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(71) Applicant: **Telecom-IT nv**

9880 Aalster (BE)

(72) Inventor: **GELAUDE, Filip**

9880 Aalter (BE)

(74) Representative: **Brantsandpatents bvba**

Pauline Van Pottelsberghelaan 24

9051 Ghent (BE)

(54) **METHOD FOR CONTROLLING VIRTUAL LAMPS AND LIGHTING SYSTEM COMPRISING VIRTUAL LAMPS**

(57) The present invention relates to a method for controlling virtual lamps comprising the steps of providing a central management system for managing light components, wherein a light component comprises one or more light elements and a control module for controlling light elements, placing one or more light components, establishing a communicative link between the one or more light components and the central management system, the method comprising the additional steps of defining at least one virtual lamp in the central management

system, wherein at least one light element of a light component is assigned to a virtual lamp, and sending messages from the central management system to control modules of the light components, wherein the messages comprise at least one command for controlling light elements of virtual lamps, wherein the light elements of a light component can be controlled individually or in groups by the control module. The invention also relates to a lighting system.

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Description

TECHNICAL FIELD

[0001] The invention relates to a method for controlling virtual lamps.

[0002] In a second aspect, the invention also relates to a lighting system for controlling virtual lamps.

[0003] In a third aspect, the invention relates to a use of a lighting system according to the second aspect for performing a method according to the first aspect.

PRIOR ART

[0004] Such a lighting system is known inter alia from US 9 655 215 (US '215).

[0005] US '215 describes a system and method for ensuring minimal control delay of grouped lighting devices in a wireless network. Lighting devices can be grouped according to location or according to a lighting scene and are assigned a group address based on this. This makes it easy to control the lighting devices together.

[0006] However, this known system is not suitable for creating more complex lighting scenes or for use for visual alerting in a building. The system uses lighting devices, of which only the light intensity and possibly the colour can be set. The use is therefore limited to lighting scenes where only the light intensity and the colour are adjusted and to changing the light intensity and colour throughout the day. A lighting device in this known system can only be used in one lighting scene at one point in time, so that a lighting device in this system cannot simultaneously serve, for example, as general lighting and as a visual alert. Another drawback of this known system is that after the loss of a communication link between a controller and the lighting devices, the last selected lighting scene is retained as a static lighting scene.

[0007] The present invention aims to solve at least some of the above problems or drawbacks.

SUMMARY OF THE INVENTION

[0008] In a first aspect, the present invention relates to a method according to claim 1.

[0009] In the method, at least one virtual lamp is defined in the central management system, the virtual lamp being assigned at least one light element of at least one light component. In addition, messages are sent from the central management system to control modules of the light components, the messages comprising at least one command for controlling light elements of virtual lamps. The light elements of a light component can be controlled individually or in groups of light elements by the control module. This is advantageous because it allows a first virtual lamp to be defined on a light component to which at least one light element of the light component is assigned, but a second virtual lamp can be defined on the same light component to which at least one light element

of the light component is also assigned. As a result, a light component can be used simultaneously for general lighting on the first virtual lamp and for visual alerting on the second virtual lamp. It is also possible to define a virtual lamp, in which light elements of different light components are assigned to the virtual lamp. This is advantageous, for example, for switching several light components in a zone on or off, or for copying a first light component onto a second light component as a visual alert.

[0010] Preferred embodiments of the method are set out in claims 2 to 9.

[0011] A particular preferred embodiment concerns a method according to claim 4. In this preferred embodiment, the commands comprised in the messages are given a priority, with light elements being controlled according to the priority of the tasks. This is advantageous for realising more complex scenarios, where a new command is simply sent to a control module of a light component and it is executed or not, depending on the priority. By assigning a priority, it is possible, for example, to prevent a visual alert on a light component from being removed by switching general lighting on or off, without complex rules having to be defined or checked in the central management system for this purpose.

[0012] In a second aspect, the present invention relates to a lighting system according to claim 10. This lighting system has the advantage, among other things, that it allows virtual lamps to be defined, for example a first virtual lamp can be defined on a light component, to which at least one light element of the light component is assigned, and a second virtual lamp can be defined on the same light component, to which at least one light element of the light component is also assigned, whereby a light component can be used, for example, simultaneously for general lighting on the first virtual lamp and for visual alerting on the second virtual lamp. It is also possible to define a virtual lamp, in which light elements of different light components are assigned to the virtual lamp, for example to switch several light components in a zone on or off, or to copy a first light component onto a second light component as a visual alert.

[0013] Preferred embodiments of the lighting system are described in the dependent claims 11 to 14.

[0014] In a third aspect, the present invention relates to a use according to claim 15. This use results in a lighting system that can be used for general lighting, complex lighting scenes and visual alerting at the same time. This is particularly advantageous in buildings where visual alerting is indispensable, for example for visual alerts for calls for assistance or for indicating evacuation routes, by only using existing lighting. This is also particularly advantageous in rooms with a multipurpose function because lighting can be adapted simply and very locally according to an event, layout or time by controlling suitable virtual lamps and possibly defining additional virtual lamps.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Figure 1 shows a schematic representation of a lighting system according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0016] Unless otherwise defined, all terms used in the description of the invention, including technical and scientific terms, have the meaning as commonly understood by a person skilled in the art to which the invention pertains. For a better understanding of the description of the invention, the following terms are explained explicitly.

[0017] In this document, 'a' and 'the' refer to both the singular and the plural, unless the context presupposes otherwise. For example, 'a segment' means one or more segments.

[0018] The terms 'comprise', 'comprising', 'consist of', 'consisting of', 'provided with', 'include', 'including', 'contain', 'containing', are synonyms and are inclusive or open terms that indicate the presence of what follows, and which do not exclude or prevent the presence of other components, characteristics, elements, members, steps, as known from or disclosed in the prior art.

[0019] Quoting numerical intervals by endpoints comprises all integers, fractions and/or real numbers between the endpoints, these endpoints included.

[0020] In the context of this document, a luminous element refers to a controllable element that emits light when controlled, such as, for example, a fluorescent lamp, an incandescent lamp, a light-emitting diode, an organic light-emitting diode, a quantum-dot light-emitting diode, a ceramic metal halide lamp (CMH), a halogen lamp, etc.

[0021] In a first aspect, the invention relates to a method for controlling virtual lamps.

[0022] In a preferred embodiment, the method comprises the steps of:

- providing a central management system for managing light components;
- placing one or more light components;
- establishing a communication link between the one or more light components.

[0023] A light component comprises several light elements and a control module for controlling the light elements of the light component. Preferably, a light component comprises at least 10 light elements per m², more preferably at least 20 light elements per m², even more preferably at least 50 light elements per m² and even more preferably at least 75 light elements per m². The light component optionally comprises a luminaire for receiving the light elements.

[0024] The light elements of a light component can be controlled in groups of light elements by the control module of the light component. Controllable means at least

that a light element can be switched on or off. Optionally, the light intensity and/or the colour of the light is also adjustable. In a group means that all light elements of a group are controlled simultaneously by the control module of the light component. The light elements of a light component can be controlled in groups of at most five light elements, preferably in groups of at most four light elements, more preferably in groups of at most three light elements, even more preferably in groups of at most two light elements and even more preferably the lighting elements can be controlled individually.

[0025] The communication link is a wired or a wireless connection. The communication link can be a point-to-point connection as well as a connection over a network, whether or not a mesh network or a bus network. Preferably, the communication link is a bidirectional connection. Preferably, the communication link is a wireless connection.

[0026] Non-limiting examples of suitable wired connections are a connection via a DALI bus, a connection via a KNX bus, a connection via a Q-bus, an Ethernet connection, a serial connection, etc.

[0027] Non-limiting examples of suitable wireless connections are a connection via a Wi-Fi network, a connection via a ZigBee network, a connection via Bluetooth, etc.

[0028] The method comprises the additional steps of:

- defining at least one virtual lamp in the central management system;
- sending messages from the central management system to control modules of the light components for controlling virtual lamps.

[0029] A virtual lamp is a logical grouping of light elements. A virtual lamp can, but does not have to, correspond to a physical lamp. At least one light element of at least one light component is assigned to a virtual lamp. Several or all light elements of a light component can therefore be assigned to a virtual lamp. Light elements of several light components can be assigned to a virtual lamp.

[0030] The messages that are sent from the central management system to the control modules of the light components for controlling virtual lamps, comprise at least one command for controlling light elements of virtual lamps. A message for controlling virtual lamps can be addressed to all light components or a message can be addressed to a selection of light components by means of a group address or a message can be addressed to a single light component. Preferably, a message for controlling a virtual lamp is addressed to a single light component. In case a virtual lamp comprises light elements on several light components, then a message is sent to each of the relevant light components.

[0031] It is apparent to one skilled in the art that in addition to the messages for controlling virtual lamps, other messages can be sent between the central management system and the light components, such as sta-

tus messages, error messages, confirmation messages, configuration messages, etc. To this end, the messages contain at least a type designation and an identification.

[0032] This method is advantageous because it makes it possible to define a first virtual lamp on a first light component, to which at least one light element of a first group of the light component is assigned, and a second virtual lamp can also be defined on the first light component, to which also at least one light element of a second group of the first light component is assigned. Since the light elements of a light component can be controlled individually or in groups by the control module, the first light component can for instance be used simultaneously for general lighting on the first virtual lamp and for visual alerting on the second virtual lamp. For example, in a hallway a number of light elements of a light component are used as general lighting, while a number of other light elements of the same light component are used for visual alerting for a nurse call system. It is also possible to define a virtual lamp, in which light elements of different light components are assigned to the virtual lamp. This is advantageous, for example, for switching several light components in a zone on or off, or for copying a first light component onto a second light component as a visual alert. An additional advantage is that virtual lamps can easily be changed, removed or added in the central management system, so that changing needs or circumstances can be quickly responded to.

[0033] In a preferred embodiment, the method comprises the additional step of sending a confirmation from a control module of a light component to the central management system upon receipt of a message, comprising at least one command for controlling light elements of virtual lamps. For this purpose, the confirmation preferably uses an identification included in the message, comprising at least one command for controlling light elements of virtual lamps. Preferably, the central management system sends said message again if no confirmation is received within a predetermined period. This is advantageous for robust control of the virtual lamps in the event of errors on the communication link.

[0034] In one embodiment, a message includes a command to dim a virtual lamp. This is advantageous for creating lighting scenes where a virtual lamp is dimmed. The command may be a separate type of command for controlling light elements of virtual lamps, the command comprising a field for indicating the type of command and a field for a desired light intensity. Alternatively, all commands for controlling light elements of virtual lamps include a field for a desired light intensity. A virtual lamp can then be switched on and off by writing a maximum possible light intensity or a minimum possible light intensity in the field for the desired light intensity, respectively. The desired light intensity is preferably shown as a relative value vis-à-vis the maximum possible light intensity. For light elements that are not dimmable, in this case only a minimum possible or a maximum possible light intensity is entered in the field for the desired light inten-

sity.

[0035] In one embodiment, a message includes a command to set a colour of a virtual lamp. This is advantageous for creating lighting scenes in which a virtual lamp emits coloured light. The command may be a separate type of command for controlling light elements of virtual lamps, the command comprising a field for indicating the type of command and a field for a desired colour. Alternatively, all commands for controlling light elements of virtual lamps include a field for a desired colour. A desired colour is preferably entered as RGB values. For light elements, whose colour is not adjustable, the field of the desired colour is ignored.

[0036] In a preferred embodiment, the communication link between the central management system and the light components is set up over a Wi-Fi network. This is advantageous because it makes it easy to use existing electricity infrastructure. Existing electrical connections for power points can be used to connect the light components. Wi-Fi networks are available in many buildings, so no additional or specific network infrastructure or bus has to be installed.

[0037] In a preferred embodiment, at least one virtual lamp is defined in the central management system, the virtual lamp comprising light elements of at least two light components. This is advantageous for defining a virtual lamp that illuminates a zone, for example all light components in a hallway. This is also advantageous for copying, for example, a first light component onto a second light component for visual alerting. For example, the first light component in a hallway can be used for visual alerting of a nurse call in a room, while a second light component in the room is a copy of the visual alert in the hallway, to reassure a patient or resident in the room that the nurse call has been made.

[0038] In a preferred embodiment, at least two virtual lamps are defined in the central management system, said virtual lamps having at least one light element in common. This is particularly advantageous for the simultaneous use of light components for, for example, general lighting or lighting scene, as well as for visual alerting. Visual alerts are in many cases dependent on an event, for example a nurse call, a fire alarm, a technical fault, pressing of a bell, etc. Such events are relatively limited relative to a need for general lighting or a lighting scene. By assigning light elements of a light component exclusively to a virtual lamp for visual alerting, these light elements of the light component are used less frequently, and a sub-optimal light output is obtained for the general lighting or for a lighting scene. Having the light elements in common allows a greater light output for the general lighting or lighting scene.

[0039] In a preferred embodiment, commands are given a priority. The light elements are controlled by the control module of the light component according to the priority of the commands.

[0040] A command with a lower priority will not be executed if a light element of a virtual lamp is controlled

according to a command with a higher priority. To this end, the control modules remember at least the priority of the last command executed. Preferably, the priority is verified per light element of a virtual lamp. A switched off light element preferably has the lowest priority, even if the light element was switched off by a command with a higher priority. This is to prevent that after switching off by a command with a higher priority, a light element can no longer be controlled by commands with the lowest or a lower priority. Alternatively, a light element of a virtual lamp is turned off by sending a cancellation of a previously sent command for controlling light elements of a virtual lamp. To this end, the messages contain at least a type designation and an identification. For commands with equal priority, the most recent command is preferably executed.

[0041] This embodiment is advantageous for realising more complex scenarios, where a new command is simply sent to a control module of a light component, and it is executed or not, depending on the priority. By assigning a priority, it is possible, for example, to prevent a visual alert on a light component from being removed by switching, for example, general lighting or a lighting scene on or off, without complex rules having to be defined or checked in the central management system for this purpose. In the central management system, a priority for a command must only be defined and included in the message containing the command. This embodiment is particularly advantageous in combination with a previously described embodiment in which two virtual lamps have light elements in common, for example a light component where all the light elements of the light component are assigned to a first virtual lamp for general lighting and where some of the light elements are assigned to a second virtual lamp for visual alerting. Because the priority is preferably verified per light element, it is, for example, possible to switch the general lighting for the light elements of the first virtual lamp on or off, without affecting existing visual alerts with a higher priority on the second virtual lamp, or it is possible to enable higher priority visual alerts on the second virtual lamp, without turning off the general lighting on the light elements on the first virtual lamp that are not in common with the second virtual lamp.

[0042] In a preferred embodiment, the control modules of the light components and the central management system comprise their own internal clock. The internal clocks of the control modules and the central management system are synchronised. The internal clocks of the control modules are synchronised with the internal clock of the central management system. Alternatively, the internal clocks of the control modules and of the central management system are synchronised with a reference clock. The synchronisation is done by means of a synchronisation protocol. Non-limiting examples of suitable protocols are NTP, SNTP and PTP. Preferably NTP is used. NTP is suitable for a synchronisation of the internal clocks, where the internal clocks deviate from each other by only

a few tens of ms, or in a local network up to even less than 1 ms. Synchronisation of the internal clocks is advantageous for synchronously controlling light elements of a virtual lamp. This is particularly advantageous in combination with a previously described embodiment in which a virtual lamp comprises light elements of at least two light components. Due to the synchronisation of the internal clocks, the virtual lamp is visually controlled as if it were one physical lamp.

[0043] In a preferred embodiment, a command comprises a time sequence for controlling light elements of virtual lamps. Each step of the time sequence includes a command for controlling the light elements of virtual lamps. In combination with a previously described embodiment where commands are prioritised, preferably each command in a sequence has a priority. Preferably, the time sequences comprise periods of fixed duration. This simplifies the determination and execution of time sequences. Fixed duration periods are particularly advantageous in combination with a previously described embodiment in which internal clocks of the control modules and the central management system are synchronised. The fixed duration is at least 5 ms and at most 1000 ms. Preferably, the fixed duration is at most 500 ms, more preferably at most 250 ms, even more preferably at most 100 ms, and even more preferably at most 50 ms. Preferred values are 10 ms, 16.67 ms, 20 ms and 33 ms. With these preferred values it is possible, for example, to change the light intensity of a light element without visual artifacts. A time sequence can be executed once, or it can be repeated automatically until the time sequence is disabled with a new command. A message comprising a command, comprising a time sequence, is preferably designated as such. To this end, the messages contain at least a type designation and an identification.

[0044] Time sequences are advantageous, for example, for providing moving visual alerts, such as, for example, a moving rope light as an indication of an evacuation direction. This can be achieved by defining several virtual lamps arranged next to each other performing the same sequence, but with an increasing phase shift between each subsequent virtual lamp in a row of virtual lamps arranged next to each other. Another example is the use of, for example, sixty virtual lamps for indicating seconds, sixty virtual lamps for indicating minutes and twelve or twenty-four virtual lamps for indicating hours. These examples can be advantageously combined with, for example, general lighting according to previously described embodiments. Time sequences are also advantageous for creating complex lighting scenes, such as a twinkling starry sky.

[0045] It is apparent to one skilled in the art that it is not necessary for each command to include a time sequence.

[0046] In a preferred embodiment, the control modules save received commands. The received commands are stored in a memory of the control module. The memory

may or may not be volatile. In this embodiment, a light element is preferably switched off by sending a cancellation of a previously sent command for controlling light elements of a virtual lamp. After cancellation, both the cancellation and the previously sent command for controlling light elements of the virtual lamp can be removed from the memory. This is advantageous to keep memory requirements for the control modules limited.

[0047] This embodiment is particularly advantageous in combination with a previously described embodiment in which commands are given priority. A light element can be assigned to different virtual lamps. A light element can be controlled differently, depending on commands for the different virtual lamps. The lighting element is controlled according to the command with the highest priority. If said command is cancelled, the light element is preferably automatically executed according to a command stored in the memory with the highest priority or with the same priority. This avoids having to send new messages, comprising commands for controlling light elements of virtual lamps, to the control modules of the light components after cancellation. This is also advantageous because after a loss of the communication link between a light component and the central management system, the light component can independently control the light elements according to commands in the memory. This is particularly advantageous in combination with a previously described embodiment in which a command comprises a time sequence for controlling light elements of virtual lamps. This allows the entire sequence to be kept in memory and repeated if necessary. This is also advantageous in case the sequence is performed on a first virtual lamp to which light elements are assigned which are in common with a second virtual lamp. For example, the sequence may comprise a command to turn off the virtual lamp. As mentioned in a previously described embodiment, a switched-off light element preferably has the lowest priority, whereby the common light element can be controlled according to a different command for the second virtual lamp, which is stored in the memory.

[0048] In one embodiment, the central management system receives tasks and/or events. The central management system analyses the received tasks and/or events and determines which virtual lamps should be controlled. After this, the central management system sends messages comprising commands for controlling light elements of virtual lamps. Tasks can be, for example, instructions from a control panel or operating software that are sent to the central management system. Events may include faults, alarms from a fire alarm panel, calls from a nurse call system, the pressing of a push button, motion detection by means of a motion detector, proximity detection of a personal wireless device, or other events.

[0049] The central management system comprises a link for this purpose. The link can be a link over an IP network, a serial link, a link over a Wi-Fi network or any

other suitable link. Preferably, the central management system comprises an ESPA interface for coupling the central management system with, for example, fire alarm panels or nurse call systems.

5 **[0050]** In a preferred embodiment, after sending a message, comprising at least one command for controlling light elements of virtual lamps, the central management system does not send any further messages comprising commands for controlling lighting elements of virtual lamps, until a virtual lamp has to be controlled differently. This embodiment is advantageous because it means that fewer messages need to be sent, whereby bandwidth in a network or on a bus or point-to-point connection is saved and energy is also saved.

10 **[0051]** In a preferred embodiment, the method comprises the additional step of displaying an error status of a light component using the light elements of the light component. An error status can be, for example, a broken communication link or, for example, detection of several central management systems or, in the case of a battery-powered light component, of a low battery voltage or detection of defective light elements. By displaying an error status using the light elements of the light component, a visual indication of a possible problem can be given even if there is no communication link with a central management system, thereby enabling the problem to be resolved more quickly. This is particularly advantageous with light components that are used for visual alerting and that are not necessarily controlled frequently, so that a possible problem can go unnoticed for a long time.

20 **[0052]** In one embodiment, the power consumption of the light elements is measured. This is advantageous because a changed power consumption for the same desired light intensity can indicate a defective light element or a high probability that a light element will be defective in the near future. This embodiment is advantageous for performing preventive maintenance. A changed power consumption can be reported to the central management system via a status message. Alternatively or additionally, the changed power consumption can be displayed as an error status using the light elements of the light component, as in a previously described embodiment.

30 **[0053]** In a preferred embodiment, the method comprises the additional step of setting up a second communication link between the one or more light components and the central management system. The second communication link uses a network, bus or point-to-point connection for this purpose, which is different from the network, bus or point-to-point connection over which the first communication link is set up.

45 **[0054]** After failure of or disruption on the first communication link, the central management system preferably automatically switches to the second communication link. Sending confirmations as in a previously described embodiment is advantageous herein for detecting the failure or disruption of the first communication link. A failed or disrupted first communication link will result in

many missing confirmations, upon which the central management system can decide to switch to the second communication link. Preferably, the central management system regularly tests the first communication link in order to switch back to the first communication link after the first communication link has been restored.

[0055] Preferably, the second communication link is a connection over a mesh network. A mesh network is beneficial for a reliable, low bandwidth communication link. Preferably, the mesh network is a mesh network between Bluetooth devices.

[0056] This embodiment is advantageous for guaranteeing reliable control of virtual lamps. This is particularly advantageous in the case of visual alerting, such as a fire alarm, a nurse call, a technical malfunction, etc.

[0057] In one embodiment, the method comprises the additional step of receiving events by light components and forwarding the events to the central management system. The events are then further processed in the central management system, as in a previously described embodiment. A light component preferably comprises a wireless receiver for this purpose. The wireless receiver is preferably a Bluetooth module. This is particularly advantageous in combination with a previously described embodiment in which the central management system sets up a second communication link, in that the Bluetooth module can be used both for setting up the second communication link and for receiving events. The events are, for example, the pressing of a push button, a motion detection by means of a motion detector, a proximity detection of a personal wireless device, etc., where the push button, the motion detector, the personal wireless device, etc. are connected with a light component via the wireless receiver.

[0058] In one embodiment, a message comprising a command for controlling light elements of a virtual lamp, contains a mention of the virtual lamp. A control module of a light component identifies the light components of the light component assigned to said virtual lamp and controls them according to the command.

[0059] In a preferred embodiment, a message comprising a command for controlling light elements of a virtual lamp comprises an identification of the light elements of a light component to be controlled. Said message does not include mention of the virtual lamp. The virtual lamps are defined in the central management system. The central management system translates a command for controlling a virtual lamp into various commands for individual light components, the command comprising instructions for controlling specific light elements. This is advantageous because it means that a light component does not need to have the concept of a virtual lamp, whereby less memory and computing power is required in a control module of a light component. The command for controlling light elements of virtual lamps can individually designate each light element to be controlled. Alternatively, a series of light elements can be indicated by means of a starting light element and a stopping light element. It

is apparent to one skilled in the art that in the case light elements can be controlled in a group, by designating a light element in this context is meant a group of light elements and a series of light elements a series of groups of light elements.

[0060] In a second aspect, the invention relates to a lighting system for controlling virtual lamps.

[0061] In a preferred embodiment, the lighting system comprises one or more light components and a central management system for controlling light elements.

[0062] A light component comprises several light elements and a control module for controlling the light elements of the light component. Preferably, a light component comprises at least 10 light elements per m², more preferably at least 20 light elements per m², even more preferably at least 50 light elements per m² and even more preferably at least 75 light elements per m². The light component optionally comprises a luminaire for receiving the light elements.

[0063] The light elements of a light component can be controlled in groups of light elements by the control module of the light component. Controllable means at least that a light element can be switched on or off. Optionally, the light intensity and/or the colour of the light is also adjustable. In a group means that all light elements of a group are controlled simultaneously by the control module of the light component. The light elements of a light component can be controlled in groups of at most five light elements, preferably in groups of at most four light elements, more preferably in groups of at most three light elements, even more preferably in groups of at most two light elements and even more preferably the lighting elements can be controlled individually.

[0064] There is a communication link between the one or more light components and the central management system. The communication link is a wired or a wireless connection. The communication link can be a point-to-point connection as well as a connection over a network, whether or not a mesh network or a bus network. Preferably, the communication link is a bidirectional connection. Preferably, the communication link is a wireless connection.

[0065] Non-limiting examples of suitable wired connections are a connection via a DALI bus, a connection via a KNX bus, a connection via a Q-bus, an Ethernet connection, a serial connection, etc.

[0066] Non-limiting examples of suitable wireless connections are a connection via a Wi-Fi network, a connection via a ZigBee network, a connection via Bluetooth, etc.

[0067] The central management system comprises a computer unit, a working memory and a non-volatile memory. The central management system is, for example, a PC, a server or an embedded computer. The central management system comprises a configuration module. The configuration module is configured to define virtual lamps in the central management system. A virtual lamp is a logical grouping of light elements. A virtual lamp can, but does not have to, correspond to a physical lamp.

A virtual lamp comprises at least one light element of at least one light component. Several or all light elements of a light component can thus be assigned to a virtual lamp. Light elements of several light components can be assigned to a virtual lamp. The non-volatile memory is provided for storing the definitions of the virtual lamps in a configuration file, database or other suitable digital format. A definition of a virtual lamp comprises at least one identification of which light elements of light components are assigned to a virtual lamp. Optionally, a definition also comprises a name for the virtual lamp.

[0068] The central management system comprises a communication module. The communication module is configured to send messages from the central management system to control modules of the light components. The messages comprise at least one command for controlling light elements of virtual lamps. A message for controlling virtual lamps is addressed to all light components or a message is addressed to a selection of light components by means of a group address or a message is addressed to a single light component. Preferably, a message for controlling a virtual lamp is addressed to a single light component.

[0069] The communication module comprises a physical interface for sending messages over a point-to-point connection, a network and/or a bus, depending on the established communication link. Non-limiting examples of physical interfaces are an RJ-45 connector and an Ethernet PHY for communicating on an Ethernet network, an antenna and a transmitter for communicating on a Wi-Fi network or a ZigBee mesh network or a Bluetooth link or a Bluetooth mesh network, or a connector and a transmitter for communication over a bus.

[0070] This lighting system has the advantage, among other things, that it allows virtual lamps to be defined, for example a first virtual lamp can be defined on a first light component, to which at least one light element of the first light component is assigned, and a second virtual lamp can be defined on the same first light component, to which at least one light element of the first light component is also assigned, whereby the first light component can be used, for example, simultaneously for general lighting on the first virtual lamp and for visual alerting on the second virtual lamp. It is also possible to define a virtual lamp, in which light elements of different light components are assigned to the virtual lamp, for example to switch several light components in a zone on or off, or to copy a first light component onto a second light component as a visual alert.

[0071] In a preferred embodiment, the central management system and the light components comprise a Wi-Fi interface. This is advantageous for setting up a communication link over a Wi-Fi network, making it easy to use existing electricity infrastructure. Existing electrical connections for power points can be used to connect the light components. Wi-Fi networks are available in many buildings, so no additional or specific network infrastructure or bus has to be installed.

[0072] In a further embodiment, the communication link between the central management system and the light components is authenticated. Non-limiting examples of suitable authentication protocols are Dot1x and WLP-2. Dot1x is an implementation of the IEEE 802.1X-2010 standard for authentication. WLP-2 is an implementation of the Websphere Liberty Protocol for authentication. This embodiment is advantageous in that it prevents unwanted clients from registering on the central management system and disrupting the correct operation of the lighting system.

[0073] In a preferred embodiment, the control modules of the light components and the central management system comprise their own internal clock and a clock synchronisation module. The clock synchronisation module is configured to synchronise the internal clocks of the light component control modules with the internal clock of the central management system. Alternatively, the clock synchronisation module is configured to synchronise the internal clocks of the control module of a light components and the internal clock of the central management system with a reference clock. The synchronisation is done by means of a synchronisation protocol. Non-limiting examples of suitable protocols are NTP, SNTP and PTP. Preferably NTP is used. Synchronisation of the internal clocks is advantageous for synchronously controlling light elements of a virtual lamp.

[0074] In a preferred embodiment, a light element of a light component is an RGB light-emitting diode. This is advantageous because it makes both the colour and the light intensity of a light element adjustable. In addition, light-emitting diodes are energy-efficient.

[0075] In a further embodiment, the light elements of a light component are a strip of RGB light-emitting diodes. The strip of RGB light-emitting diodes is at least 0.5 m and at most 3 m long.

[0076] The strip of RGB light-emitting diodes is preferably at least 0.6 m in length, more preferably at least 0.7 m, even more preferably at least 0.8 m and even more preferably at least 0.9 m.

[0077] The strip of RGB light-emitting diodes is preferably at most 2.8 m in length, more preferably at most 2.6 m, even more preferably at most 2.4 m, and even more preferably at most 2.2 m.

[0078] The strip comprises at least 75 RGB light-emitting diodes per metre, preferably at least 85 RGB light-emitting diodes per metre, more preferably at least 95 RGB light-emitting diodes per metre, and even more preferably at least 105 RGB light-emitting diodes per metre.

[0079] A light component comprising a strip of RGB light-emitting diodes is advantageous for forming elongated lighting fixtures, which can illuminate a corridor, a reception area, a table, etc. and which are also useful for indicating moving visual alerts, such as a moving rope light. By placing such light components parallel to each other along their longitudinal direction, surfaces can be illuminated.

[0080] In an alternative embodiment, the light ele-

ments of a light component are a grid of RGB light-emitting diodes. The grid is at least 0.5 m and no more than 3 m long.

[0081] The grid of RGB light-emitting diodes is preferably at least 0.6 m in length, more preferably at least 0.7 m, even more preferably at least 0.8 m, and even more preferably at least 0.9 m.

[0082] The grid of RGB light-emitting diodes is preferably at most 2.8 m in length, more preferably at most 2.6 m, even more preferably at most 2.4 m, and even more preferably at most 2.2 m.

[0083] A light component comprising a grid of RGB light-emitting diodes is advantageous for illuminating surfaces and is also useful for indicating moving visual alerts.

[0084] It is apparent to one skilled in the art that other suitable arrangements of light elements are possible, such as, for example, curved curves or surfaces. The invention is not limited to previously described embodiments of light components comprising a strip or a grid of light elements.

[0085] In a preferred embodiment, the control module of a light component comprises a memory. The memory is configured to store received commands. The memory may or may not be volatile. This is advantageous because after a loss of the communication link between a light component and the central management system, the control module of the light component can independently control the light elements according to commands in the memory.

[0086] In a preferred embodiment, a light component comprises a battery for powering the control module and the light elements. This is advantageous for the use of light components at a location in a building where no power grid is provided. This is also advantageous for light components whose light elements are assigned to a virtual lamp which is used, for example, for visual alerting, for example indicating an evacuation route in the event of a fire. In the event of a fire, it is possible that the power grid will fail. Because the light component comprises a battery, the evacuation route can still be indicated.

[0087] In one embodiment, the central management system comprises a link for receiving tasks and/or events. The link is a link over an IP network, a serial link, a link over a Wi-Fi network or another suitable link. Preferably, the central management system comprises an ESPA interface for coupling the central management system with, for example, fire alarm panels or nurse call systems.

[0088] This embodiment is advantageous for controlling virtual lamps by the central management system based on tasks and/or events from outside the lighting system. Tasks can be, for example, instructions from a control panel or operating software that are sent to the central management system. Events may include faults, alarms from a fire alarm panel, calls from a nurse call system, the pressing of a push button, motion detection by means of a motion detector, proximity detection of a personal wireless device, etc. or other events.

[0089] In a preferred embodiment, the light components and the central management system comprise a Bluetooth module. A Bluetooth module is advantageous for setting up a Bluetooth mesh network. A mesh network is beneficial for a reliable, low bandwidth communication link. The Bluetooth mesh network is advantageous for setting up a second communication link between the central management system and the light components. The second communication link is a backup in case the first communication link is down or disrupted. A Bluetooth module is also advantageous for receiving events from light components and for forwarding the events to the central management system. The events are, for example, the pressing of a push button, a motion detection by means of a motion detector, a proximity detection of a personal wireless device, etc., where the push button, motion detector, the personal wireless device, etc. are connected with a light component via the Bluetooth module.

[0090] In one embodiment, the light components comprise sensors. Non-limiting examples of sensors are PIR sensors, sensors for measuring temperature, air humidity, air quality, etc. Measured values from these sensors can be sent to the central management system. The measured values can be sent over the communication link between the central management system and the light components and/or with the aid of a Bluetooth module as in a previously described embodiment. Measured values from sensors can be used as events in the central management system or locally in the light components.

[0091] In one embodiment, the control module of a light component comprises a circuit for measuring a power consumption of the light elements. The power consumption can be measured for all light elements together and/or for groups of light elements and/or for each individual light element. The power consumption is preferably measurable for each individual light element. A changed power consumption for the same desired light intensity can indicate a defective light element or a high probability that a light element will be defective in the near future. This embodiment is advantageous for performing preventive maintenance.

[0092] A person skilled in the art will appreciate that a method according to the first aspect is preferably performed using a lighting system according to the second aspect and that a lighting system according to the second aspect is preferably configured to perform a method according to the first aspect. Each feature described in this document, both above and below, can therefore relate to any of the three aspects of the present invention.

[0093] In a third aspect, the invention relates to a use of a lighting system according to the second aspect for performing a method according to the first aspect.

[0094] This use results in a lighting system that can be used for general lighting, complex lighting scenes and visual alerting at the same time. This is particularly advantageous in buildings where visual alerting is indispensable, for example for visual alerts for calls for assistance

or for indicating evacuation routes, by only using existing lighting. This is also particularly advantageous in rooms with a multipurpose function because lighting can be adapted simply and very locally according to an event, layout or time by controlling suitable virtual lamps and possibly defining additional virtual lamps.

[0095] In what follows, the invention is described by means of a non-limiting figure illustrating the invention, and which is not intended to or should not be construed as limiting the scope of the invention.

DETAILED DESCRIPTION OF THE FIGURES

[0096] Figure 1 shows a schematic representation of a lighting system according to an embodiment of the present invention.

[0097] The lighting system comprises a central management system (1), a first light component (2), a second light component (6) and a third light component (7). Each light component (2), (6) and (7) comprises several light elements (4) and a control module (3) for controlling the light elements (4). The light elements (4) can be individually controlled by the control module (3). The light components (2), (6) and (7) are communicatively connected to the central management system (1) via a Wi-Fi connection (5). In the central management system (1), four virtual lamps (8), (9), (10) and (11) are defined. The rightmost light elements (4) of the light components (2), (6) and (7) are always assigned to a first virtual lamp (8). The three leftmost light elements (4) of the third light component (7) are assigned to a second virtual lamp (9). The second virtual lamp (9) does not have any light elements (4) in common with one of the other virtual lamps (8), (10) or (11). All light elements (4) of the second light component (6) are assigned to a third virtual lamp (10). The third virtual lamp (10) has the rightmost light element (4) of the second light component (6) in common with the first virtual lamp (8). Four light elements (4) of the second light component (6) are assigned to a fourth virtual lamp (11). The fourth virtual lamp (11) has all its light elements (4) in common with the third virtual lamp (10). It is clear from Figure 1 that not all light elements (4) have to be assigned to a virtual lamp (8), (9), (10) or (11).

Claims

1. Method for controlling virtual lamps, comprising:

- providing a central management system for managing light components, wherein a light component comprises a plurality of light elements and a control module for controlling light elements;
- placing one or more light components;
- establishing a communication link between the one or more light components and the central management system;

characterised in that the method comprises the additional steps of:

- defining at least one virtual lamp in the central management system, wherein at least one light element of at least one light component is assigned to a virtual lamp;
- sending messages from the central management system to control modules of the light components for controlling virtual lamps, wherein the messages comprise at least one command for controlling light elements of virtual lamps, wherein the light elements of a light component can be controlled individually or in groups of light elements by the control module of the light component.

2. Method according to claim 1, **characterised in that** at least one virtual lamp is defined in the central management system, the virtual lamp comprising light elements of at least two light components.
3. Method according to claim 1 or 2, **characterised in that** at least two virtual lamps are defined in the central management system, said virtual lamps having at least one light element in common.
4. Method according to any of the preceding claims 1-3, **characterised in that** commands are assigned a priority, with light elements being controlled according to the priority of the commands.
5. A method according to any of the preceding claims 1-4, **characterised in that** the control modules of the light components and the central management system have their own internal clock, the internal clocks of the control modules and the central management system being synchronised.
6. A method according to any of the preceding claims 1-5, **characterised in that** the control modules of the light components store commands received.
7. A method according to any of the preceding claims 1-6, **characterised in that** a command comprises a time sequence for controlling light elements of virtual lamps.
8. A method according to any of the preceding claims 1-7, **characterised in that** the central management system receives tasks and/or events, wherein the central management system analyses the received tasks and/or events and determines which virtual lamps should be controlled.
9. A method according to any of the preceding claims 1-8, **characterised in that**, after sending a message, comprising at least one command for control-

ling light elements of virtual lamps, the central management system does not send any further messages comprising commands for controlling lighting elements of virtual lamps, until a virtual lamp has to be controlled differently.

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10. Lighting system for controlling virtual lamps comprising one or more light components, wherein a light component comprises a plurality of light elements and a control module for controlling light elements, and a central management system for managing light components, wherein there is a communication link between the one or more light components and the central management system, **characterised in that** the central management system comprises a configuration module, wherein the configuration module is configured to define virtual lamps in the central management system, wherein a virtual lamp comprises at least one light element of a light component, and the central management system comprises a communication module, wherein the configuration module is configured to send messages from the central management system to control modules of the light components, wherein the messages comprise at least one command for controlling light elements of virtual lamps, wherein the light elements of a light component can be controlled individually or in groups of light elements by the control module of the light component.
11. Lighting system according to claim 10, **characterised in that** the control modules of the light components and the central management system comprise their own internal clock and a clock synchronisation module.
12. Lighting system according to claim 10 or 11, **characterised in that** a light element of a light component is an RGB light-emitting diode.
13. Lighting system according to claim 10, 11 or 12, **characterised in that** the control module of a light component comprises a memory, wherein the memory is configured to store received commands.
14. Lighting system according to any of claims 10-13, **characterised in that** a light component comprises a battery, for powering the control module and the light elements.
15. Use of a lighting system according to any of claims 10-14, for performing a method according to any of claims 1-9.

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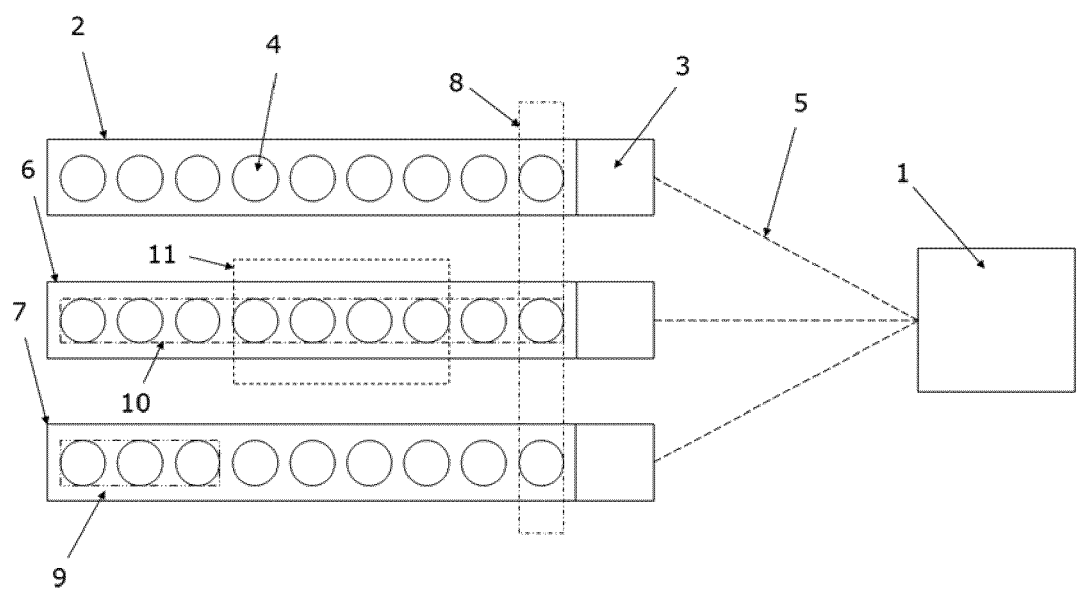


FIG. 1



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Application Number
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