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(54) PATIENT MONITORING DEVICE AND ARRANGEMENT

(57) The present invention concerns a patient monitoring device (1) as well as a patient monitoring arrangement.

The inventive patient monitoring device (1) comprises attachment means (3) to mount the device (1) to a surface in a vibration transferring way, sensor elements (10) for continuously detecting measurements reflecting the surroundings of the patient monitoring device (1) and a communication module (20) to transmit the measured values to a central evaluation unit (30). The sensor elements (10) comprise an accelerometer (11), a noise detector (12), a far infrared sensor element (13), a CO_2 sensor element (15), and a light sensor element (16), wherein all sensor elements (10) are suitably arranged relative to the attachment means (3) to detect their respective measurements.

The inventive patient monitoring arrangement further comprises a central evaluation unit (30) connected to patient monitoring device(s) (1) for transmitting their respective measured values, which is configured to
- warehouse the received continuously measured values;
- determine and/or update a typical variation in the measurements during a day;
- determine discrepancies in the measured values from the typical variations during a day; and
- put out an alert in case a severe discrepancy is determined.

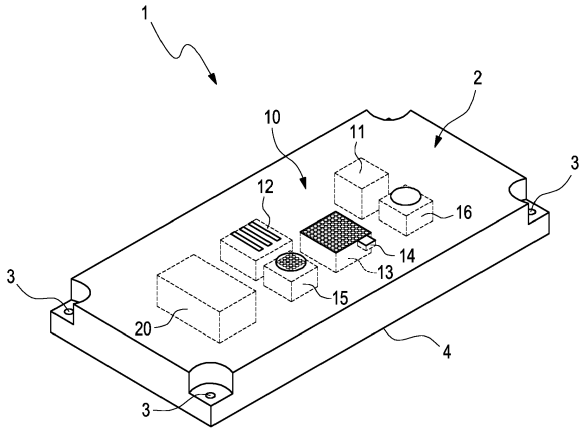

Fig. 1

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Description

[0001] The present invention concerns a patient monitoring device as well as a patient monitoring arrangement.

[0002] The demographic change and the increasing part of the elderly in the population will most likely lead to serious difficulties with care services in the short or at least medium term, especially since there is a trend towards elderly people living alone. For example, it may be estimated that of the 8 million people over 65 in Germany in 2019 approximately 2 million people will eventually require care services provided to their homes. Especially, since most of those people cannot afford private home care, efficient and effective care services are required.

[0003] Since general daily visits by a human care person to check the health and status of all patients will most likely not be possible in the near future due to lack of personnel and costs, there are various approaches to use technology in order to avoid the need for daily visits at patients not necessarily requiring actual assistance each day, while at the same time ensuring the alerting of support persons in the case of both a declining trend or an emergency.

[0004] A currently rather widespread technology is the use of an emergency button system to be worn by the patients, e.g. like a necklace or a wristband. The system comprises a button to be pressed in case of an emergency by the patients to remotely initiate an alarm signal at an operation center, which then can send help. Disadvantage of this system are the low acceptability of actually wearing the emergency button system at all times as well as the requirement of the patient actively pushing the emergency button. The latter is simply not viable in case of emergencies where the patient becomes demented, forgetful, anxious or unconscious. Furthermore, it became apparent that the system is prone to false alarms or misuse, e.g. in case a patient feels lonely and uses the emergency button for a person to simply come visit faking an emergency is far more prevalent.around.

[0005] Another technology currently investigated is the use of video surveillance and potentially artificial intelligence for evaluating the recorded pictures. However, the vast amount of video data created as well as the required computational power to process the data are almost prohibitive. Furthermore, for any video surveillance to be effective, it needs to be installed in every room of a patient's home which generally lacks acceptance due to the extreme invasion of privacy.

[0006] Emergency systems based on speech recognition also exhibit at least some of the disadvantages of the previously described systems. While a speech based system does not require the patient to constantly wear a device, it also requires the patient to actively call for help usually by using a specified word sequence, which is impossible in cases of unconsciousness and at least problematic for patients suffering memory loss. Depending on the actual configuration of such systems, they may also be objectively seen or subjectively felt as invasive to the patient's privacy and thus might lack acceptance.

[0007] It is thus an object of the present invention to provide an improved patient monitoring device and arrangement, which does not or at least only to a lesser extent suffer the disadvantages of the prior art.

[0008] This object is solved by a patient monitoring device according to claim 1 as well as a patient monitoring arrangement according to claim 9. Preferred embodiments are the subject matter of the dependent claims.

[0009] The present invention concerns a patient monitoring device comprising attachment means to mount the device to a surface in a vibration transferring way, sensor elements for continuously detecting measurements reflecting the surroundings of the patient monitoring device and a communication module to transmit the measured values to a central evaluation unit, wherein the sensor elements comprise

- an accelerometer
- a noise detector;
- a far infrared sensor element;
- a $C0_2$ sensor element; and
- a light sensor element,

wherein sensor elements are suitably arranged relative to the attachment means to detect their respective measurements.

[0010] Furthermore, the present invention concerns a patient monitoring arrangement comprising at least one patient monitoring device according to one of the preceding claims and a central evaluation unit, wherein the monitoring device(s) and the central evaluation unit are connected for the monitoring device(s) to transmit the measured values to the central evaluation unit, wherein the central evaluation unit is configured to

- warehouse the received continuously measured values;
- determine and/or update a typical variation in the measurements during a day;
- determine discrepancies in the measured values from the typical variation in the measurements during a day; and
- put out an alert in case a severe discrepancy is determined.

[0011] The invention is based on the insight that by combining a certain set of common and rather unsophisticated sensor elements for continuous measurements,

a sufficient and reliable monitoring of patients is possible without severely intruding the privacy of a user and resulting only in a manageable amount of data to be processed in order to automatically determine a potential emergency situation. Due to the simplicity of the sensor elements the inventive patient monitoring device also allows for cost-effective production.

[0012] "Continuous measurements" in context of the present invention encompasses a constant taking of measurements of a sensor as well as periodic taking of measurements in short intervals of e.g. 5 to 20 seconds, preferably of approx. 10 seconds.

[0013] The patient monitoring device is configured to be mounted to a surface so that the accelerometer can detect vibrations of said surface. The surface can preferably be the wall of a room in a patient's home. Alternatively, an item, e.g. a piece of furniture, within the room may provide a surface for the patient monitoring device to be mounted to. However, in order for the patient monitoring device to be able to detect the vibrations most relevant for patient monitoring, the item preferably transfers vibrations of the floor of a room to the patient monitoring device while at the same time not being moved around too often. For example, a bookshelf, wardrobe, a desk or a table might be suitable items for the patient monitoring device to be mounted to, while light chairs often are not. With the accelerometer, the inventive patient monitoring device - if suitably mounted - is usually capable of detecting footsteps and falls of a human. For this and greatly reducing the requirements for the mounting of the patient monitoring device, the accelerometer preferably is configured to detect vibration and movement in three perpendicular axis, including especially the Z axis capturing vertical vibration on surfaces from floors due to human movements. This way, the accelerometer can register any vibration in all directions in space.

[0014] The noise detector of the patient monitoring device allows the registration of noises in the surroundings of the patient monitoring device. The invention realized that for the present monitoring purposes, it is sufficient to measure the noise level and, eventually, the noise frequency. Explicitly, the recording of speech or voice recognition is not required, thus the privacy of humans close to the patient monitoring device is secured. Preferably, the maximum resolution of the noise detector is even restricted to a resolution insufficient for recording speech. With this restriction of the actual hardware used as a noise detector, the low invasion of privacy can be guaranteed and verified by external parties.

[0015] The far infrared sensor element may help to identify the presence of a person in the surroundings of the patient monitoring device. For this, single infrared sensors or arrays of infrared sensors may be used. In the latter case, it is preferred that the infrared sensor array has a resolution sufficient for differentiating a human from the environment but insufficient to reflect the human's detailed movements and actions. The resolution is thus preferably sufficient to reliably detect the present of a human being and to e.g. distinguish a human from a heater or an animal such as a dog, while at the same time not allowing to identify what a detected human is actually doing even in case the detected temperatures are illustrated in the form of a heat map. Again, this helps to ensure the privacy of a user and can be guaranteed and verified by external parties.

[0016] It is preferred that the far infrared sensor may detect body temperature from at least 7 meters away. A suitable array of infrared sensors with a resolution sufficiently low to be able to determine the presence of a human but not to picture the actual activity of the human are the MLX90621 by Melexis NV, Belgium, which offers a resolution of 16x4 Pixels in a viewing field of up to 100°x25°, or the AMG8833 from Panasonic, JP which offers a resolution of 8x8 Pixels at a viewing angle of approx. 60° and a temperature depth of 127 gradients per pixel.

[0017] With the CO_2 sensor element either the total concentration or at least relative changes in concentration of CO_2 in the air surrounding the patient monitoring device can be monitored. Apart from human respiration, this sensor element may hint at certain human actions as well as certain emergencies. For example, the CO_2 sensor element in a patient monitoring device mounted in a kitchen might be utilized to hint a human to be cooking as a sign of him getting sufficient nutrition but also help to detect fire due to a left on stove. Preferably, the $C0_2$ sensor elements is integrated in or supplemented with a TVOC ("total volatile organic compounds") sensor element, which can provide additional information on the status of the surroundings of the patient monitoring device and, especially the status and health of a human therein. With a TVOC sensor elements, alcohol, cleaning fluids, cooking smells, biological smells form the bathroom might be registered.

[0018] The light sensor of the patient monitoring device can be used to provide supplemental information about the general activity and/or the occupancy in a room. During daytime, the light sensor can help to recognize whether the window shades have been opened, during nighttime whether the light is switched on. Preferably, the light sensor element is capable of distinguishing between natural and artificial light. Especially due to the rise of energy saving light sources that have a spectrum very different from that of natural light, this distinction can easily be made.

[0019] In addition, the patient monitoring device may comprise an ambient temperature sensor element, preferably suitable to calibrate the far infrared sensor element to provide the absolute body temperature of a human. This way, not only can a human presence be detected by the far infrared sensor element, but his absolute temperature can also be obtained.

[0020] Furthermore, the patient monitoring device may comprise means to measure the signal strength of Wi-Fi-signals of Wi-Fi-devices in the surroundings. Due to many people carrying a Wi-Fi-device - e.g. a smartphone

or a smartwatch - around with them, the signal transmitted by said Wi-Fi-device may be used to help detecting the presence of a person. The sensor device detecting the Wi-Fi-signal strength may be provided as a function of the communication module described below.

[0021] Additional sensors may comprise a pressure and/or humidity sensor element, a magnetic field sensor element and/or a sensor element suitable for detecting electromagnetic interference of e.g. a cooker, a heater or a washing machine.

[0022] All sensor elements present in an inventive patient monitoring device are arranged in a way that they provide generally unbiased measurement results if the patient monitoring device is correctly mounted. Regularly, all sensors requiring direct access to the surroundings of the patient monitoring device are arranged connected to a surface of the monitoring device not being used for mounting by e.g. means of an opening.

[0023] It must be noted that none of the sensor elements cited above as such is sufficient to monitor a patient. Furthermore, it is generally not possible to define any common rules for determining an emergency situation or the like. However, it has been realized by the present invention that continuously monitoring at least the sensor elements cited in the main claim can, over a certain period of time, provide an image of a typical daily routine of a patient in form of measurements. While these data do generally not allow detailed conclusions on a patient's actual activity, they are sufficient to assume an emergency or other kind of problem in case they show a large deviation from the patient's daily routine. This is especially the case if all regularly used rooms of a patient's house or flat, including the bathroom, are equipped with an inventive patient monitoring device.

[0024] In order for the data provided by the various sensor elements of the patient monitoring device to be processed and analyzed to determine typical variations in the measurements during a day and/or discrepancies from said typical variations, the inventive device does not comprise any processing means itself but rather relies on a communication module to transmit the measured values to a central evaluation unit, where the actual processing of data happens. Apart from this setup usually being more cost-effective, the centralized processing of data facilitates the co-processing of measured data of a plurality of related patient monitoring devices, e.g. all monitoring devices present in a patient's house or flat. Furthermore, if the measured data of the patient monitoring devices of a plurality of patients are processed by a mutual centralized evaluation unit, comparative analysis of measurements obtained for different patients becomes possible, potentially helping in identifying anomalies in a patient's behavior. Also, by having the data of a plurality of patients centrally processed, identified emergency cases can be prioritized.

[0025] Preferably, the communication module is configured to connect to a Wi-Fi and/or a mobile network to transmit the measured values to the central evaluation unit. The actual data transfer may be handled via any arbitrary data transport scheme, e.g. as used for the internet. Preferably, the communication module comprises an intermediate storage memory to buffer the measured values. The intermediate storage memory may be used only in cases the communication module temporarily loses its connection. Preferably, however, the intermediate storage memory may be utilized to provide a generally batchwise transmission of the measured values. This allows the connection of a patient monitoring device to be active only in intervals, which can save both energy and network load. Of course, the batches need to be transmitted in sufficiently short intervals to still allow for a near-realtime monitoring of the patient. However, typical and sufficient intervals for transmitting batches of measured values might e.g. be every minute or every 30 seconds.

[0026] Preferably, the data provided to the central evaluation unit is timestamped by the patient monitoring device, i.e. for each measured value the time of the actual measurement is derivable. This allows the correct allocation of measured values to their respective actual measurement times, even in case there is no live feeding of the measured values to the central evaluation unit. Said time stamps, usually provided by the patient monitoring device and/or the sensor units, are preferably synchronized to a common accurate clock source (e.g. a radio time signal like DCF77 or an internet time server like an NTP server). This allows all measurements, even from different patent monitoring devices, to be accurately allocated the correct time.

[0027] The central evaluation unit - as e.g. present in the inventive arrangement - is configured to receive and save, i.e. warehouse the received continuously measured values of all sensor elements of all patient monitoring devices connected thereto, at least temporarily. Based on the received data, the typical variation in the measurements during a day can be determined or - if preexisting - updated. For this, the measured values of several patient monitoring devices that are logically related, e.g. because being installed in the same house or flat, may be processed and analyzed concurrently in order to better determine the potential deviations of the typical variation in the measurements. General mathematical methods to derive typical variations in data series and sets of data series are known in the prior art. A skilled person can readily utilize on these known mathematical foundations and apply them to the data gathered by the inventive device.

[0028] In case typical variation in the measurements during a day are determined, any discrepancies in future measured values from the typical variations during a day may be determined and assessed for relevance. For this, the co-processing of the measured values of related patient monitoring devices may be helpful since a discrepancies in the measured values of a first patient monitoring device from its typical variation in the measurements during the day may either be countered or amplified by a respective discrepancy in the measured values of a sec-

ond patient monitoring device relating to the first patient monitoring device. Again, general mathematical methods to determine and assess said discrepancies are known.

[0029] In case a severe discrepancy is determined, the central evaluation unit may put out an alert. This alert could, for example, be forwarded to an operation center, which may automatically or manually try to contact the patient in question by e.g. phone in order to remotely check his wellbeing or inform care staff to personally check on the patient. It is also possible to provide a gradually increasing alert, which is initiated by a first discrepancy and is gradually increased in case of the first discrepancy persisting or additional discrepancies being determined. This allows identifying impending emergencies in advance.

[0030] Due to the likelihood of different living routines for various days of a week, it is preferred that the typical variation in the measurements during a day is determined weekday-specific. This way, weekly routines may be more easily be taken into account without potentially causing a false alert.

[0031] It is preferred if a severe discrepancy is established in view of the standard variance of the measured values of a measurements and/or a combination of severe discrepancies for two or more measurements. As already mentioned above, also the measured values of a plurality of related patient monitoring devices may be considered when establishing a severe discrepancy.

[0032] The invention will now be described in further detail in regard to the enclosed figure:

Figure 1: a schematic illustration of a first embodiment of a patient monitoring device according to the pre-sent invention; and

Figure 2: a schematic diagram of a first embodiment of a patient monitoring arrangement according to the invention utilizing a patient monitoring device according to figure 1.

[0033] Figure 1 shows the schematics of a first embodiment of a patient monitoring device 1 according to the present invention. Elements, which are inside the patient monitoring device 1 and thus not actually visible are depicted in broken lines.

[0034] The patient monitoring device 1 comprises of a housing 2 with mounting holes as attachment means 3 to fixedly mount the patient monitoring device 1 with its bottom 4 to a surface, e.g. a wall. The attachment means 3 allow a mounting of the patient monitoring device 1 that transfers all vibrations from the mounting surface to the device 1.

[0035] The housing 2 of the patient monitoring device 1 holds a plurality of sensor elements 10, wherein some of the sensor elements 11 are fully encapsulated by the housing 2, while other sensor elements 12, 13, 14, 15, 16 are connected with the outside by means of apertures in the top 5 of the housing 2.

[0036] One sensor element 10 is an accelerometer 11, which is configured to detect vibration and movement in three perpendicular axis. In case the patient monitoring device 1 is rigidly mounted to e.g. a wall, the accelerometer 11 can detect even the slightest vibrations caused by e.g. a person walking in the room surrounded by the wall, the device 1 is attached to.

[0037] The device 1 also comprises a noise detector 12, which is only capable of registering noise, but does not provide sufficient maximum resolution to record speech.

[0038] The far infrared sensor element 13 comprises an infrared sensor array in a matrix of 8x8, which is sufficient to differentiate a human from the environment. The far infrared sensor element 13 is supplemented by an ambient temperature sensor element 14, which helps to calibrate the far infrared sensor element 13 in order not to only determine temperature differences but also record absolute temperature values.

[0039] The sensor element 15 is a combined CO_2- and TVOC-sensor element. The light sensor element 16 is capable of detecting light intensity but also to differentiate between natural and artificial light by means of analyzing the light spectrum.

[0040] All sensor elements 10 are connected to a communication module 20. For illustrative purposes, neither the connections nor the battery used as an energy source for the communication module 20 and the sensor elements 10 are shown.

[0041] The communication module 20 is a Wi-Fi-communication module suitable for connecting to a Wi-Fi-network. At the same time the communication module 20 acts as a sensor element 10 by collecting information about all Wi-Fi-devices being active within its reach and their respective signal strength.

[0042] The communication module 20 is configured to collect the measured values of the sensor elements 10, wherein some of the sensor elements 10, e.g. the accelerometer 11 and the noise sensor 12, continuously provide measurement values, while other sensor elements 10 like e.g. the CO_2- and TVOC-Sensor element 15 provide readings every 10 seconds. The measurement values collected from the various sensor elements 10 at individual rates are timestamped and cached in an intermediate storage memory of the communication module 20. This is also true for the information collected about the active Wi-Fi-devices being in reach.

[0043] The communication module 20 transmits the collected measurement values batchwise every 30 seconds via an established Wi-Fi-connection and the Internet to a central evaluation unit 30, which will be explained in more detail in context with figure 2.

[0044] Figure 2 schematically shows a patient's home 40, where every room 41 that is regularly used is equipped with a patient monitoring device 1 according to figure 1. For this, in each room 41 to be monitored, a patient monitoring device 1 is mounted to a wall of the

respective rooms 41.

[0045] The patient's home 40 is also equipped with a Wi-Fi-Router 42 that allows Wi-Fi-enabled devices such as the patient monitoring devices 1 to connect to the internet. Via the Wi-Fi-Router 42 and the internet, the patient monitoring devices 1 are connected to the central evaluation unit 30, which comprises a processing unit 31 and a storage unit 32.

[0046] Each of the patient monitoring devices 1 transmits their respective measured values batchwise in intervals of approx. 30 seconds to the central evaluation unit 30, where there are at least temporarily stored in the storage unit 32. The received data is also processed by the processing unit 31 in order to determine a typical variation in the measurements during a day. For this, the measured values of all patient monitoring devices 1 that can be regarded to be related due to be installed in the same patient's home are analyzed concurrently. The determined variation in the measurements during a day is then stored in the storage unit 32. In case a respective variation has already been determined, additional data received from the patient monitoring devices 1 is used to verify or update said variation.

[0047] At the same time, in case a severe discrepancy between the measured values and the determined variation in the measurements during a day are determined, because e.g. there is a strong deviation in parts of the measured values from what had to be expected on the basis of the historic data without other measured values sufficiently countering such a deviation, an alert is put out by the central evaluation unit 30, e.g. in form of an electronic message to an operation center which may then take further action.

[0048] For example, assuming a patient monitoring device 1 in a first room 41 usually registers vibrations caused by a human walking around in a specific daily time frame, a sudden stop in the vibration measured by said patient monitoring device 1 may be countered by another patient monitoring device 1 in a different room 41 where similar vibration suddenly occur, suggesting the human having changed the room 41. Even though this might be unusual based on the previous observations as represented by the variation in the measurements during a day, such a change in the measured signals do not necessarily need to raise a concern. However, in case said vibration measured by a specific patent monitoring device 1 abruptly stops without other changes in the measured values potentially explaining the stop in the vibration, may cause an alert due to the risk of the patient having a sudden medical emergency.

[0049] The interrelations of the various values measured by all patent monitoring devices 1 in a patient's home are too complex to be set up manually, but rather have to be derived from data recorded during an initial setup phase of the system, usually lasting a few days or weeks. Indeed, it has been established by way of experiment that after a setup phase of approx. 48 week, the typical variation in the measurements during a day determined during these weeks are sufficient to determine and correctly classify discrepancies in the measured values from these variations in view of whether an alert needs to be put out or not.

Claims

1. Patient monitoring device (1) comprising attachment means (3) to mount the device (1) to a surface in a vibration transferring way, sensor elements (10) for continuously detecting measurements reflecting the surroundings of the patient monitoring device (1) and a communication module (20) to transmit the measured values to a central evaluation unit (30), wherein the sensor elements (10) comprise

   - an accelerometer (11);
   - a noise detector (12);
   - a far infrared sensor element (13);
   - a CO_2 sensor element (15); and
   - a light sensor element (16)

   wherein sensor elements (10) are suitably arranged relative to the attachment means (3) to detect their respective measurements.

2. Patient monitoring device according to claim 1, wherein the noise detector (12) has a maximum resolution insufficient for recording speech.

3. Patient monitoring device according to any one of the preceding claims, wherein
   the far infrared sensor element (13) comprises an infrared sensor array with a resolution sufficient for differentiating a human from the environment but insufficient to reflect the human's detailed movements and actions.

4. Patient monitoring device according to any one of the preceding claims, wherein
   the CO_2 sensor element (15) is integrated in or supplemented with a TVOC sensor element.

5. Patient monitoring device according to any one of the preceding claims, wherein
   the light sensor element (16) is capable of distinguishing between natural and artificial light.

6. Patient monitoring device according to any one of the preceding claims, wherein
   the sensor elements (10) further comprise an ambient temperature sensor element (14), preferably suitable to calibrate the far infrared sensor element (13) to provide the absolute body temperature of a human.

7. Patient monitoring device according to any one of

the preceding claims, wherein
the patient monitoring device (1) comprises means to measure the signal strength of WiFi-signals of WiFi-devices in the surroundings.

8. Patient monitoring device according to any one of the preceding claims, wherein
the communication module (20) is configured to connect to a WiFi and/or a mobile network and preferably comprises an intermediate storage memory to buffer the measured values.

9. Patient monitoring arrangement comprising at least one patient monitoring device (1) according to one of the preceding claims and a central evaluation unit (30), wherein the patient monitoring device(s) (1) and the central evaluation unit (30) are connected for the patient monitoring device(s) (1) to transmit the measured values to the central evaluation unit (30), wherein the central evaluation unit (30) is configured to

- warehouse the received continuously measured values;
- determine and/or update a typical variation in the measurements during a day;
- determine discrepancies in the measured values from the typical variations during a day; and
- put out an alert in case a severe discrepancy is determined.

10. Patient monitoring arrangement according to claim 9, wherein
the typical variation in the measurements during a day is determined weekday-specific.

11. Patient monitoring arrangement according to claim 9 or 10, wherein
a severe discrepancy is established in view of the standard variance of the measured values of a measurements and/or a combination of severe discrepancies for two or more measurements.

12. Patient monitoring arrangement according to claim 9, 10 or 11, wherein
the measured values are transmitted to the central evaluation unit (30) batchwise.

Amended claims in accordance with Rule 137(2) EPC.

1. Patient monitoring device (1) comprising attachment means (3) to mount the device (1) to a surface of a piece of furniture or the wall of a room in a vibration transferring way, sensor elements (10) for continuously detecting measurements reflecting the surroundings of the patient monitoring device (1) and a communication module (20) to transmit the measured values to a central evaluation unit (30), wherein the sensor elements (10) comprise

- an accelerometer (11);
- a noise detector (12);
- a far infrared sensor element (13);
- a CO_2 sensor element (15); and
- a light sensor element (16)

wherein sensor elements (10) are suitably arranged relative to the attachment means (3) to detect their respective measurements if the patient monitoring device (1) is correctly mounted.

2. Patient monitoring device according to claim 1, wherein the noise detector (12) has a maximum resolution insufficient for recording speech.

3. Patient monitoring device according to any one of the preceding claims, wherein
the far infrared sensor element (13) comprises an infrared sensor array with a resolution sufficient for differentiating a human from the environment but insufficient to reflect the human's detailed movements and actions.

4. Patient monitoring device according to any one of the preceding claims, wherein
the CO_2 sensor element (15) is integrated in or supplemented with a TVOC sensor element.

5. Patient monitoring device according to any one of the preceding claims, wherein
the light sensor element (16) is capable of distinguishing between natural and artificial light.

6. Patient monitoring device according to any one of the preceding claims, wherein
the sensor elements (10) further comprise an ambient temperature sensor element (14), preferably suitable to calibrate the far infrared sensor element (13) to provide the absolute body temperature of a human.

7. Patient monitoring device according to any one of the preceding claims, wherein
the patient monitoring device (1) comprises means to measure the signal strength of WiFi-signals of WiFi-devices in the surroundings.

8. Patient monitoring device according to any one of the preceding claims, wherein
the communication module (20) is configured to connect to a WiFi and/or a mobile network and preferably comprises an intermediate storage memory to buffer the measured values.

9. Patient monitoring arrangement comprising at least

one patient monitoring device (1) according to one of the preceding claims and a central evaluation unit (30), wherein the patient monitoring device(s) (1) and the central evaluation unit (30) are connected for the patient monitoring device(s) (1) to transmit the measured values to the central evaluation unit (30), wherein the central evaluation unit (30) is configured to

- warehouse the received continuously measured values;
- determine and/or update a typical variation in the measurements during a day;
- determine discrepancies in the measured values from the typical variations during a day; and
- put out an alert in case a severe discrepancy is determined.

10. Patient monitoring arrangement according to claim 9, wherein
the typical variation in the measurements during a day is determined weekday-specific.

11. Patient monitoring arrangement according to claim 9 or 10, wherein
a severe discrepancy is established in view of the standard variance of the measured values of a measurements and/or a combination of severe discrepancies for two or more measurements.

12. Patient monitoring arrangement according to claim 9, 10 or 11, wherein
the measured values are transmitted to the central evaluation unit (30) batchwise.

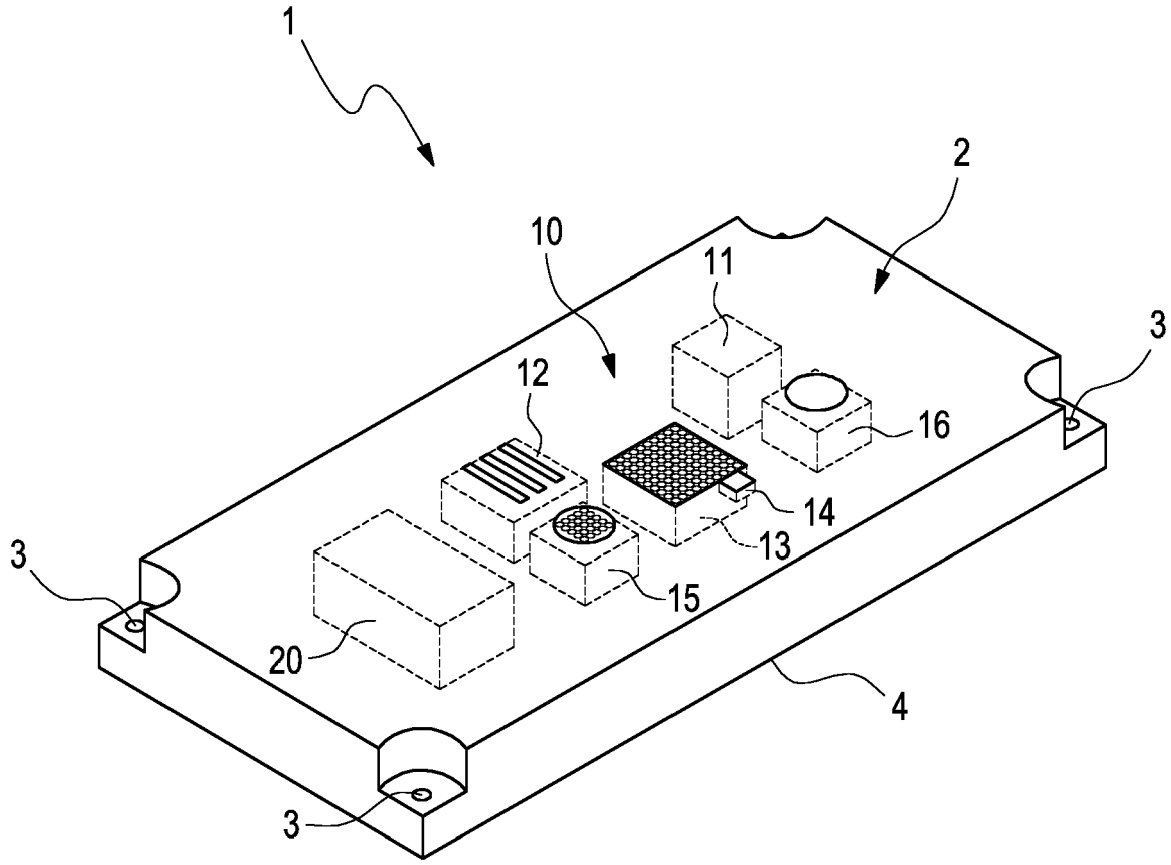

Fig. 1

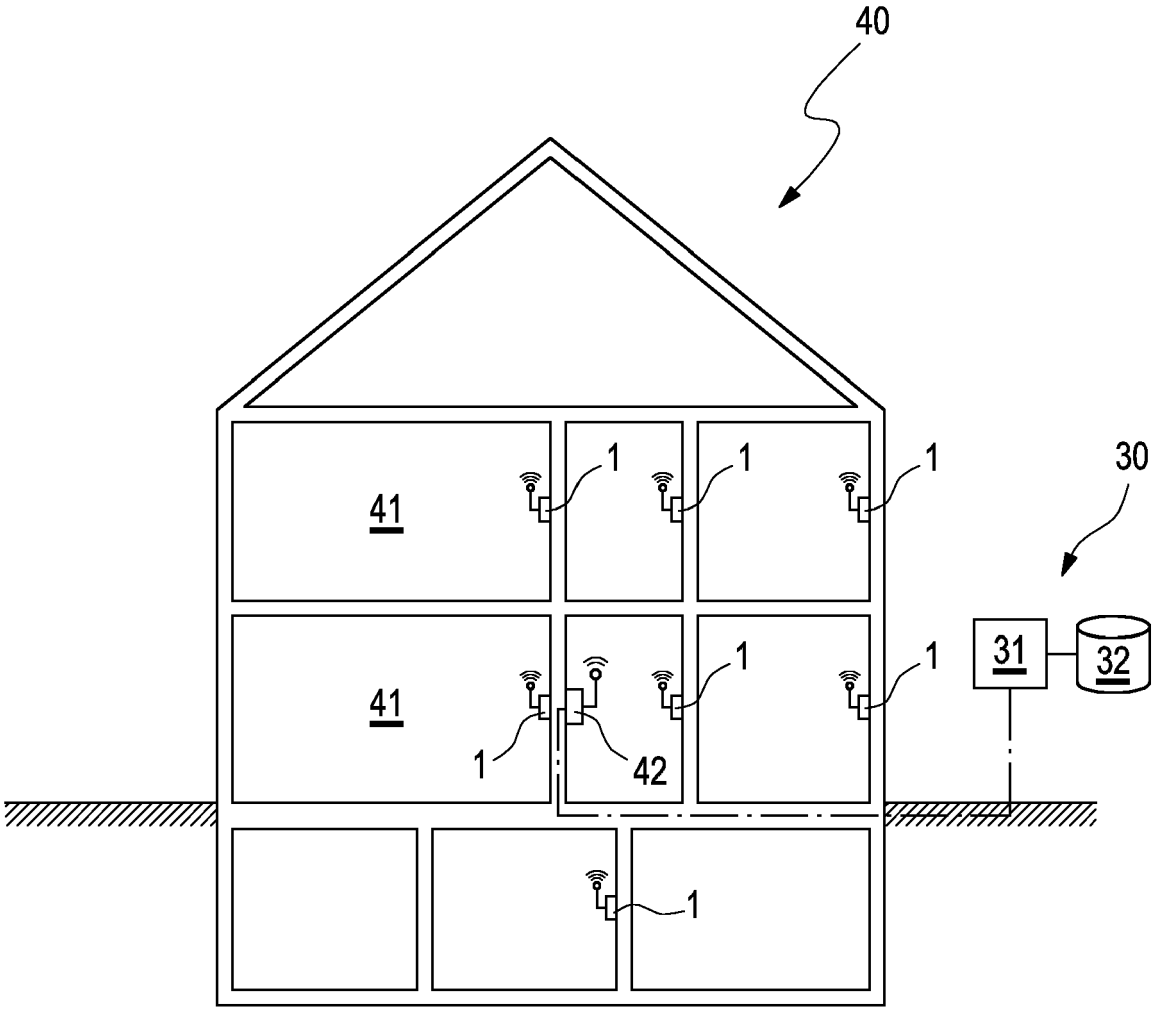

Fig. 2

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 21 1668

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2017/365149 A1 (TEN KATE WARNER RUDOLPH THEOPHILE [NL]) 21 December 2017 (2017-12-21) * paragraph [0002] - paragraph [0005] * * paragraph [0011] - paragraph [0018] * * paragraph [0029] * * paragraph [0042] * * paragraph [0102] - paragraph [0105] * * paragraph [0182] * * paragraph [0223] *	1,9	INV. G08B21/04
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 May 2019	Bourdier, Renaud

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