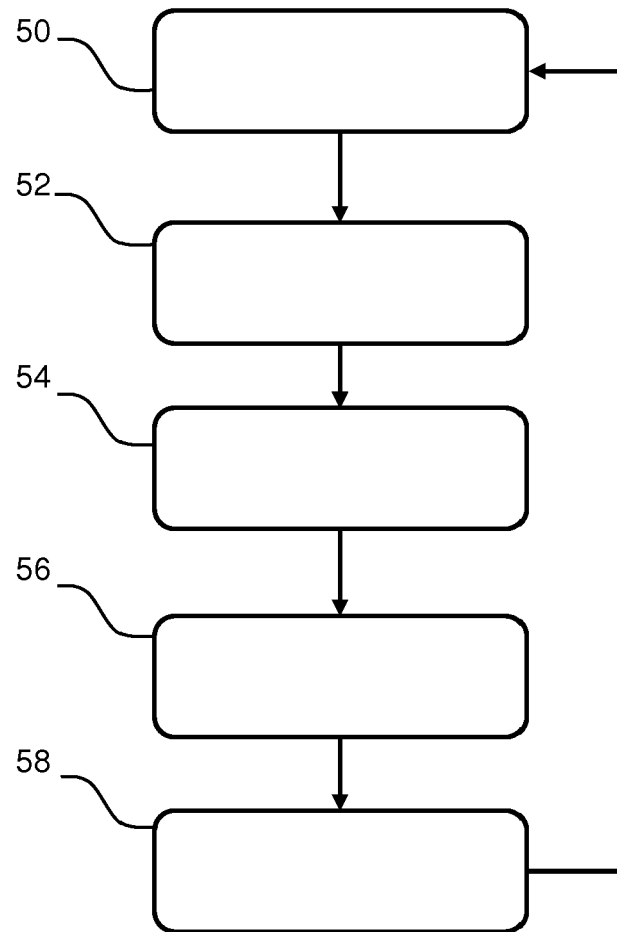


FIG. 3



EUROPEAN SEARCH REPORT

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Place of search Munich		Date of completion of the search 26 June 2018	Examiner Djemour, Anna
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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