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(54) **LUMINAIRES FOR EMERGENCY LIGHTING OPERATION AND METHODS OF OPERATING THE SAME**

(57) Disclosed is a luminaire (1) for emergency lighting operation. The luminaire (1) comprises a sensor unit (11); a control unit (12); a driver unit (13); an LED load (14); and a first communication unit (15). The sensor unit (11) is configured to selectively provide the control unit (12) with a supply voltage (10, L) of the luminaire (1) in response to a sensor reading. The control unit (12) is configured to control the driver unit (13) in accordance with a rule of behavior for the emergency lighting operation.

ation and the selectively provided supply voltage (10', L'); and to trigger the first communication unit (15) in response to an absence of zero crossings in the selectively provided supply voltage (10', L'). The driver unit (13) is configured to drive the LED load (14); and the first communication unit (15) is configured to send an indication of the emergency lighting operation in response to the trigger. Such luminaires are cost-efficient and may be configured for emergency lighting operation on-demand.



Description**Technical Field**

5 **[0001]** The present disclosure relates to lighting technology, and in particular to luminaires for emergency lighting operation.

Background Art

10 **[0002]** Basic lighting systems may require the deployment of cost-conscious system components. Luminaires of such lighting systems may for cost reasons not be arranged to detect an emergency situation and to perform a corresponding emergency lighting operation, let alone in connection with some kind of configurability.

Summary

15 **[0003]** In view of the above-mentioned drawbacks and limitations, the present disclosure aims to improve the lighting systems of the background art. An objective is to provide cost-efficient luminaires that can be configured for emergency lighting operation on-demand.

20 **[0004]** The objective is achieved by the embodiments as defined by the appended independent claims. Preferred embodiments are set forth in the dependent claims and in the following description and drawings.

25 **[0005]** A first aspect of the present disclosure relates to a luminaire for emergency lighting operation. The luminaire comprises a sensor unit; a control unit; a driver unit; an LED load; and a first communication unit. The sensor unit is configured to selectively provide the control unit with a supply voltage of the luminaire in response to a sensor reading. The control unit is configured to control the driver unit in accordance with a rule of behavior for the emergency lighting operation and the selectively provided supply voltage; and to trigger the first communication unit in response to an absence of zero crossings in the selectively provided supply voltage. The driver unit is configured to drive the LED load; and the first communication unit is configured to send an indication of the emergency lighting operation in response to the trigger.

30 **[0006]** The first communication unit may further be configured to receive the indication of the emergency lighting operation.

35 **[0007]** A second aspect of the present disclosure relates to a luminaire for emergency lighting operation. The luminaire comprises a control unit; a driver unit; an LED load; and a first communication unit. The first communication unit is configured to receive an indication of the emergency lighting operation. The control unit is configured to control the driver unit in accordance with a rule of behavior for emergency lighting operation and a permanently provided supply voltage of the luminaire. The driver unit is configured to drive the LED load.

40 **[0008]** The control unit may further be configured to trigger the first communication unit in response to an absence of zero crossings in the permanently provided supply voltage; and the first communication unit may further be configured to send the indication of the emergency lighting operation in response to the trigger.

45 **[0009]** The supply voltage of the luminaire may comprise one of: an alternating current, AC, voltage or a rectified AC voltage under regular lighting operation; and a direct current, DC, voltage under the emergency lighting operation.

50 **[0010]** The control unit may further comprise a zero crossing detection, ZXD, circuit; and the control unit may further be configured to detect the absence of the zero crossings using the ZXD circuit upon a lapse of a zero crossing timeout period in excess of a reciprocal value of a mains frequency.

55 **[0011]** The control unit may further be configured to detect a presence of the zero crossings using the ZXD circuit upon a completion of a zero crossing countdown being set upon an emergence of the emergency lighting operation.

60 **[0012]** The first communication unit may comprise one of: a Wireless Local Area Network, WLAN, communication interface in accordance with IEEE 802.11; a Thread communication interface in accordance with IEEE 802.15.4; a Bluetooth communication interface, a Bluetooth Low Energy, BLE, communication interface, a SubGHz communication interface preferable in the ISM bands (e.g. 433 MHz, 868 MHz, 915 MHz), or operating at another frequency.

65 **[0013]** The sensor unit may comprise one of: a presence and/or motion sensor, being configured to selectively provide the control unit with the supply voltage of the luminaire in response to a presence and/or motion sensor reading; a light intensity sensor, being configured to selectively provide the control unit with the supply voltage of the luminaire in response to a light intensity sensor reading; and a communication interface of a lighting control bus, being configured to selectively provide the control unit with the supply voltage of the luminaire in response to a sensor reading via the lighting control bus.

70 **[0014]** The lighting control bus may comprise a Digital Addressable Lighting Interface, DALI, bus.

75 **[0015]** The luminaire may further comprise a second communication unit; and the control unit may further be configured to receive, via the second communication unit, a parameter being indicative of the rule of behavior for the emergency

lighting operation.

[0016] The second communication unit may comprise a Near Field Communication, NFC, interface.

[0017] The rule of behavior for the emergency lighting operation may comprise one of: not driving the LED load and not responding to the provided supply voltage any further, if the parameter corresponds to a value of 0; driving the LED load at a dim level corresponding to the parameter and not responding to the provided supply voltage any further, if the parameter corresponds to a value between 1 and 100; driving the LED load at a predefined dim level and not responding to the provided supply voltage any further, if the parameter corresponds to a value of 101; and driving the LED load at a dim level corresponding to regular operating conditions in response to the provided supply voltage, if the parameter corresponds to a value of 255.

[0018] A third aspect of the present disclosure relates to a method of operating a luminaire for emergency lighting operation. The method comprises selectively providing a control unit of the luminaire with a supply voltage of the luminaire in response to a sensor reading. The method further comprises controlling a driver unit of the luminaire in accordance with a rule of behavior for the emergency lighting operation and the selectively provided supply voltage. The method further comprises driving an LED load of the luminaire. The method further comprises triggering a first communication unit of the luminaire in response to an absence of zero crossings in the selectively provided supply voltage; and sending an indication of the emergency lighting operation in response to the trigger.

[0019] A fourth aspect of the present disclosure relates to a method of operating a luminaire for emergency lighting operation. The method comprises receiving an indication of the emergency lighting operation. The method further comprises controlling a driver unit of the luminaire in accordance with a rule of behavior for the emergency lighting operation and a permanently provided supply voltage of the luminaire; and driving an LED load of the luminaire.

Advantageous Effects

[0020] The present disclosure provides cost-efficient luminaires using simple components, such as presence/movement sensors behaving like light switches. The luminaires are on-demand configurable for emergency lighting operation, detect emergency situations via voltage supply or indications received from other luminaires, and perform the emergency lighting operation in accordance with said configuration.

[0021] The technical effects and advantages described above in relation with the luminaires equally apply to the methods of operating the same having corresponding features.

Brief Description of Drawings

[0022] The above-described aspects and implementations will now be explained with reference to the accompanying drawings, in which the same or similar reference numerals designate the same or similar elements.

[0023] The features of these aspects and implementations may be combined with each other unless specifically stated otherwise.

[0024] The drawings are to be regarded as being schematic representations, and elements illustrated in the drawings are not necessarily shown to scale. Rather, the various elements are represented such that their function and general purpose become apparent to those skilled in the art.

FIG. 1 illustrates a luminaire in accordance with the present disclosure;

FIG. 2 illustrates a luminaire in accordance with the present disclosure;

FIG. 3 illustrates a lighting system in regular lighting operation;

FIG. 4 illustrates a lighting system in emergency lighting operation;

FIG. 5 illustrates a state diagram of the control unit of the luminaire;

FIG. 6 illustrates the ZXD circuit of the control unit of the luminaire;

FIG. 7 illustrates a flow diagram of a method in accordance with the present disclosure of operating the luminaire; and

FIG. 8 illustrates a flow diagram of a method in accordance with the present disclosure of operating the luminaire.

Detailed Descriptions of Drawings

[0025] FIG. 1 illustrates a luminaire 1 in accordance with the present disclosure.

[0026] The depicted luminaire 1 is suitable for regular lighting operation (i.e., regular illumination) as well as for emergency lighting operation (i.e., emergency illumination).

[0027] The luminaire 1 comprises a sensor unit 11; a control unit 12; a driver unit 13; an LED load 14; and a first communication unit 15.

[0028] In accordance with FIG. 1, the sensor unit 11 may comprise a presence and/or motion sensor, being configured to selectively provide the control unit 12 with the supply voltage 10, *L* of the luminaire 1 in response to a presence and/or motion sensor reading.

[0029] Alternatively, the sensor unit 11 may comprise a light intensity sensor (not shown), such as a daylight sensor, being configured to selectively provide the control unit 12 with the supply voltage 10, *L* of the luminaire 1 in response to a light intensity sensor reading.

[0030] Alternatively, the sensor unit 11 may comprise a communication interface (not shown) of a lighting control bus, such as a Digital Addressable Lighting Interface (DALI, or DALI-2) bus. The communication interface may be configured to selectively provide the control unit 12 with the supply voltage 10, *L* of the luminaire 1 in response to a sensor reading indicated via the lighting control bus.

[0031] The sensor unit 11 is configured to selectively provide the control unit 12 with a supply voltage 10, *L* of the luminaire 1 in response to a sensor reading such as presence/motion, daylight, etc. In other words, the sensor unit 11 behaves like a light switch in that it switches/connects through the supply voltage 10, *L* of the luminaire 1 to the control unit 12 upon the sensor reading.

[0032] The control unit 12 may comprise one of: an Application-Specific Integrated Circuit (ASIC), a field-programmable gate array (FPGA), a microcontroller (μ C), a Central Processing Unit (CPU), and the like.

[0033] The driver unit 13 may comprise a commercially available LED driver matching the electrical requirements of the LED load 14.

[0034] The LED load 14 may comprise at least one LED.

[0035] The first communication unit 15 may comprise one of: a Wireless Local Area Network, WLAN, communication interface in accordance with IEEE 802.11; a Thread communication interface in accordance with IEEE 802.15.4; a Bluetooth communication interface, a Bluetooth Low Energy, BLE, communication interface, a SubGHz communication interface preferable in the ISM bands (e.g. 433 MHz, 868 MHz, 915 MHz), or operating at another frequency.

[0036] The supply voltage 10, *L* of the luminaire 1, which may be applied at a port suggested on top of FIG. 1, may comprise one of: an alternating current (AC) voltage or a rectified AC voltage under regular lighting operation; and a direct current (DC) voltage under the emergency lighting operation. That is to say, the luminaire 1 regularly receives an AC supply voltage having zero crossings, whereas in emergency situations the luminaire 1 receives a DC supply voltage from a central emergency power supply such as a battery.

[0037] The control unit 12 may be configured to detect a presence of zero crossings (i.e., regular lighting operation) using a zero crossing detection, ZXD, circuit 121 (not shown, see FIG. 6 below).

[0038] In particular, the presence of zero crossings may be detected upon a completion of a zero crossing countdown being set upon an emergence of the emergency lighting operation. For example, the zero crossing countdown may be started from a value of 1 for immediate detection of the presence of zero crossings, whereas higher start values may prevent a premature detection of the presence of zero crossings.

[0039] The control unit 12 may further be configured to detect the absence of the zero crossings (i.e., emergency lighting operation) using the ZXD circuit 121.

[0040] In particular, the absence of zero crossings may be detected upon a lapse of a zero crossing timeout period in excess of a reciprocal value of a mains frequency. For example, a mains frequency of $f = 50$ or 60 Hz implies a zero crossing every $1/f = 10$ ms (8, 3 ms). Thus, depending on the applicable mains frequency, a zero crossing timeout period in excess of 10 ms (8, 3 ms) should be used, and the corresponding timer should be (re-)set to this zero crossing timeout period each time a zero crossing is detected.

[0041] Accordingly, the luminaire 1 of the first aspect is capable of distinguishing regular lighting operation and emergency lighting operation once the sensor unit 11 is active.

[0042] The luminaire 1 may further comprise a second communication unit 16, such as a Near Field Communication (NFC) interface; and may further be configured to receive, via the second communication unit 16, a parameter 17, *X* being indicative of a rule of behavior for the emergency lighting operation.

[0043] For example, the rule of behavior of the control unit 12 for the emergency lighting operation may comprise one of:

If the parameter 17, X corresponds to ...	... then ...
... a value of 0, ...	not driving the LED load 14 and not responding to the provided supply voltage 10, L any further ⇒ stop regular lighting operation ;
... a value between 1 and 100, ...	driving the LED load 14 at a dim level corresponding to the parameter 17, X and not responding to the provided supply voltage 10, L; 10, L' any further ⇒ proceed to emergency lighting operation with defined dim level ;
... a value of 101, ...	driving the LED load 14 at a predefined dim level and not responding to the provided supply voltage
	10, L; 10, L' any further ⇒ proceed to emergency lighting operation with predefined dim level ;
... a value between 102 and 254, ...	(reserved)
... a value of 255, ...	driving the LED load 14 at a dim level corresponding to regular operating conditions in response to the provided supply voltage 10, L; 10, L' ⇒ continue regular lighting operation .

[0044] Accordingly, an arbitrary luminaire 1, 1' may be configured as an emergency luminaire (or regular luminaire) by holding an NFC tag to it. Other luminaires 1, 1' may be configured to be switched off in emergency situations so as to preserve the central emergency DC supply.

[0045] The control unit 12 is further configured to control the driver unit 13 in accordance with the rule of behavior for the emergency lighting operation and the selectively provided supply voltage 10', L'.

[0046] Evidently, the driver unit 13 is configured to drive the LED load 14.

[0047] The control unit 12 is further configured to trigger the first communication unit 15 in response to the selectively provided supply voltage 10', L', and in particular in response to the absence of the zero crossings in the selectively provided supply voltage 10', L'.

[0048] The first communication unit 15 is configured to send an indication of the emergency lighting operation in response to the trigger to other luminaires 1, 1'; and may further be configured to receive the indication of the emergency lighting operation from the other luminaires 1, 1'.

[0049] In summary, the luminaire 1 of the first aspect enables

- recognizing emergency situations by detecting, upon a sensor reading, a lack of zero crossings in a centralized emergency DC voltage supply (or by receiving an indication of such situations), and
- responding to the recognized emergency situations in accordance with an on-demand configuration.

[0050] FIG. 2 illustrates a luminaire 1' in accordance with the present disclosure.

[0051] Like the luminaire 1 of FIG. 1, the luminaire 1' of FIG. 2 is suitable for regular lighting operation as well as for emergency lighting operation.

[0052] The depicted luminaire 1' comprises a control unit 12; a driver unit 13; an LED load 14; and a first communication unit 15 as described in connection with FIG. 1.

[0053] However, unlike the luminaire 1 of FIG. 1, the luminaire 1' of FIG. 2 lacks a sensor unit 11.

[0054] Despite the lack of a sensor unit 11, the luminaire 1' of the second aspect is capable of distinguishing regular lighting operation and emergency lighting operation as follows:

First, the control unit 12 of the luminaire 1' of FIG. 2 is configured to receive a permanently provided supply voltage 10, L.

[0055] This permanently provided supply voltage 10, L may comprise one of: an AC voltage or a rectified AC voltage under regular lighting operation; and a DC voltage under the emergency lighting operation.

[0056] The control unit 12 of the luminaire 1' of FIG. 2 is further configured to control the driver unit 13 in accordance with a rule of behavior (see above) for emergency lighting operation and the permanently provided supply voltage 10, L. In other words, the luminaire 1' of FIG. 2 may autonomously establish emergency situations by detecting an absence of the zero crossings in the permanently provided supply voltage 10, L as described above.

[0057] Second, the first communication unit 15 of the luminaire 1' of FIG. 2 is further configured to receive an indication of the emergency lighting operation from other luminaires 1, 1'. Accordingly, the luminaire 1' of FIG. 2 may further establish emergency situations by receiving appropriate indications from other luminaires 1, 1'.

[0058] As before, the driver unit 13 is configured to drive the LED load 14.

[0059] The control unit 12 may further be configured to trigger the first communication unit 15 in response to the absence of zero crossings in the permanently provided supply voltage 10, L; and the first communication unit 15 may further be configured to send the indication of the emergency lighting operation in response to the trigger.

[0060] The luminaire 1, 1' may also comprise a second communication unit 16 such as an NFC interface; and the control unit 12 may further be configured to receive, via the second communication unit 16, a parameter 17, X being indicative of the rule of behavior for the emergency lighting operation.

[0061] In summary, the luminaire 1' of the second aspect enables

- recognizing emergency situations by detecting a lack of zero crossings in a centralized emergency DC voltage supply (or by receiving an indication of such situations), and
- responding to the recognized emergency situations in accordance with an on-demand configuration.

[0062] FIG. 3 illustrates a lighting system 1, 1' in regular lighting operation.

[0063] In this example, the lighting system 1, 1' comprises the luminaires 1 (with a sensor unit 11) and 1' (without a sensor unit 11) as explained in connection with FIGs. 1 and 2, respectively.

[0064] Under regular lighting operation, the supply voltage 10, L applied comprises one of an AC voltage or a rectified AC voltage. That is to say, the luminaires 1, 1' receive a same AC supply voltage having zero crossings.

[0065] Assuming a sensor reading such as a presence/motion, daylight, and the like, the sensor unit 11 of the luminaire 1 (left side of FIG. 3) is configured to selectively provide the control unit 12 with a supply voltage 10, L of the luminaire 1 in response to the sensor reading, such that the control unit 12 of the luminaire 1 receives the selectively provided supply voltage 10', L'.

[0066] By contrast, the control unit 12 of the luminaire 1' (right side of FIG. 3) receives a permanently provided supply voltage 10, L.

[0067] The control units 12 of both luminaires 1, 1' are further configured to control their driver units 13 in accordance with a respective rule of behavior (see above) for emergency lighting operation and the respective provided supply voltage 10, L, 10, L'.

[0068] Under regular lighting operation, both control units 12 will detect a presence of zero crossings and therefore not control their driver units 13 in accordance with an emergency lighting operation.

[0069] FIG. 3 also indicates operating staff proceeding from luminaire 1 to luminaire 1' for a respective configuration as an emergency luminaire (or regular luminaire) by holding an NFC tag to its NFC interface 16, if any.

[0070] FIG. 4 illustrates a lighting system 1, 1' in emergency lighting operation.

[0071] The lighting system 1, 1' of FIG. 4 corresponds to the lighting system of FIG. 3.

[0072] However, under emergency lighting operation, the supply voltage 10, L applied comprises a DC voltage. Accordingly, the luminaires 1, 1' receive a DC supply voltage wherein zero crossings are absent.

[0073] Assuming a sensor reading such as a presence/motion, daylight, and the like, the sensor unit 11 of the luminaire 1 (left side of FIG. 4) is configured to selectively provide the control unit 12 with a supply voltage 10, L of the luminaire 1 in response to the sensor reading, such that the control unit 12 of the luminaire 1 receives the selectively provided supply voltage 10', L'.

[0074] The control unit 12 of the luminaire 1' (right side of FIG. 4) receives a permanently provided supply voltage 10, L.

[0075] The control units 12 of both luminaires 1, 1' are further configured to control their driver units 13 in accordance with a respective rule of behavior (see above) for emergency lighting operation and the respective provided supply voltage 10, L, 10, L'.

[0076] Under emergency lighting operation, both control units 12 will detect an absence of zero crossings and therefore control their driver units 13 in accordance with an emergency lighting operation.

[0077] The control unit 12 of the luminaire 1 (left side of FIG. 4) further triggers its first communication unit 15 in response to the absence of the zero crossings in the selectively provided supply voltage 10', L'; and the first communication unit 15 of the luminaire 1 (left side of FIG. 4) further sends an indication of the emergency lighting operation in response to the trigger.

[0078] In turn, the first communication unit 15 of the luminaire 1' (right side of FIG. 4) receives the indication of the emergency lighting operation from the other luminaire 1.

[0079] Accordingly, the luminaire 1' (right side of FIG. 4) may autonomously establish emergency situations by detecting the absence of the zero crossings in the permanently provided supply voltage 10, L as described above, and may further establish emergency situations by receiving appropriate indications from the sensor-based luminaire 1. Thus, an arbitrary luminaire 1, 1' of a lighting system may respond to an emergency situation even without any a zero crossing detection.

[0080] FIG. 5 illustrates a state diagram of the control unit 12 of the luminaire 1, 1'.

[0081] The stripped-down state diagram includes two states S_1 (regular lighting operation, i.e., no emergency illumination) and S_2 (emergency lighting operation, i.e., emergency illumination), respectively.

[0082] On the left side of FIG. 5, a transition from emergency lighting operation to regular lighting operation is shown.

[0083] Note the sine shapes of the provided supply voltage $10, L, 10, L'$ in the diagrams on the left of FIG. 5.

[0084] The control unit 12 may be configured to detect the corresponding presence of zero crossings in the provided supply voltage $10, L, 10, L'$ using its zero crossing detection, ZXD, circuit 121 (not shown, see FIG. 6 below), in particular upon a completion of a zero crossing countdown being set upon an emergence of the emergency lighting operation. For example, the zero crossing countdown may be started from a value of 1 for immediate detection of the presence of zero crossings. The zero crossing counter is decremented every time a zero crossing is detected.

[0085] The regular detection/presence of zero crossings is indicated by the non-lapse of a zero crossing timeout period in excess of a reciprocal value of a mains frequency. In other words, as long as the appropriate zero crossing timeout period doesn't lapse, regular lighting operation applies.

[0086] A transition from regular lighting operation to emergency lighting operation is shown on the right side of FIG. 5.

[0087] Note the discontinuation of the sine-shaped provided supply voltage $10, L, 10, L'$ in the diagram on the right of FIG. 5 and the subsequent transition to a provided DC supply voltage $10, L, 10, L'$ upon reception from the central emergency power supply.

[0088] The control unit 12 may be configured to detect the corresponding absence of the zero crossings in the provided supply voltage $10, L, 10, L'$ using the ZXD circuit 121 upon a lapse of the zero crossing timeout period in excess of a reciprocal value of a mains frequency.

[0089] In other words, as long as the zero crossing timeout period lapses, emergency lighting operation (state S_2) applies. As soon as zero crossings emerge and the zero crossing timeout period fails to lapse, a return to the regular lighting operation (state S_1) is appropriate.

[0090] FIG. 6 illustrates the ZXD circuit 121 of the control unit 12 of the luminaire 1, 1'.

[0091] An electrically connected zero-crossing detection (not shown) may include a ZXD circuit 121 within the control circuit 12 preceded by a series resistor.

[0092] The electrically isolated zero-crossing detection indicated in FIG. 6 may include an arbitrary General Purpose Input/Output (GPIO) port the control circuit 12 preceded by a low-pass circuit, an opto-coupler, and an optional rectifier bridge.

[0093] The low-pass circuit includes a resistor and a capacitor in series. An appropriate dimensioning of the low-pass circuit achieves an incomplete smoothing of the resulting ZCD signal so that zero crossings may still be detected.

[0094] FIG. 7 illustrates a flow diagram of a method 2 in accordance with the present disclosure of operating the luminaire 1.

[0095] The method 2 is suitable for operating the luminaire 1 for emergency lighting operation of FIG. 1.

[0096] The method 2 comprises a step of selectively providing 21 a control unit 12 of the luminaire 1 with a supply voltage $10, L$ of the luminaire 1 in response to a sensor reading.

[0097] The method 2 further comprises controlling 22 a driver unit 13 of the luminaire 1 in accordance with a rule of behavior for the emergency lighting operation and the selectively provided supply voltage $10', L'$.

[0098] The method 2 further comprises driving 23 an LED load 14 of the luminaire 1.

[0099] The method 2 further comprises triggering 24 a first communication unit 15 of the luminaire 1 in response to an absence of zero crossings in the selectively provided supply voltage $10', L'$; and sending 25 an indication of the emergency lighting operation in response to the trigger.

[0100] FIG. 8 illustrates a flow diagram of a method 2' in accordance with the present disclosure of operating the luminaire 1'.

[0101] The method 2' is suitable for operating the luminaire 1' for emergency lighting operation of FIG. 2.

[0102] The method 2' comprises receiving 25' an indication of the emergency lighting operation. In particular, this may be the indication of the emergency lighting operation sent by a luminaire 1 of the first aspect (i.e., including a sensor unit).

[0103] The method 2' further comprises controlling 22' a driver unit 13 of the luminaire 1 in accordance with a rule of behavior for the emergency lighting operation and a permanently provided supply voltage $10, L$ of the luminaire 1; and driving 23 an LED load 14 of the luminaire 1.

Claims

1. A luminaire (1) for emergency lighting operation, comprising

a sensor unit (11); a control unit (12); a driver unit (13); an LED load (14); and a first communication unit (15); the sensor unit (11) being configured to

- selectively provide the control unit (12) with a supply voltage ($10, L$) of the luminaire (1) in response to a sensor reading;

the control unit (12) being configured to

- control the driver unit (13) in accordance with a rule of behavior for the emergency lighting operation and the selectively provided supply voltage (10', L'); and
- trigger the first communication unit (15) in response to an absence of zero crossings in the selectively provided supply voltage (10', L');

the driver unit (13) being configured to

- drive the LED load (14); and

the first communication unit (15) being configured to

- send an indication of the emergency lighting operation in response to the trigger.

2. The luminaire (1) of claim 1,
the first communication unit (15) further being configured to

- receive the indication of the emergency lighting operation.

3. A luminaire (1') for emergency lighting operation, comprising

a control unit (12); a driver unit (13); an LED load (14); and a first communication unit (15);
the first communication unit (15) being configured to

- receive an indication of the emergency lighting operation;

the control unit (12) being configured to

- control the driver unit (13) in accordance with a rule of behavior for emergency lighting operation and a permanently provided supply voltage (10, L) of the luminaire (1'); and

the driver unit (13) being configured to

- drive the LED load (14).

4. The luminaire (1') of claim 3,

the control unit (12) further being configured to

- trigger the first communication unit (15) in response to an absence of zero crossings in the permanently provided supply voltage (10, L);

the first communication unit (15) further being configured to

- send the indication of the emergency lighting operation in response to the trigger.

5. The luminaire (1, 1') of any one of the preceding claims,
the supply voltage (10, L) of the luminaire (1, 1') comprising one of:

- an alternating current, AC, voltage or a rectified AC voltage under regular lighting operation; and
- a direct current, DC, voltage under the emergency lighting operation.

6. The luminaire (1, 1') of any one of the preceding claims,

the control unit (12) further comprising
a zero crossing detection, ZXD, circuit (121);
the control unit (12) further being configured to

- detect the absence of the zero crossings using the ZXD circuit (121) upon a lapse of a zero crossing timeout period in excess of a reciprocal value of a mains frequency.

7. The luminaire (1, 1') of claim 6,
the control unit (12) further being configured to

- detect a presence of the zero crossings using the ZXD circuit (121) upon a completion of a zero crossing countdown being set upon an emergence of the emergency lighting operation.

8. The luminaire (1, 1') of any one of the preceding claims,
the first communication unit (15) comprising one of:

- a Wireless Local Area Network, WLAN, communication interface in accordance with IEEE 802.11;
- a Thread communication interface in accordance with IEEE 802.15.4;
- a Bluetooth communication interface,
- a Bluetooth Low Energy, BLE, communication interface,
- a SubGHz communication interface preferable in the ISM bands (e.g. 433 MHz, 868 MHz, 915 MHz), or operating at another frequency.

9. The luminaire (1, 1') of any one of the preceding claims,
the sensor unit (11) comprising one of:

a presence and/or motion sensor, being configured to

- selectively provide the control unit (12) with the supply voltage (10, L) of the luminaire (1) in response to a presence and/or motion sensor reading;

a light intensity sensor, being configured to

- selectively provide the control unit (12) with the supply voltage (10, L) of the luminaire (1) in response to a light intensity sensor reading; and

a communication interface of a lighting control bus, being configured to

- selectively provide the control unit (12) with the supply voltage (10, L) of the luminaire (1) in response to a sensor reading via the lighting control bus.

10. The luminaire (1, 1') of claim 9,
the lighting control bus comprising a Digital Addressable Lighting Interface, DALI, bus.

11. The luminaire (1, 1') of any one of the preceding claims, further comprising

a second communication unit (16);
the control unit (12) further being configured to

- receive, via the second communication unit (16), a parameter (17, X) being indicative of the rule of behavior for the emergency lighting operation.

12. The luminaire (1, 1') of claim 11,
the second communication unit (16) comprising
a Near Field Communication, NFC, interface.

13. The luminaire (1, 1') of claim 11 or claim 12,
the rule of behavior for the emergency lighting operation comprising one of:

- not driving the LED load (14) and not responding to the provided supply voltage (10, L) any further, if the parameter (17, X) corresponds to a value of 0;
- driving the LED load (14) at a dim level corresponding to the parameter (17, X) and not responding to the

provided supply voltage (10, L ; 10, L') any further, if the parameter (17, X) corresponds to a value between 1 and 100;

- driving the LED load (14) at a predefined dim level and not responding to the provided supply voltage (10, L ; 10, L') any further, if the parameter (17, X) corresponds to a value of 101; and

- driving the LED load (14) at a dim level corresponding to regular operating conditions in response to the provided supply voltage (10, L ; 10, L'), if the parameter (17, X) corresponds to a value of 255.

14. A method (2) of operating a luminaire (1) for emergency lighting operation, the method (2) comprising

- selectively providing (21) a control unit (12) of the luminaire (1) with a supply voltage (10, L) of the luminaire (1) in response to a sensor reading;

- controlling (22) a driver unit (13) of the luminaire (1) in accordance with a rule of behavior for the emergency lighting operation and the selectively provided supply voltage (10', L');

- driving (23) an LED load (14) of the luminaire (1); and

- triggering (24) a first communication unit (15) of the luminaire (1) in response to an absence of zero crossings in the selectively provided supply voltage (10', L');

- sending (25) an indication of the emergency lighting operation in response to the trigger.

15. A method (2') of operating a luminaire (1') for emergency lighting operation, the method (2') comprising

- receiving (25') an indication of the emergency lighting operation;

- controlling (22') a driver unit (13) of the luminaire (1) in accordance with a rule of behavior for the emergency lighting operation and a permanently provided supply voltage (10, L) of the luminaire (1); and

- driving (23) an LED load (14) of the luminaire (1).

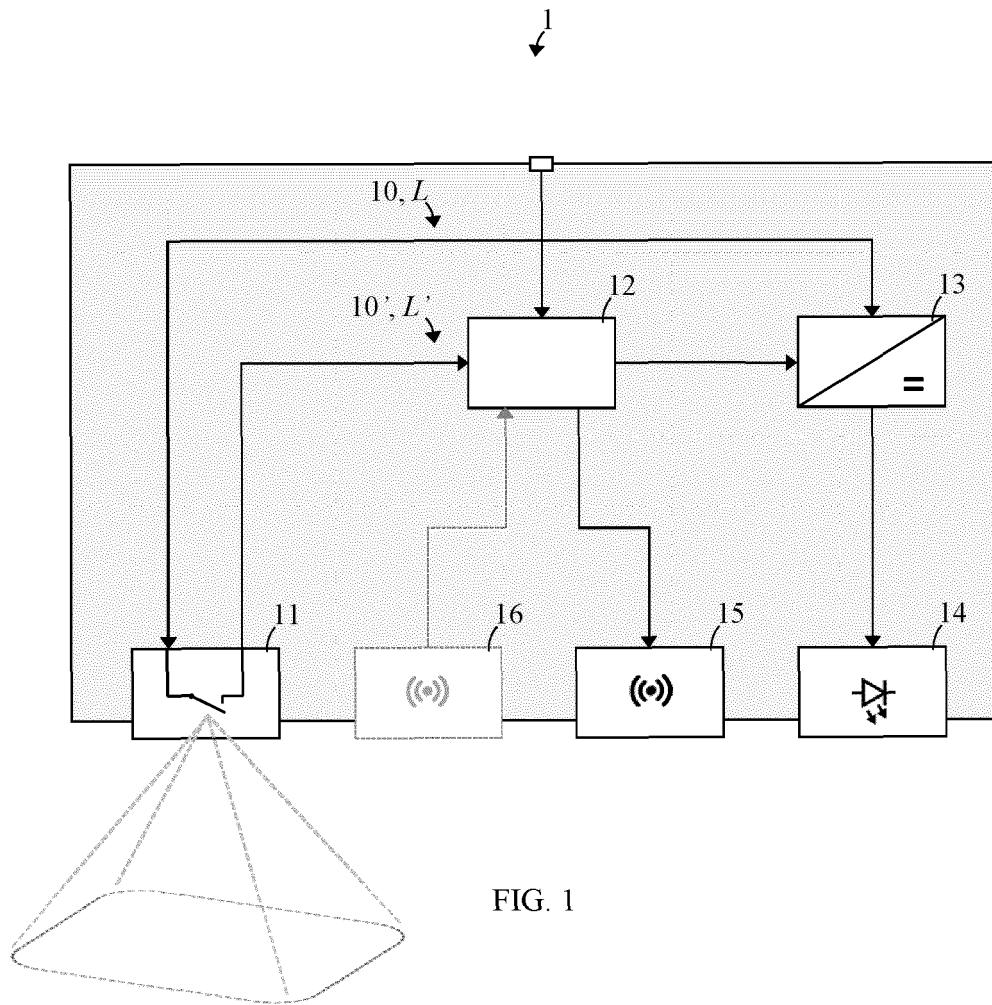


FIG. 1

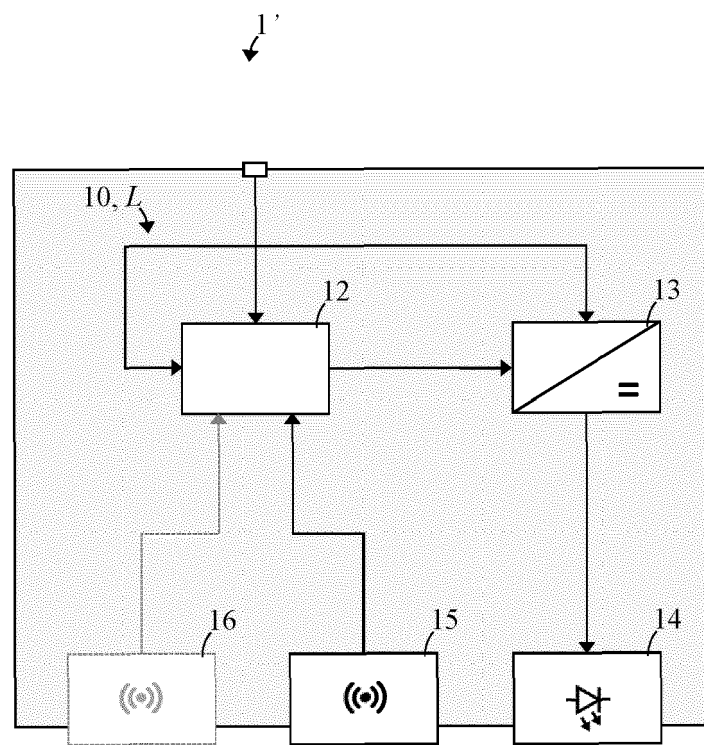


FIG. 2

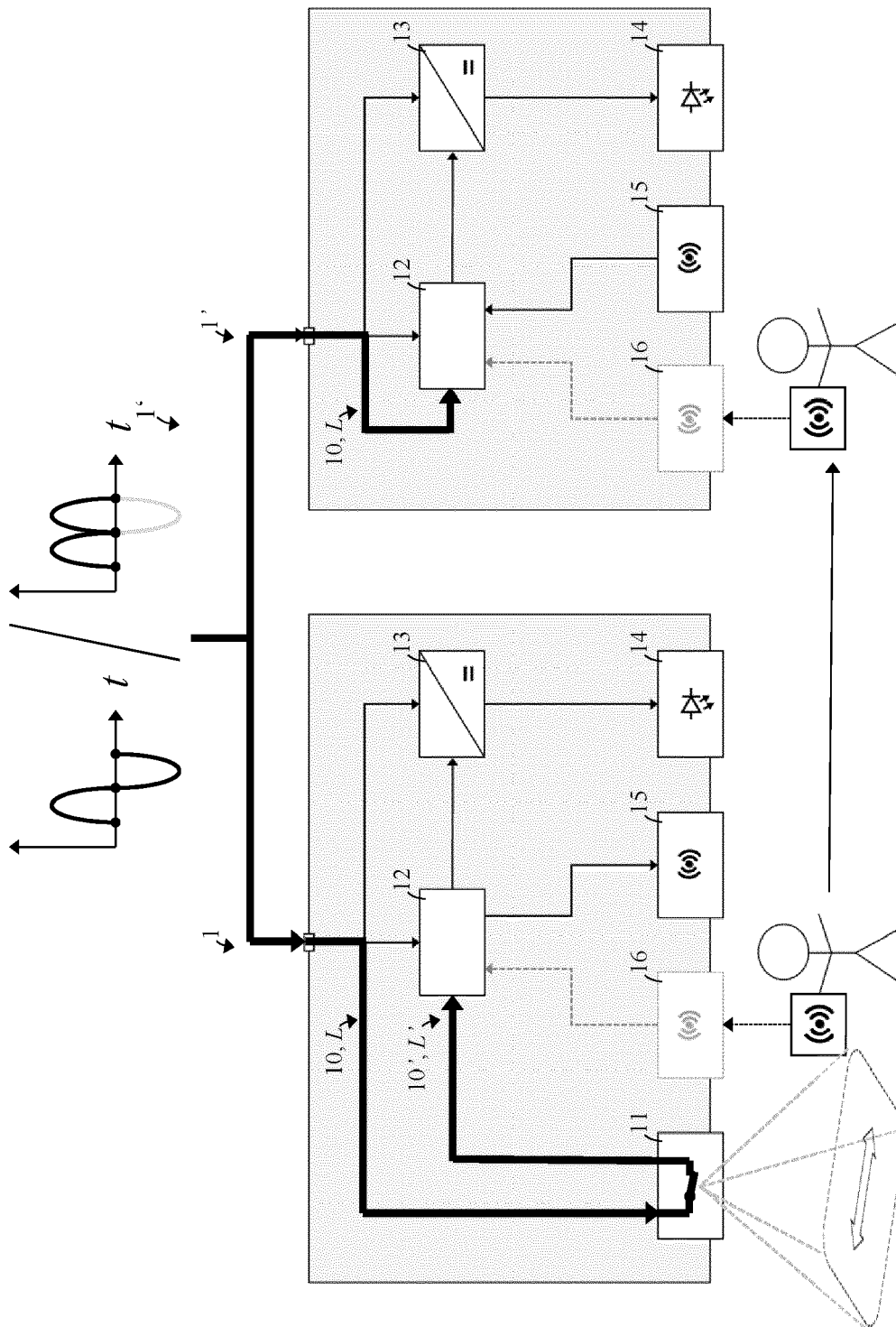


FIG. 3

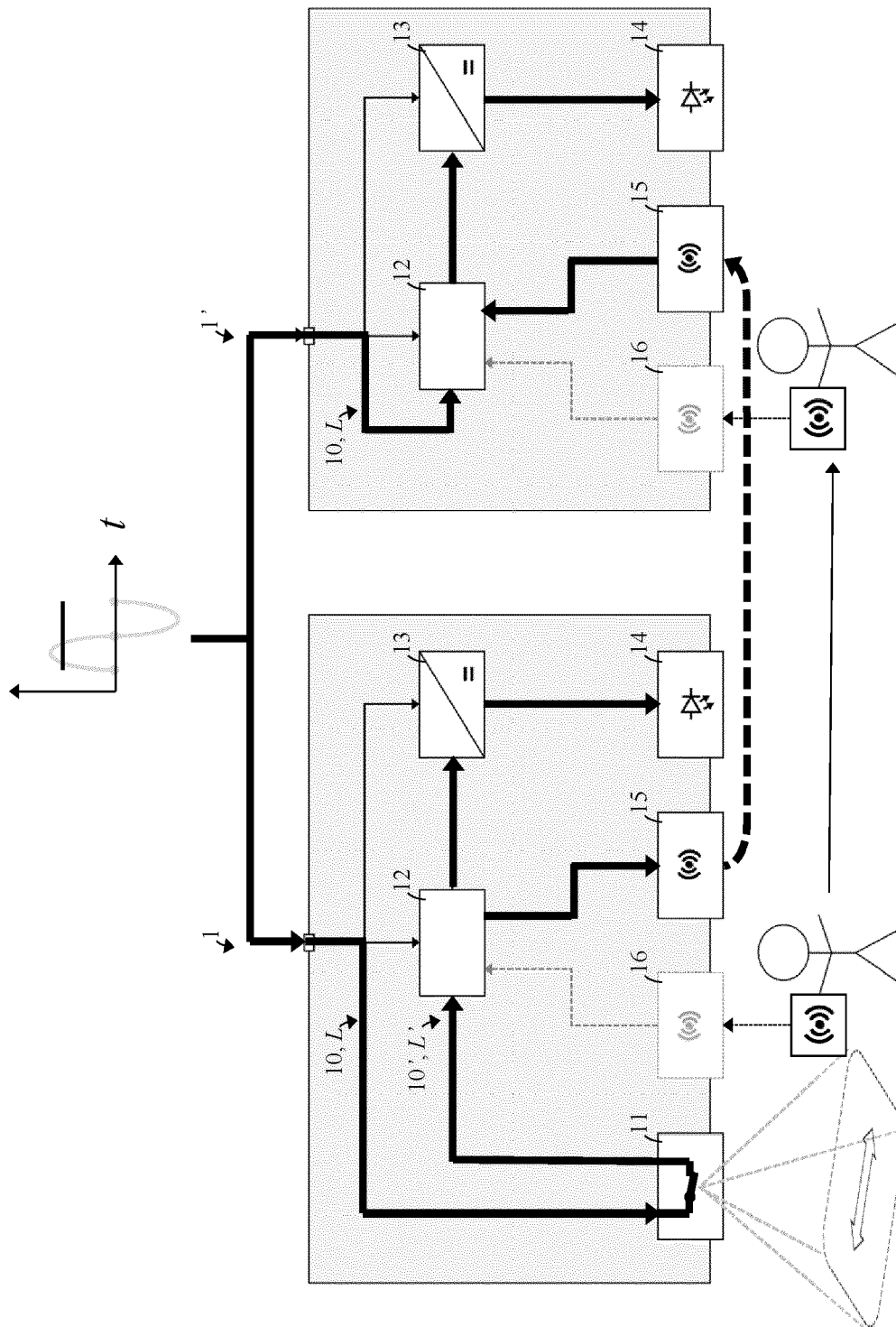


FIG. 4

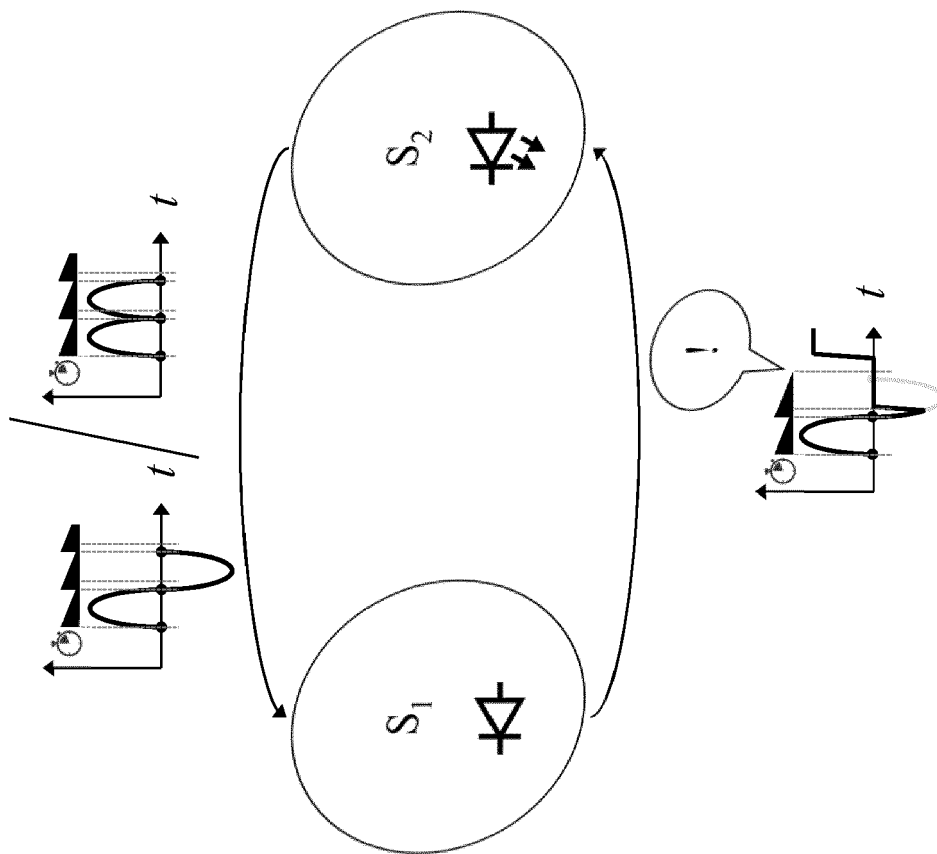


FIG. 5

I_{21}

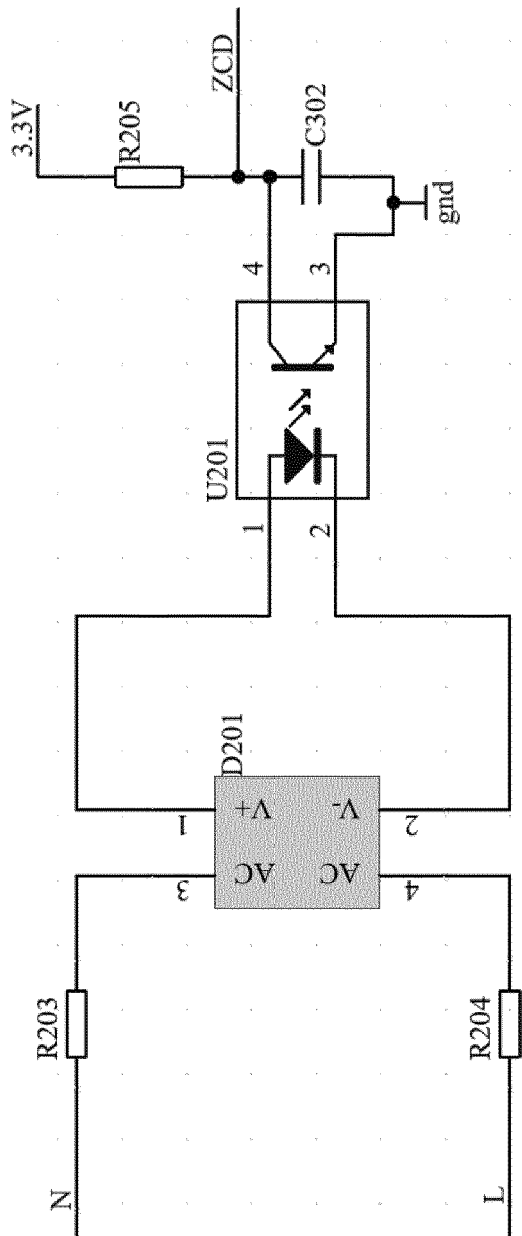


FIG. 6

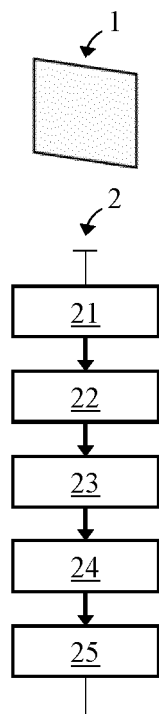


FIG. 7

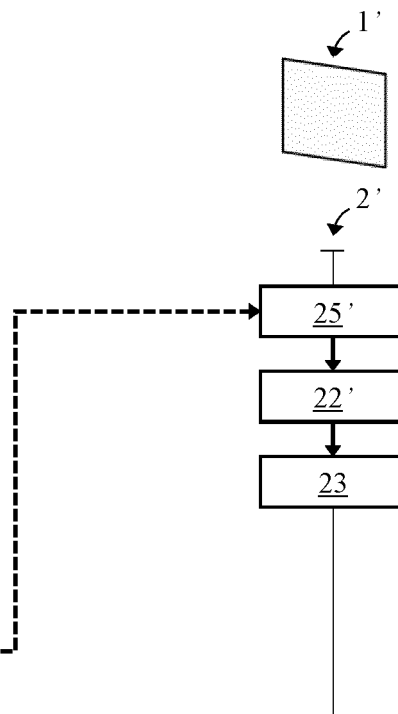


FIG. 8



EUROPEAN SEARCH REPORT

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 2019/261493 A1 (DOLAN DAVID J [US] ET AL) 22 August 2019 (2019-08-22) * paragraphs [0016] - [0062]; figures 1, 7 *	1, 2, 5, 6, 8-14 7	INV. H05B47/17 H05B47/115
X	US 2009/072970 A1 (BARTON ROBERT A [US]) 19 March 2009 (2009-03-19) * paragraphs [0026] - [0135]; figure 7a *	1, 14	
X	US 2015/120000 A1 (COFFEY KELLY [US] ET AL) 30 April 2015 (2015-04-30) * paragraphs [0082] - [0160]; figure 3c *	1, 14	
			TECHNICAL FIELDS SEARCHED (IPC)
			H05B H02J
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 16 August 2023	Examiner Morrish, Ian
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	



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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1, 2, 5-14

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



**LACK OF UNITY OF INVENTION
SHEET B**

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1, 2, 5-14

A device which determines conditions for emergency lighting and informs other devices of that condition.

2. claims: 3, 4, 15

A device which responds to a received message to indicate the emergency operation.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 23 16 3915

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-08-2023

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