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(54) **METHOD FOR CONTROLLING AN OPERATIONAL STATE OF AT LEAST ONE AUXILIARY DEVICE IN THE LIGHTING SYSTEM, LUMINAIRE AND LIGHTING SYSTEM**

(57) A luminaire and a system are configured to execute a method for controlling an operational state of at least one auxiliary device (15, ..., 20) in the lighting system (1). The lighting system comprising a plurality of radio communication units (9,... 14), and the method comprises the steps of repeatedly detecting indicator values (S1) indicating a received signal strength of a radio commu-

nication signal transmitted between the radio communication units (9,... 14), storing the indicator values (S2) in a memory (24), analyzing the indicator values over time (S4). Depending on the result of the analysis, the at least one auxiliary device is switched (S6.1) from a first operational state into a second operational state or from the second operational state to the first operational state.

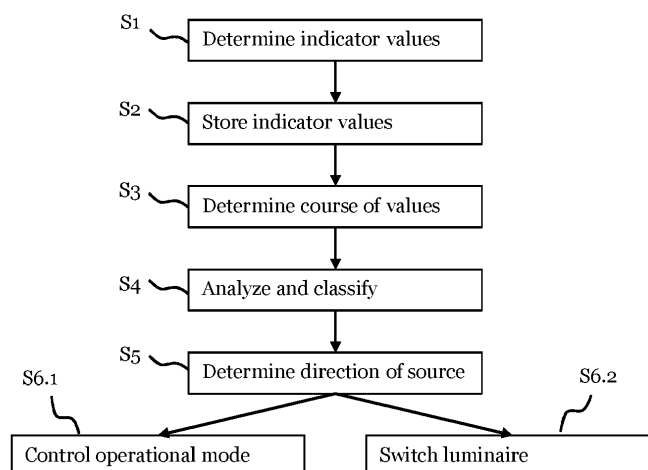


Fig. 1

Description

[0001] The invention regards a method, a luminaire and a lighting system. The method controls an operational state of at least one auxiliary device in the lighting system.

[0002] Modern lighting systems comprise a lot more functionalities than simply switching on and off light. In order to be able to perform such plurality of functions, it is often necessary to equip the lighting system with additional sensors and communication units so that the behavior of the different components in the lighting system are adapted and the components act cooperatively. A first step towards automation of such systems is to equip luminaires or rooms, which are illuminated by a plurality of luminaires with sensors that automatically detect presence of a person and, accordingly, switch on or off the luminaires. This is for example well known for rooms in a building. While such systems rapidly develop in order to provide additional functionalities, the awareness for energy saving is increasing at the same time. However, it would not be satisfying to reduce the functionality of the systems in order to achieve energy savings as desired. The energy consumption of sensors is a particular waste and therefore unwanted when it is caused by devices or in situations where it is likely that the respective function is not necessary at that point in time. Nevertheless, the sensors need to be ready to sense a situation, which, although unlikely, may occur at any time.

[0003] The problem becomes specifically obvious if presence detection is considered. The sensors providing the signal when a person enters a room must be ready in order to be able to switch on luminaires in the room as soon as a person enters. Thus, while this does not seem to cause a major problem for areas that are really frequently used by persons, it is evident that areas which are not entered by a person over a long period of time waste quite a lot of energy due to the readiness of the present detection 24 hours a day.

[0004] It is therefore an object of the present invention to provide a method, luminaire and system capable of reducing wasted energy. The problem is solved by the inventive method, luminaire and system as defined in attached independent claims.

[0005] The dependent claims provide advantageous aspects and features of the present invention.

[0006] According to the invention, it is exploited that modern systems, in addition to a present detection unit, mostly comprise communication units that are integrated in a network, for example, in order to exchange information with each other. One common example for such a communication unit might be a Bluetooth device by which the device equipped with the Bluetooth unit becomes part of a mesh network. However, such a mesh network is not necessary in order to understand or work the current invention.

[0007] According to the invention, the signal strength indicator, which is measured in systems using radio com-

munication units like the Bluetooth device regularly, is obtained by a control unit. The lighting system stores the measured are transmitted indicator values indicating the signal strength received by the radio communication unit at least for a certain period of time. Usually, as long as no person moves through an area where the radio signals propagate, the indicator value is almost constant. However, as soon as a person moves in the area of signal propagation, the measured signal strength by the radio communication device receiving the radio signal will significantly change its characteristic. The values will differ from the almost constant signal values which can be measured in the absence of a person. Thus, identifying such a change in the course of the measured signals allows to conclude that a person somewhere moves in an area such that the person will change propagation of the radio signal.

[0008] It is to be noted, that within a building usually multipath propagation of radio signals occurs. This fact is exploited by the present invention in order to recognize even persons, which did not yet enter a room in which, for example, a presence detection unit like a radar sensor is provided. The radar sensor (or any other known presence sensor) cannot detect presence of a person outside the room, because the detection range end at the next wall. Consequently, a person approaching two a room equipped with such a presence sensor may already be recognized from the change in the RSSI (received signal strength indicator) before the person enters the room. The reason is that the frequency, which is usually used for operating radio communication units significantly differs from the frequency used by radar sensors, typically 24 GHz or 60GHz. However, it is to be noted that the present invention is not limited to the combination of Bluetooth communication units and radar sensors but is applicable to systems which use radio communication and any kind of auxiliary device which acts in response to presence of a person.

[0009] According to the present invention, the course of the stored indicator values is analyzed in order to determine whether the presence of a person or movement disturbed signal propagation. Thus, from a change in the course of the indicator values it can be concluded that a person must be present in an area through which propagation towards a receiving radio communication unit occurs. Based on the result of the analysis, the at least one auxiliary device is then switched from a first operational state into a second operational state or from the second operational state in the first operational state.

[0010] The inventive approach for controlling the operational state of the auxiliary device in a lighting system has the advantage, that the auxiliary device may be switched into an active state only in case that it is actually needed. Thus, in particular for devices, which act in response on presence of a person, it is possible to switch them to a standby state or completely switch off the devices in case that no person is present. A coarse determination of the presence of a person is possible using

the indicator value obtained from the radio communication unit, although such a determination may not have a desirable accuracy. However, based on such coarse determination, the device providing more accurate results is switched into its active state. In the example of presence detection, a radar sensor might be switched in to its active state. However, for longer time periods like for example over night in an office building, the auxiliary device can be switched at least into a standby state when no person is recognized from the analysis of the indicator values, e.g. for a certain time interval, which allows considerable energy saving.

[0011] It is to be noted that the overall lighting system may distribute the units cooperating to achieve the inventive effect. Alternatively, it is also possible that each and any element which is necessary to perform the inventive method is included in a single luminaire. The only prerequisite is that a radio communication unit is in communication with at least one further radio communication unit so that a received signal strength can be measured which is the indicator value that is then analyzed in order to determine the course of indicator values. Although in principle the invention requires only a single communicative connection and thus two radio communication units, it is desirable to exploit a plurality of indicator values individually obtained from a plurality of communication connections (more than two) between a radio communication unit and a plurality of further communication units. Usually, such plurality of radio communication units are present since the radio communication unit measuring the indicator values as part of a network comprising more than one additional ready communication unit.

[0012] Preferably, the radio communication unit operates in a first frequency range, which is below a second frequency range in which the auxiliary device operates. Usually devices operating on a higher frequency range consume more energy in their active state. Consequently, energy savings that can be achieved with the present invention are more significant in case that the auxiliary device operates on a frequency range lying above the frequency range of the radio communication unit.

[0013] One advantageous way of analyzing the course of the indicator values over time is to conduct a comparison of a characteristic of a distribution of measured values around an average value with a predefined threshold. As indicated above already, in the absence of any person or a movement of a person, the indicator values are almost constant over time. Thus, the distribution of the measured indicator values is very narrow around the average value. As a characteristic describing the distribution around the average value, a standard deviation could be calculated. However, other characteristics that describe the distribution may achieve the desired effect, equally. In any case, the characteristic value describing the distribution of the individual measured indicator values is compared to a threshold which can be set in advance and stored in a memory of the lighting system. This threshold can be determined during the design

phase of the system or even at a later point in time, for example, during a commissioning phase such that the actual environmental conditions in the specific building can be taken into consideration. The threshold is for example set such that the change in the characteristic compared with the threshold allows to classify the situation in which the indicator values are measured either to be a situation in which a person is present or a situation in which no person is present. Thus, when the characteristic indicates a wider distribution of the measured indicator values, the system concludes that a person must be present somewhere in the area through which the radio signals propagate until they are received by the radio communication unit. On the other hand, in case that a narrow distribution can be recognized, because the characteristic lies below the predefined threshold, it is concluded that no person is in the area through which the radio signals propagate.

[0014] Thus, the situations (corresponding to the measured indicator values at that time) can be classified into "no person present" or "person present". It is to be noted that a person even influences propagation of radio communication signals when the person is outside a room, because of the moderate attenuation of radio signals in frequency ranges used for radio communication signals (typically 2,4 GHz or 5 GHz for Bluetooth). This allows to determine that a person is present even in case that the person is still outside the room.

[0015] Instead of analyzing the course of measured indicator values only by a comparison between a characteristic of a distribution of the measured values, it is also possible to compare the course of the measured indicator values over a certain period of time with a reference pattern, that can be determined in the design phase of the system and stored in a memory. This reference pattern could for example comprise a significant increase during a time period when a person is approaching. Further, such a pattern may even include a plurality of courses of indicator values each one corresponding to an individual node (radio communication units) so that not only a single course of time of an indicator value is analyzed but the measured indicator values for a plurality of signals received from different radio communication units. An analysis of such a plurality of indicator values even allows to roughly determine a position of the person causing the disturbance of the indicator value. For enabling such an analysis, it is advantageous to compare of the analysis results with a predefined set of patterns for the individual indicator values over time.

[0016] It is furthermore advantageous, to directly switch on a luminaire of the lighting system in response to classifying the situation as "person present" before the person enters the room. For example, in case that one or more luminaires in a room where no person is present is switched off but the analysis of the indicator values over time allows to recognize that a person is approaching the room, one or more of the luminaires in the room are switched on, preferably to a relatively low dim level.

As a consequence, a person entering the room thereafter has not to enter a completely dark room. Since the dim level may be set to be relatively low if the luminaire is switched on because of the analysis results of the indicator values, no significant energy waste is caused in case that the person in the end does not enter the room. This could happen for example in case that the person walks through a corridor without entering the room, nevertheless disturbing the radio signals which leads to classifying the situation as "person is present".

[0017] On the other hand, in case that the person in fact enters the room, the auxiliary device, in the present case for example a radar presence sensor, has already been switched into the active state. Thus, as soon as the person enters the room, the signal output by the radar sensor will cause the lighting system to behave as desired. In most cases this will result in switching on the luminaires in the room. However, other behaviors might be desired as well.

[0018] The present invention will now be explained with reference to the attached drawings in which

Figure 1 illustrates a simplified flowchart for controlling an operational state of at least one auxiliary device,

Figure 2 shows an exemplary indicator values over time for by different nodes

Figure 3 shows a schematic of the inventive lighting system, and

Figure 4 shows an exemplary of a luminaire according to the present invention.

[0019] As mentioned above already, the present invention is applied in a lighting system in which at least two radio communication units are present communicating with each other. Thus, each of the radio communication units repeatedly measures an indicator value representing a measured received signal strength at a time. Thus, in step S1 indicator values over time are determined. It is to be noted that although this determination may be performed in any of the radio communication units comprised by the lighting system, it is only necessary to analyse the measured indicator values at one of the radio communication devices. However, it is preferred that the measured indicator values over time of a plurality of radio communication units are collected to improve accuracy of the analysis, which will be described later.

[0020] The determined indicator values are then, in step S2, stored in the memory of the lighting system. Storing of the determined indicator values may be performed at least for a certain period of time, which is sufficient in order to perform the analysis. The time interval for which the determined indicator values are stored in the memory may be determined based on the repetition frequency of measuring the received signal strength in

the radio communication units. However, a typical time interval may be considered to be at least three seconds, preferably five seconds or even 10 seconds. Such a length of a time interval should be sufficient in order to determine a suddenly occurring disturbance. Thus, the time interval is also sufficient in order to conclude whether a person entered the area, through which the radio waves of the communication signals propagate.

[0021] In order to allow an analysis of the individual measured indicator values, the course of values is determined in step S3. In the simplest embodiment, determination of the course of values is meant to perform calculations based on all indicator values that are comprised by a certain time interval reaching to the current point in time. For example, the determination of the course of values might comprise calculation of a standard deviation of the indicator values comprised by the considered time interval. Alternatively, the determination may be performed by fitting a curve through the indicator values or preprocessed indicator values. Such preprocessing may be performed for example by averaging a plurality of successive indicator values using the sliding time interval.

[0022] In the following step, S4, the course of the indicator values is analyzed and the situation is classified. The analysis can be, in case that the determination comprises only the calculation of the standard deviation, a comparison of the calculated standard deviation with a threshold. The classification then associates the result of the analysis (calculated standard deviation below the threshold or at least equal to the threshold) with a certain situation which can be either "no person present" or "person present".

[0023] Alternatively, the analysis and classification step could use a more sophisticated routine. For example, the determined course of indicator values coming out of step S3 is compared to a plurality of pre-stored patterns for the indicator values over time. These patterns can be generated in the design phase of the lighting system or can be obtained from an analysis of situations occurring after the system has been put into operation. This might be done in a training phase of the system where for example a commissioner teaches the system to store determined causes of indicator values for which the operator indicates that the person was present. Such patterns regardless whether they are pre-stored from a design phase or generated during a training phase of the system, allow that determined courses of indicator values in the operation phase of the system are compared to the stored patterns in order to classify the situation.

[0024] After the situation has been classified or the measured indicator values are analyzed, it is possible to determine not only whether a person is present at all, but also to roughly estimate the position of the person, shown as step S5, which is optional. This can be achieved by comparing a plurality of individually determined sources of indicator values with a set of different patterns. These different patterns are generated also either in the design phase or during a training phase. In order to make such

an estimation of the position of the person, it is necessary that a plurality of individual indicator values for different radio communication units is analyzed. This is preferably performed in case that a (preferably regular) grid of, for example, a plurality of luminaires is comprised by the lighting system, each of the luminaires comprising a radio communication unit. Such a configuration will be explained later with reference to figure 3 in greater detail.

[0025] After the situation has been classified in step S4, operation of the lighting system can be performed based on the class into which the situation has been classified. At least, the auxiliary device is switched according to the classified situation in step S6.1. This means, that, in case the auxiliary device is in the standby state (example for a first operational mode), the auxiliary device is switched into its active state (example for a second operational mode).

[0026] Thus, assumed that during the night, there was no person in the area through which the radio signal waves propagate for a communication between the radio communication units, the luminaires are switched off and the auxiliary devices, namely radar sensors for presence detection, are in their standby states, the radar sensor is are switched into their active states. Consequently, when the person which caused the disturbance of the radio signal propagation determined by measuring the indicator values and analyzing the indicator values over time, enters a detection area in which presence of a person can be detected by the radar sensor, the radar sensor is already in its active state allowing to perform an accurate measurement of presence of a person.

[0027] It is to be noted that once the radar sensor is in its active state, the system no longer distinguishes from known prior art systems using presence detection by a radar sensor for automation of the lighting system. Thus, in order to avoid unnecessary explanations, the regular operation of a system comprising an active radar sensor will not be explained in detail. It is to be noted that the desired energy savings are specifically relevant for the use of radar sensors. However, in general the effect is achievable also for other presence sensor, like PIR sensors (passive infrared sensors) but even for entirely different types of sensors.

[0028] Apart from switching a radar sensor into its active state, it is also possible to switch it back from its active state into the standby state. The following explanations will be made based on the assumption that for the analysis of the indicator values over time only a characteristic indicative of the distribution of the individual indicator values is compared to a threshold in order to classify a situation as "person present" or "no person present". When the radar sensor has been switched into its active state, this means that prior to that switching the analysis showed that the characteristic exceeded the threshold. However, after the person left the room and even the area through which the radio communication signals propagate before they are received by the radio communication unit, the measured indicator values will

be rather constant again. Thus, the calculated standard deviation or any other characteristic indicative of a distribution of the measured indicator values, falls below the threshold again. Thus, the situation will be classified as "no person present". In response to classifying the situation as "no person present" the radar sensor will be switched back from its active states into its standby state.

[0029] The determination and the analysis of the indicator values over time are performed repeatedly. Thus, the inventive method allows to continuously determine whether the latest classified situation is still valid. It is to be noted that classifying the situation as either "no person present" or "person present" was used only for explaining the inventive approach. The switching of the radar sensor, or, to be more general, the auxiliary device from the first operational state to the second operational state or vice versa, may, however, be performed directly based on the outcome of the comparison between the characteristic indicative of the distribution of the indicator values and the respective threshold. A similar consideration is true for a comparison of the indicator values over time with the corresponding pattern allowing to distinguish between the classes as mentioned above. A similar consideration is valid for the analysis of the course of the measures indicator values with respect to a pattern.

[0030] While switching an auxiliary device, which is only needed in its active state when a person is present in a detection range of the auxiliary device, the analysis of the indicator values over time may also be used in order to control operation of the lighting system or parts thereof other than the auxiliary device. For example, it might be desirable to achieve a minimum illumination inside the room before the person that caused the recognized disturbance in the received signal strength enters. This can be achieved by switching on at least one of the luminaires inside the room that might be entered by the person, which is performed in step S6.2. The dim level for the switched on luminaire may be set relatively low, because illumination is only necessary for the first moment when the person enters the room, and specifically near the door where the person might enter. Thereafter, the person directly enters the detection range of the auxiliary device, which is then responsible for causing an appropriate behavior of the lighting system, preferably switching on the luminaires in the room.

[0031] Figure 2 shows measured indicator values for the received signal strength for the first node A and for a second node B, which correspond to two different radio communication devices which are in communicative connection with a radio communication unit which determines the respective received signal strength as indicator values. It is evident that in case the two nodes A, B are a different positions inside a building, the propagation paths of their respectively emitted radio signal waves are different. Consequently, a person present in the propagation path of one of the nodes A or B does not necessarily influence propagation of the radio signal of the other node.

[0032] The illustration in figure 2 exactly shows such an example. As can be seen, both nodes A and B emit radio waves for which the indicator signal strength measured by a radio communication unit of the system is disturbed because of presence of a person in the propagation path until time T1. However, between T1 and T2 only propagation of signals emitted by node B are still disturbed, while propagation of radio waves emitted by node A is received undisturbed by the measuring radio communication unit. Thus, starting at T1 for node A or at T2 for node B, the respectively measured received signal strength is quite constant. This may correspond, as indicated in the figure, to the case during night time. However, in the morning when the office building is used again and persons walk along the corridors thereby passing rooms in which the inventive system is installed, these persons disturb propagation of the emitted radio waves again. In the figure, this can be recognized after time T3. For both individual indicator values the measured indicator values are distributed around the almost constant value measured during night time, which may approximately correspond to an average value after time T3.

[0033] As it becomes directly clear from the measured indicator values over time for nodes A and B, a characteristic indicative of the distribution around an average value allows to discriminate between presence and absence of persons disturbing propagation of radio waves.

[0034] The system used for executing the above explained method for controlling the operational states of an auxiliary device will now be described with reference to figure 3. Figure 3 shows part of a lighting system 1, which is arranged in a room 2 forming part of the building. It is evident, that the lighting system 1 does not show an entirety, as a lighting system may comprise additional units for operation. However, it is evident, that these additional units do not directly concern the present invention and are fully understood in the art as they serve their usual purpose. The part of the lighting system 1 illustrated in figure 3 is thus limited to those parts, which are necessary to achieve the inventive effect and to apply the inventive method.

[0035] In the room 2 a plurality of luminaires 3 to 8 are installed. In the present case, each of these luminaires 3 to 8 have an identical configuration. However, this is not necessary and even a plurality of different types of luminaires may be combined. In the present case, each of the luminaires 3 to 8 comprises a Bluetooth communication 9 to 14 constituting the radio communication units of the invention. These Bluetooth units 9 to 14 may operate in a first frequency range, for example 2.4 GHz or 5.0 GHz. Additionally, each of the luminaires 3 to 8 may also each comprise a radar sensor 15 to 20. However, it is obvious that such a radar sensor 15 to 20 as an auxiliary device may also be commonly present in the room 2, external from the luminaires 3 to 8.

[0036] In the illustrated embodiment, the Bluetooth units 9 to 14 are communicatively connected with each other so that each of the Bluetooth communication units

9 to 14 measures a received signal strength and thus determines an indicator value with respect to each of the other Bluetooth communication devices 9 to 14. In the illustrated and preferred embodiment, all of the measured indicator values are transmitted to a control unit 23. The control unit 23 stores the received indicator values associated with the Bluetooth communication unit 9 to 14 which caused emission of the radio waves for which the respective indicator values have been measured. Thus, the indicator values over time may be individually analyzed with respect to the node that caused the measurement.

[0037] In the illustrated embodiment, a common control unit 23 is used in order to obtain the measured indicator values from any of the participating Bluetooth communication units 9 to 14. However, the collection of the measured indicator values and the analysis performed on the collected indicator values may be performed individually in each of the luminaires 3 to 8. In that case, each of the luminaires 3 to 8 requires its own control unit 23.

[0038] In order not to overload the drawing, the signal flow between the Bluetooth communication units and the control unit 23 or, the transmission of the control signal from the control unit 23 to the auxiliary devices 15 to 20 or luminaires 2 to 8 is illustrated only with respect to the luminaire 8 closest to the door 21 of the room 2. However, the same information or signal transmission between is true also for the other luminaires 3 to 7 and their communication units 9 to 13 and auxiliary devices 15 to 19.

[0039] Based on the received indicator values, which are stored by the control unit 23 in a memory 24, the analysis as explained with reference to figure 1 is executed. After it has been determined, whether switching from a first operational state to a second operational state or vice versa shall be performed, a respective control signal is supplied by the control unit 23 to the radar sensor 20 of luminaire 8. The same happens for all the radar sensors as further auxiliary devices of the other luminaires 3 to 7.

[0040] In addition, the system may be configured in order to control the luminaire 8, which is closest to the door 21 to switch on at a dim level allowing the person 22 to safely enter the room. In case that the person 22 passes the room 2, because the person 22 only walks along the corridor towards another room, the disturbance of the radio waves emitted by the Bluetooth communication devices 9 to 14 will end, and thus, the analysis of the indicator values will reveal that no person is present any longer. As a consequence, the radar sensors 15 to 20 will be switched back into their standby mode and luminaire 8 will be switched off.

[0041] Figure 4 shows a block diagram of a single luminaire, in the present example a luminaire 8. As mentioned above, all of the luminaires inside the room 2 may be of the same type and do have the same configuration.

[0042] As indicated already when explaining figure 3, luminaire 8 comprises a Bluetooth communication mod-

ule 14 and a radar sensor 20. Bluetooth communication module 14 measures the received signal strength when communicating with any other radio communication device connected for example in a network with the Bluetooth communication module 14. The Bluetooth communication module 14 is connected to the control unit 23, which is in the illustrated embodiment of figure 4 comprised by the luminaire 8. As explained above, this is an alternative configuration to the configuration of figure 3.

[0043] The indicator values measured by the Bluetooth communication unit 14 are supplied to the control unit 23, comprising the memory 24 and a processing unit 25. The analysis of the indicator values provided by the Bluetooth communication module 14 is performed in a processing unit 25, for example a microcontroller or processor. The control unit 24 is connected to the memory 24 in order to be able to retrieve already stored indicator values from the memory 24 and also to store the latest indicator values received in the memory 24. Further, the memory 24 may store thresholds or patterns, which are used to perform the analysis as explained above with respect to the flow chart illustrated in figure 1.

[0044] Since the Bluetooth communication unit 14 is provided in the luminaire 8 in order to enable communication of the luminaire 8 with other components of the lighting system 1, the Bluetooth communication unit 14 is also connected to an operating device 26 of the luminaire 8. In the present case, the control unit 23 is illustrated as a separate component within the luminaire 8. However, it is also possible to integrate the control unit 23 into the operating device 26.

[0045] Finally, the operating device 26 is connected to a light source 27, which is preferably an LED module or a plurality thereof. Obviously, the present invention is not limited to LED lighting but can also be used in any other lighting system provided that the system comprises radio communication units and at least one auxiliary device.

Claims

1. Method for controlling an operational state of at least one auxiliary device in a lighting system (1) comprising a plurality of radio communication units (9,...14), the method comprising the steps of

repeatedly detecting indicator values (S1) indicating a received signal strength of a radio communication signal transmitted between the radio communication units (9,...14),
storing the indicator values (S2) in a memory (24),
analyzing the indicator values over time (S4),
and, depending on the result of the analysis, switching the at least one auxiliary device (S6.1) from a first operational state into a second operational state or from the second operational state to the first operational state.

2. Method for controlling an operational state according to claim 1, wherein
the analysis of the indicator values (S4) comprises a comparison of a characteristic of a distribution around an average value with a predefined threshold.
3. Method for controlling an operational state according to claim 1, wherein
the analysis of the indicator values (S4) comprises a comparison of a course of time of the indicator values with a predefined pattern for indicator values over time.
4. Method for controlling an operational state according to any one of claims 1 to 3, wherein
the first operational state is a standby state and the second operational state is an active state of the auxiliary device.
5. Method for controlling an operational state according to any of the claims 1 to 4, wherein
indicator values are repeatedly detected for a plurality of different communication units and the analysis of the indicator values (S4) over time is performed for each of the different communication units individually.
6. Method for controlling an operational state according to claim 5, wherein
the individual analysis results are compared with a predefined sets of patterns for the individual indicator values over time.
7. Method for controlling an operational state according to any one of claims no more 1 to 6, wherein
the control unit (23) causes at least one luminaire (3, ..., 8) of the lighting system (1) to switch on at a first level in case that the luminaire (3, ..., 8) was switched of.
8. Luminaire (3, ..., 8) comprising a radio communication unit (9, ..., 14) configured to communicate with at least one other communication unit (9, ..., 14), at least one auxiliary device ((15, ..., 20), a memory (24) and a control unit (23), wherein the control unit (23) is configured to execute the method according to any one of claims 1 to 7.
9. Lighting system (1) comprising a plurality of radio communication units (9, ..., 14) configured to communicate with each other, at least one auxiliary device (15, ..., 20), a memory (24) and a control unit (23), wherein the control unit (23) is configured to execute the method according to any one of claims 1 to 7.
10. Luminaire or lighting system according to claim 8 or

9, wherein
the communication units (9, ..., 14) operate in a first
frequency range and the at least one auxiliary device
((15, ..., 20) operates on a second frequency range,
the second frequencies range having higher fre- 5
quencies as the first frequency range.

11. Luminaire or lighting system according to any one
of claims 8 to 10, wherein 10
the at least one auxiliary device (15, ..., 20) compris-
es a sensor producing sensor signals in response to
presence of a person within a detection area of the
sensor.
12. Luminaire or lighting system according to any one 15
of claims 8 to 11, wherein
the sensor is a radar sensor detecting presence of
a person for controlling the lighting system.
13. Lighting system according to any one of claims 9 to 20
12, wherein
the lighting system (1) comprises a plurality of lumi-
naires (3, ..., 8), each luminaire (3, ---, 8) equipped
with one of the communication units(9, ..., 14), the
units(9, ..., 14) being configured to transmit the re- 25
spective indicator values to the control unit (24).

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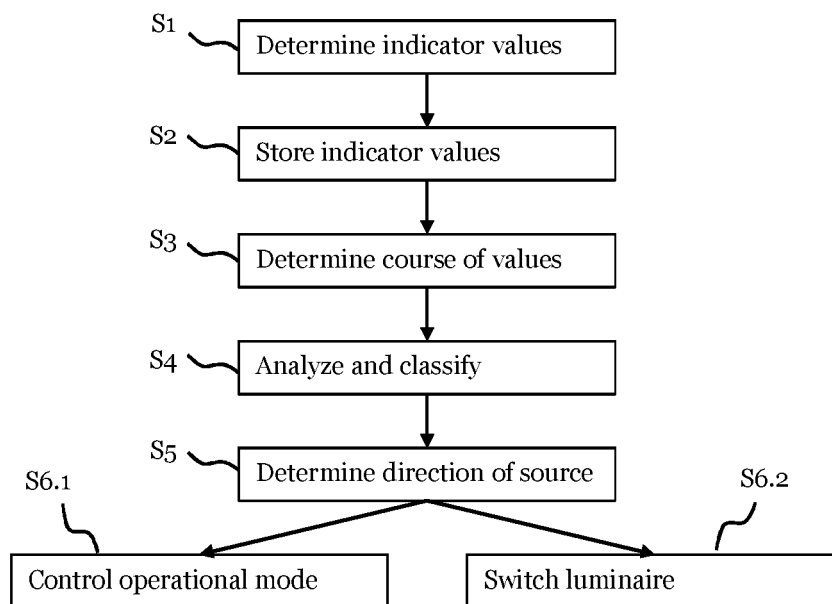


Fig. 1

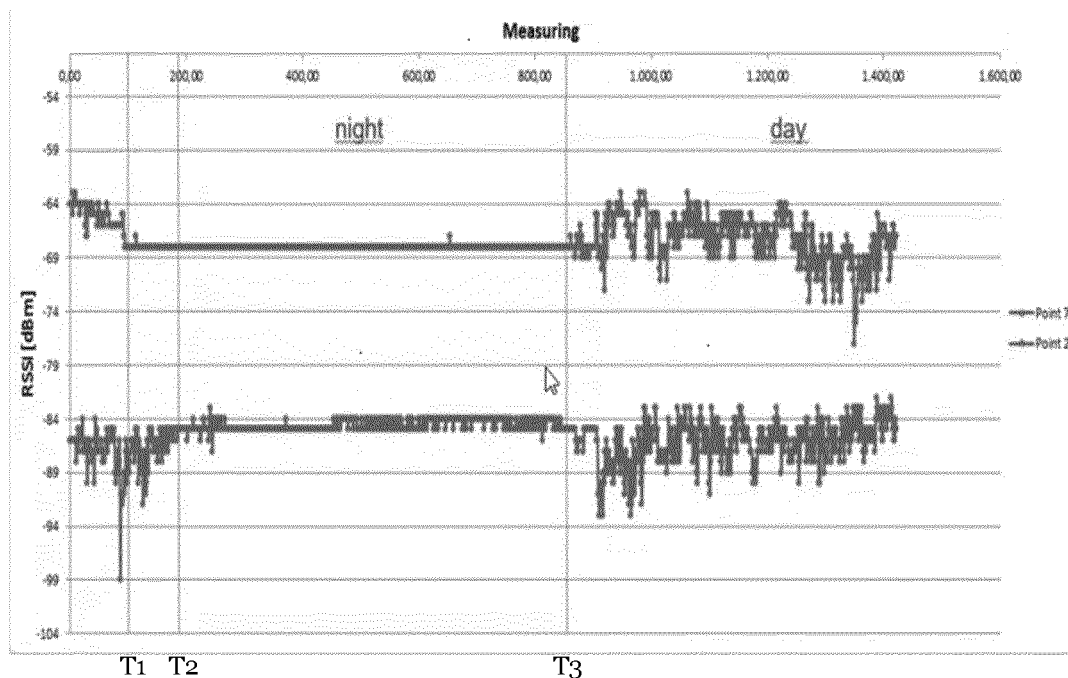


Fig. 2

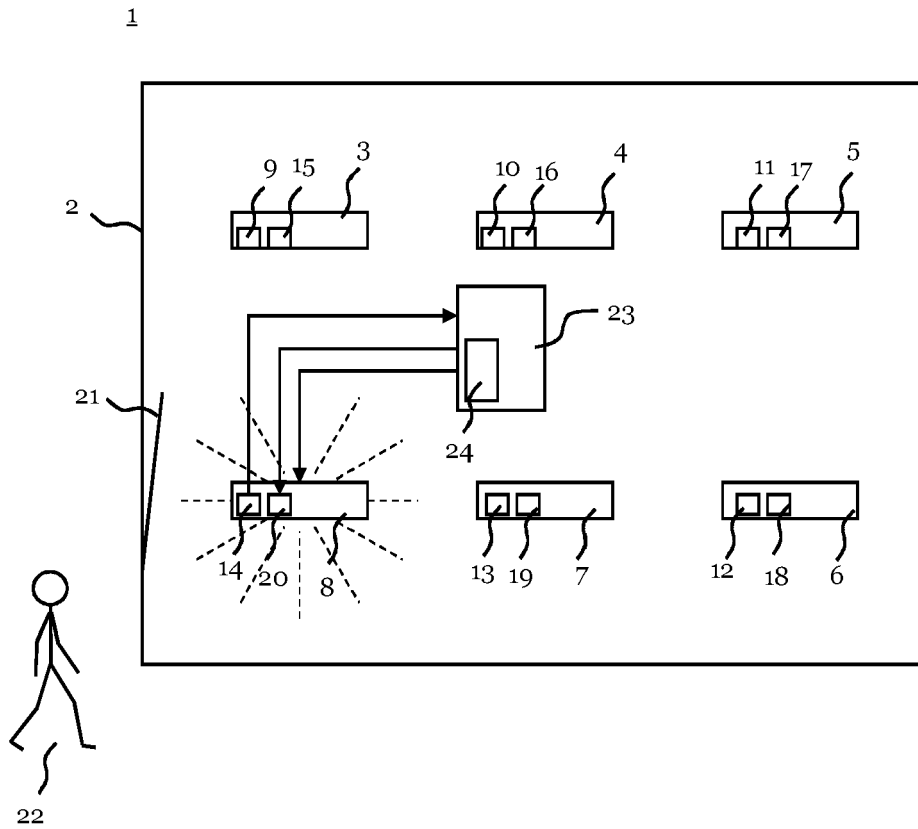


Fig. 3

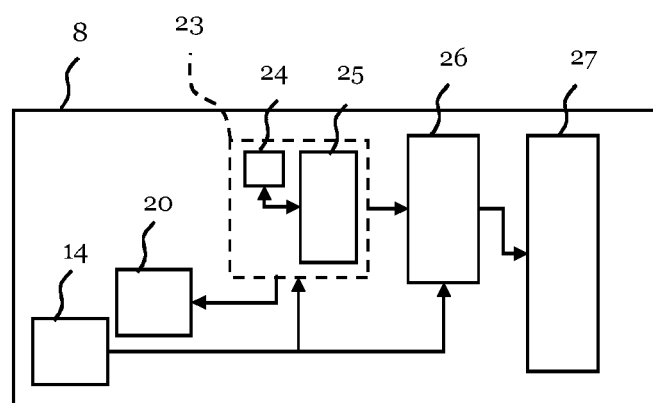


Fig. 4



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Munich		31 July 2023	Drabko, Jacek
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