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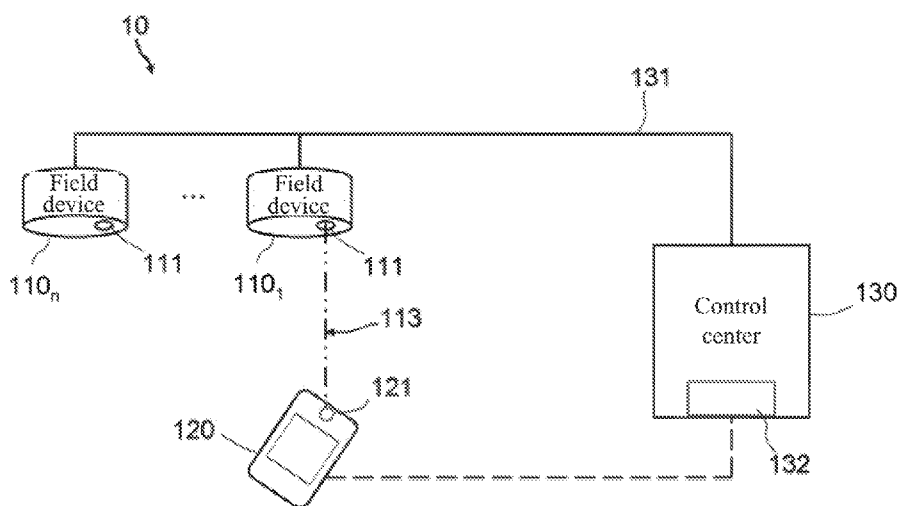


FIG. 1

(57) Abstract: A control system comprises a field device, provided with a status indicator light and configured to, at least based on corresponding identity (ID) information of the field device, control a flashing state of the status indicator light to transmit the ID information; a mobile terminal, configured to acquire the ID information of the field device by sensing the flashing state of the status indicator light, and to acquire corresponding physical location information and correlate the physical location information with the acquired ID information of the field device; and a control center, coupled to the field device and configured to acquire the ID information of each field device, and acquire the ID information and the physical location information correlated therewith of each field device from the mobile terminal.

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DETERMINATION OF THE PHYSICAL LOCATION OF FIELD DEVICE

TECHNICAL FIELD

[0001] The present invention relates to the technical field of field devices, to management of field devices, and particularly to determination of physical location information of field devices.

BACKGROUND

[0002] Generally, various types of field devices can be installed as field terminals at various physical locations inside and/or outside a building. A plurality of field devices interconnects and undergoes information interaction with a control center to form a system. Depending on different functions of the field devices, systems of various functions can be formed. For example, in a fire detection and alarm (D & A) system inside a building, many field devices such as detectors and manual calling devices are employed by D & A system, they are installed at various physical locations (for example, locations on a certain floor, locations in a room, and the like) inside the building, and serve as keys terminals in a local area monitored by the D & A system.

[0003] During normal operation of the control center in various systems, it is generally required to determine a monitored physical location from which information acquired from a field device is from, or determine a monitored physical location to which information sent to a field device goes. Therefore, when each of the field devices is installed at a predetermined physical location, the control center needs to know physical location information of each field device.

[0004] Accordingly, during the installation (or the replacement) of the field device, the control center generally needs to determine the physical location information of a field device currently installed.

SUMMARY

[0005] According to a first aspect of the present invention, a control system is provided, which includes:

[0006] one or more field devices, provided with a status indicator light and configured to, at least based on corresponding identity (ID) information of the field device, control a flashing state of the status indicator light to transmit the ID information;

[0007] a mobile terminal, configured to acquire the ID information of the field device by sensing the flashing state of the status indicator light, and to acquire corresponding physical location information and correlate the physical location information with the acquired ID information of the field device; and

[0008] a control center, coupled to the one or more field devices and configured to acquire the ID information of each field device, and to acquire the ID information and the physical location information correlated therewith of each field device from the mobile terminal.

[0009] According to a second aspect of the present invention, a method for determining physical location information of a field device is provided, which includes the steps of:

[0010] S510: flashing a status indicator light of the field device at least based on corresponding identity (ID) information of the field device;

[0011] S520: sensing, by a mobile terminal, a flashing state of the status indicator light and acquiring the ID information of the field device;

[0012] S540: acquiring corresponding physical location information of the field device by means of a positioning chip of the mobile terminal or by user input;

[0013] S550: correlating the physical location information with the acquired ID information of the field device, and sending both of them to a control center; and

[0014] S560: matching out, by the control center, the physical location information of the field device based on the ID information of the field device, and determining the physical location information as the physical location information of the field device.

[0015] According to a third aspect of the present invention, a field device is provided, which is provided with a status indicator light and a drive module for driving the status indicator light, where the drive module is configured to, at least based on identity (ID) information of the field device, control a flashing state of the status indicator light in accordance with a predetermined encoding format, to transmit the ID information.

[0016] According to a fourth aspect of the present invention, a mobile terminal for interacting at least with a field device is provided, which is configured to acquire identity (ID) information of the field device by sensing a flashing state of a status indicator light of the field device, and to acquire corresponding physical location information and correlate the physical location information with the acquired ID information of the field device.

[0017] The above features, operations and effects of the present invention will become more apparent from the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The foregoing and other objects and advantages of the present invention will become clearer from the following detailed description taken in conjunction with the accompanying drawings in which like or similar elements are denoted by the same reference numerals.

[0019] FIG. 1 is a schematic structural diagram of a system for determining physical location information of a field device according to an embodiment of the present invention.

[0020] FIG. 2 is a schematic diagram showing a module structure of a field device according to an embodiment of the present invention.

[0021] FIG. 3 is a schematic diagram showing a module structure of a mobile terminal according to an embodiment of the present invention.

[0022] FIG. 4 is a schematic diagram showing an interaction principle between a field device and a mobile terminal in the system as shown in FIG. 1.

[0023] FIG. 5 is a schematic process flow chart of a method for determining physical location information of a field device according to an embodiment of the present invention.

[0024] FIG. 6 is a schematic process flow chart of a method for reading status information/configuration information of a field device by a mobile terminal according to an embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0025] The present invention will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the present invention are shown. However, the present invention may be embodied in various forms and it should be understood that the present invention is not limited to the embodiments set forth herein. Rather, these embodiments are provided for making the disclosure of the invention thorough and complete, and for fully conveying the teachings of the present invention to those skilled in the art.

[0026] Some of the block diagrams shown in the figures are functional entities that do not necessarily have to correspond to physically or logically independent entities. These functional entities may be implemented in the form of software or implemented in one or more hardware modules or integrated circuits, or implemented in various processing devices and/or in microcontrollers.

[0027] FIG. 1 is a schematic structural diagram of a system for determining physical location information of a field device according to an embodiment of the present invention. A system 10 in the embodiment includes a field device 110 according to an embodiment as shown

in FIG. 2 and a mobile terminal 120 according to an embodiment as shown in FIG. 3, and is further provided with a control center 130.

[0028] In the embodiment, the description is made with an example in which a specific application of the system 10 is a fire detection and alarm (D & A) system inside a building. It should be understood that the system 10 may also be particularly implemented as a structure of other systems similar to the D & A system, for example, systems where corresponding field terminals need to be installed at numerous field physical locations and these terminals can interact with a control center. The application scenarios of the system 10 are not particularly limited, and the system can even, for example, be used in an environment outside of a building.

[0029] As shown in FIG. 1, the control center 130 may be a center of a D & A system, and may be, for example, implemented as one or more computer servers that can be collectively provided at a location that facilitates the setting and operation by an operator; and of course, in yet another embodiment, may also be implemented as a plurality of computer devices scatteredly provided at a plurality of locations. In general, the control center 130 can be provided at a management center of a building (for example, a high-rise building). The control center 130 includes a communication module 132, which is in communication connection with each mobile terminal 120, for achieving the data transmission therebetween.

[0030] As shown in FIGs. 1 and 2, the field device 110 includes 110₁, 110₂, ..., and 110_n, and there are n field devices in total. The number of the field device 110 is not particularly limited, and generally a large number of field devices exist in the D & A system. The field devices 110 are installed at various physical locations of the building, so as to accomplish the detection and monitoring of each physical location, or accomplish the input of feedback information via each physical location. The field device 110 may be a detector, a manual alarm and other devices, which can, for example, monitor and acquire the individual information of the field physical locations, and/or deliver information to the field physical location, and/or obtain manually input feedback from the field physical locations. The type of the field device 110 is not particularly limited, and various types of field devices 110 may be selected and installed, depending on the particular function requirements of the system 110 and the requirements of particular physical locations. Moreover, a plurality of different types of field devices 110 may be provided at a same physical location.

[0031] Each field device 110 is coupled to the control center 130, for example, by wired connection to the control center 130 via a bus 131 or the like. Each field device 110 may be imparted a corresponding logical address by the control center 130, for ease of the management. However, the control center 130 also needs to acquire physical location information (that is,

physical address) of each field device 110, to implement corresponding functions of the D & A system 10. Therefore, during the installation of each field device 110, the control center 130 also needs to determine the physical location information of the field device 110, such that the control processing can be performed based on the physical location information during the subsequent operation process of the D & A system 10.

[0032] It should be understood that the physical location information may be information reflecting an actual planar location at which the field device 110 is fixed and installed, or information reflecting an actual spatial location at which the field device 110 is fixed and installed, and which is expressed in a format that can be identified by the control center 130. The expression format is not particularly limited, for example, expression in the format of “room XXX”.

[0033] The field device 110 generally each has identity (ID) information representing its uniqueness, for example, each field device 110 is allocated a serial number at the factory, which may be served as the ID information for use by the system during the determination of the physical location information of the field device 110. In other embodiments, a user of the field device 110 may additionally impart corresponding ID information to each field device.

[0034] In the embodiment, during the installation of each field device 110, the control center 130 can read the serial number stored in the field device 110 through the bus 131 and impart a corresponding logical address thereto. Accordingly, the control center 130 has the serial numbers of all the field devices 110 coupled thereto, or has the logical addresses corresponding to the serial numbers of the field devices 110.

[0035] Each field device 110 further has a status indicator light 111. In the embodiment as shown in FIG. 2, the status indicator light 111 may be an LED status light having an on/off flashing process controlled by a drive module 112. The drive module 112 is specifically implemented as, for example, but not limited to, a chip (for example, CPU) or a circuit board that is provided inside the field device 110, and can at least acquire the serial number of the field device 110 and may also acquire, for example, status information, configuration information, and others of the field device 110. The drive module 110 controls a flashing state 113 of the LED status light 111 at least based on the corresponding serial number of the field device 110. The specific principle of control will be described in detail by way of example hereinafter. Therefore, the flashing state 113 emitted by the LED status light 111 carries corresponding serial number information, and the serial number of the field device 110 is transmitted through the flashing of the LED status light 111. In an embodiment, the control center 130 can also acquire the serial number, the status information, and/or the configuration

information from the drive module 112.

[0036] As shown in FIGs. 1 and 3, the system 10 further includes the mobile terminal 120. One or more mobile terminals 120 may exist, and is/are used by the operator during the installation (or the replacement) of the field device 110. The mobile terminal 120 is approximate to the field device 110, so as to receive the flashing state of the LED status light 111. For example, the mobile terminal 120 is directly positioned close to the LED status light 111 of the field device 110. The mobile terminal 120 may be, for example, a smart phone terminal having mobile communication function; or of course, it may be any other types of handheld mobile intelligent terminals.

[0037] In an embodiment, the mobile terminal 120 has a sensor 111 as shown in FIGs. 1 and 3. The sensor 111 may be, for example, an image sensor owned by a smart phone terminal per se, by which the flashing state 113 emitted by the LED status light 111 in a period of time is taken. The flashing state 113 (for example, video information containing the flashing state 113) acquired by the sensor 111 is sent to a converter module 122 in the mobile terminal 120, and the flashing state 113 in the video information is analyzed and converted by the converter module 122 to acquire the serial number information corresponding to the flashing state 113. In this way, the field interaction between the mobile terminal 120 and the field device 110 is realized, that is, the serial number of the field device 110 is read on site.

[0038] In an embodiment, the mobile terminal 120 is further provided with an input module 124, which is configured to input physical location information of a current field device 110 corresponding to the mobile terminal 120. For example, after the mobile terminal 120 corresponding to a field device 110 installed in a room 3301 senses a flashing state 113 emitted by the field device 110, an operator manually input the physical location information "room 3301" via the input module 124 of the mobile terminal 120. In other embodiments, if the mobile terminal 120 can automatically (for example, by means of GPS precise positioning) acquire physical location information of a current location, the input of the physical location information can be automatically accomplished.

[0039] In an embodiment, the mobile terminal 120 is further provided with a correlation module 125. The correlation module 125 correlates the input physical location information with the acquired corresponding serial number of the field device 110. For example, the correlation module 125 can store the serial numbers of a plurality of field devices 110 in correspondence to plural pieces of input physical location information, in which each serial number corresponds to one piece of physical location information. The mobile terminal 120 is further provided with a communication module or port, which can transfer the serial number

and the physical location information corresponding thereto stored in the correlation module 125 together to the control center 130. When the mobile terminal 120 is a smart phone terminal having mobile communication function, the communication module 132 of the control center 130 may also be a GPS communication module, and the mobile terminal 120 can send the correlated serial number and physical location information to the control center 130 in real time on site. In an alternative embodiment, the mobile terminal 120 may also send a plurality of correlated serial numbers and physical location information at a time to the control center 130. For example, after a plurality of field devices 110 is detected by each operator, the mobile terminal 120 is wiredly or wirelessly connected to the communication module 132 of the control center 130, to send or up load all the serial numbers and the physical location information correlated thereto to the control center 130.

[0040] In an embodiment, as shown in FIG. 3, the mobile terminal 120 is further provided with a display module 123, which is configured to display at least the ID information acquired through conversion, for example, “serial number XXX”, so as to facilitate the reading and determination by an operator.

[0041] It should be noted that the converter module 122, the display module 123, the input module 124, and the correlation module 125 etc in the mobile terminal 120 according to the above embodiment can be implemented as APP software. In this manner, when the APP software is installed on, for example, a smart phone terminal carried by the operator, the smart phone terminal is implemented as a mobile terminal according to the embodiment of the present invention, and no mobile terminal is needed to be additionally provided in the system 10. This causes no increase in the hardware cost of the system 10, and is easy to be accepted by an operator, since the on-site operation by the operator is convenient and simple.

[0042] It should be noted that the number of the mobile terminal 120 in the system 10 is not limited. For example, there may be a plurality of mobile terminals, and one mobile terminal 120 can be held by each of multiple operators.

[0043] As shown in FIG. 1, the control center 130 can acquire the serial number of each field device 110 from the bus 131 on one hand, and can acquire the serial number of each field device 110 and the physical location information correlated and corresponding thereto from the mobile terminal 120 on the other hand, as described above. Therefore, in an embodiment, the control center 130 matches out the physical location information of the field device 110 based on the serial number of the field device 110, and determines the physical location information as the physical location information of the field device 110. In this way, the control center 130 can determine the physical location information of each field device 110, and

correlate the physical location information and the logical address of each field device 110. During the subsequent operation and working of the system 10, the working, for example, positioning a fire alarm location, is based on the physical location information.

[0044] The operation principle of the system 10 according to the embodiment of the present invention will be described in further detail with reference to FIG. 4.

[0045] In an embodiment, the serial number generally consists of multiple bits of data. The drive module 112 of the field device 110 is configured to convert each bit of data of the serial number into a Morse code to control the flashing of the status indicator light 111. For example, each grid in the time coordinate shown in FIG. 4 represents the unit time over which the sensor 121 captures each frame of image (which is determined according to the sampling rate of the sensor, the flashing frequency of the status indicator light 111, and so on). If the data of the serial number is “1”, the Morse code is expressed as one short and three long signals (with each grid as the unit time), and the drive module 112 can output corresponding code based on the Morse code principle, to control the status indicator light 111 to flash in the pattern of “on-off-on/on/on-off-on/on/on-off-on/on/on”. If the data of the serial number is “2”, the Morse code is expressed as two short and three long signals, and the drive module 112 can output corresponding code based on the Morse code principle, to control the status indicator light 111 to flash in the pattern of “on-off-on-off-on/on/on-off-on/on/on-off-on/on/on”. In this manner, the status indicator light 111 can successively emit the flashing state 113 representing the serial number.

[0046] Correspondingly, the mobile terminal 120 performs decoding processing based on the Morse code principle of the field device 110 above. As shown in FIG. 4, shoot sampling is conducted by the sensor 121 based on a corresponding sampling rule to obtain a flash image as shown in FIG. 4. Then the video image is analyzed by the converter module 122, to obtain the flashing state. The corresponding Morse codes are further read, and each Morse code is converted into data representing the serial number. Therefore, the decoding and reading of the serial number transmitted by the field device 110 are achieved.

[0047] It should be noted that in the above embodiment, the field device 110 interacts with the mobile terminal 120 based on the Morse code. It can be understood that the interaction therebetween may be achieved by using other encoding rules analogously, whereby the mobile terminal 120 can acquire at least the serial number information of the field device 110.

[0048] In still another embodiment, in the process of maintenance, for example, to facilitate the reading of the status information of the field device 110, it is possible to enable the field device 110 to interact with the mobile terminal 120 based on the status information by

configuring the field device 110 and the mobile terminal 120. The status information refers to environmental status information acquired by the field device 110 by sensing a physical location corresponding thereto, for example, CO concentration, field temperature, and others. Such status information is collectively encoded into a format of code, for example, Morse code. The drive module 112 of the field device 110 can acquire the status information at a given time, and encode it into a Morse code, and the drive module 112 further controls the flashing of the status indicator light 111 based on the status information (that is, corresponding Morse code), so as to emit the flashing state 113. Similarly, the mobile terminal 120 is further configured to acquire the status information of the field device 110 by sensing the flashing state 113 of the status indicator light 111. For example, the converter module 122 is further configured to convert the flashing state 113 of the status indicator light 111 into the Morse code and then further into the status information able to be read on the mobile terminal 120. The status information can be displayed on a display screen of the mobile terminal 120. As a result, the operator can easily and accurately read the status information of each field device 110; rather than outputting the currently limited several types of simple status information, the types of the status information output by the field device through the status indicator light 111 are greatly widened; and it is possible to reduce the dependence on the voice broadcast output function of the status information.

[0049] In yet another embodiment, in the process of maintenance, to facilitate the acquisition of the configuration information of the field device 110 (for example, whether the power configuration information of a battery of a current field device 110 is “high”, “medium”, or “low”), it is possible to enable the field device 110 to interact with the mobile terminal 120 based on the configuration information by configuring the field device 110 and the mobile terminal 120. The configuration information is physical configuration information reflecting the field device 110 itself, for example, the battery power, whether a component operates normally, and the parameter configuration of some component, etc. Such configuration information can be collectively encoded into a format of code, for example, Morse code. Under the trigger conditions, the drive module 112 of the field device 110 can acquire the configuration information at a given time and encode it into a Morse code, and the drive module 112 further controls the flashing of the status indicator light 111 based on the configuration information (i.e., the corresponding Morse code), so as to emit the flashing state 113. Similarly, the mobile terminal 120 is further configured to acquire the configuration information of the field device 110 by sensing the flashing state 113 of the status indicator light 111. For example, the converter module 122 is further configured to convert the flashing state 113 of the status

indicator light 111 into the Morse code and then further into the configuration information able to be read on the mobile terminal 120. The configuration information may be displayed on a display screen of the mobile terminal 120. As a result, the operator can easily and accurately read the configuration information of each field device 110. For example, the battery status information of the field device 110 and the information regarding whether a key component is normal can be obtained, thereby greatly improving the maintenance and detection efficiency of the field devices.

[0050] When at least two of the serial number, the status information, and the configuration information can be transmitted by the field device 110 through the status indicator light 111, they can be collectively encoded such that such information can be collectively identified and read on the mobile terminal.

[0051] It is to be understood that the interaction between the field device 110 and the mobile terminal 120 of the above embodiments is not limited to being accomplished through Morse encoding or Morse decoding based on the Morse protocol as schematically shown in FIG. 4. That is, the transmission of the serial number information, the status information and/or the configuration information is not limited to being carried out by way of Morse code format, and the encoding or decoding may also be accomplished based on other protocols. For example, the encoding and decoding are performed by using a custom encoding protocol.

[0052] It should be noted that in the system 10 of the above embodiment, the function of the drive module 112 of the field device 110 may also be achieved by means of software programming, through which the increase in the hardware cost of the field device 110 can be avoided, since the LED status light 111 has normally been provided in the field device 110. For the system 10, the field device 110 and the mobile terminal 120 can be separately implemented as, without limitation, an existing field device and a smart phone terminal with software configuration. This causes no increase in the cost of the system 10, and can greatly reduce the cost spent for determining the physical location information of the field device, particularly in a system having a quite large number of field devices, compared with an existing dedicated handheld terminal requiring radio frequency identification (RFID).

[0053] FIG. 5 is a schematic process flow chart of a method for determining physical location information of a field device according to an embodiment of the present invention. The operation principle of the system 10 and a specific process for determining the physical location information according to the embodiments of the present invention are schematically illustrated below with reference to FIGs. 1 to 5.

[0054] First, in a step S510, the status indicator light 111 of the field device 110 is driven to work and flash over a period of time by the drive module 112. The flashing state 113 carries corresponding ID information, so the ID information of the field device 110 is transmitted through the flashing of the status indicator light 111. This step can be completed during the installation of the field device 110, and the flashing of the status indicator light 111 can be driven and controlled based on the Morse code principle, for example, the status indicator light 111 works in a flashing mode as shown in FIG. 4.

[0055] In a step S520, an operator holds a mobile terminal 120 (for example, a smart phone terminal of the operator) as shown in FIG. 3, in a manner such that the sensor 121 of the mobile terminal 120 targets at and senses the status indicator light 111 of the field device 110, so as to sense the flashing state 113 of the status indicator light 111 over a period of time. In this step, the mobile terminal 120 can acquire images of the status indicator light 111 based on a corresponding sampling rule.

[0056] In a step S530, the mobile terminal 120 analyzes and converts the acquired images, and obtains the corresponding ID information. Specifically, the flashing state 113 as shown in FIG. 4 is sensed; and then the video image is analyzed by the converter module 122 to read the Morse codes (as shown in FIG. 4) corresponding to the flashing state 113, and each Morse code is converted into data representing the serial number. Therefore, the reading by decoding the ID information transmitted by the field device 110 is accomplished.

[0057] In the step S530, the acquired ID information, for example, "serial number XXX", may also be displayed on the mobile terminal 120 in real time, so as to facilitate the reading and determination by an operator.

[0058] In a step S540, physical location information is input via the mobile terminal 120. Specifically, an operator manually input physical location information of a field device 110 currently installed, for example, an operator manually input the physical location information "room 3301" via the input module 124 of the mobile terminal 120.

[0059] In a step S550, the physical location information is correlated with the corresponding ID information and then they both are sent to the control center. In this step, specifically, the correlation module 125 of the mobile terminal 120 correlates the input physical location information (input in the step S540) with the acquired corresponding ID information (acquired in the step S530) of the field device 110. For example, the correlation module 125 can store the ID information of a plurality of field devices 110 in correspondence to plural pieces of input physical location information, in which each piece of the ID information corresponds to one piece of the physical location information. After the mobile terminal 120

and the control center 130 are in communication connection, the stored ID information and the physical location information corresponding thereto can be transmitted to the control center 130 together.

[0060] In the step S550, the mobile terminal 120 records and statistically count corresponding field devices that have finished the steps S520 to S540, to prevent the omission of the physical location information of some field device 110.

[0061] In a step S560, the control center 130 determines the physical location information of the field device 110. In this step, the control center 130 acquires the ID information of each field device 110 from the bus 131 on one hand, and acquires the ID information of each field device 110 and the physical location information correlated and corresponding thereto sent from the mobile terminal 120 on the other hand; and then the control center 130 matches out the physical location information of the field device 110 based on the ID information of the field device 110, and determines the physical location information as the physical location information of the field device 110. In this way, the control center 130 determines the physical location information of each field device 110, and correlates the physical location information and the logical address of each field device 110.

[0062] So far, the determination of the physical location information for one of the field devices 110 is accomplished. The process is repeated, to accomplish the determination of the physical location information of each field device in the system 10. Therefore, the control center 130 has the physical location information of the field device 110 corresponding to each logical address. During the subsequent operation and working of the system 10, the working, for example, positioning a physical location of field fire alarm input information and controlling the working of other field devices at the corresponding physical location (for example, sprinkling water) is based on the physical location information.

[0063] The process for determining the physical location information of the field device 110 has simple operations, and can be easily implemented at a low cost with no need to introduce other dedicated device of high cost.

[0064] FIG. 6 is a schematic process flow chart of a method for reading status information/configuration information of a field device by a mobile terminal according to an embodiment of the present invention. In the embodiment, after the field device 110 is installed and its physical location information is determined, the status information, the configuration information and the like of the field device can also be read by the mobile terminal. Hereinafter, the description is made with reference to FIGs. 1 to 4, and 6.

[0065] In a step S610, under a certain trigger condition, the status indicator light 111 of the field device 110 is driven to work and flash over a period of time by the drive module 112. The flashing state 113 carries corresponding status information/configuration information, so the status information/configuration information of the field device 110 is transmitted through the flashing of the status indicator light 111. This step can be completed in the process of maintenance and detection of the field device 110; and the flashing of the status indicator light 111 can be driven and controlled based on the Morse code principle, for example, the status indicator light 111 works in a flashing mode as shown in FIG. 4.

[0066] In a step S620, an operator holds a mobile terminal 120 (for example, a smart phone terminal of the operator) as shown in FIG. 3, in a manner such that the sensor 121 of the mobile terminal 120 targets at and senses the status indicator light 111 of the field device 110, so as to sense the flashing state of the status indicator light 111 over a period of time. In this step, the mobile terminal 120 can acquire images of the status indicator light 111 based on a corresponding sampling rule.

[0067] In a step S630, the mobile terminal 120 analyzes and converts the acquired images, and obtains the corresponding status information/configuration information. Specifically, the flashing state 113 as shown in FIG. 4 is sensed; and then the video image is analyzed by the converter module 122 to read the corresponding Morse codes (as shown in FIG. 4), and each Morse code is converted into data representing the status information/configuration information. Therefore, the reading by decoding the status information/configuration information transmitted by the field device 110 is accomplished.

[0068] It should be noted that the status information refers to environmental status information acquired by the field device 110 by sensing a physical location corresponding thereto, for example, CO concentration, field temperature, and others. Such status information is collectively encoded into a format of code, for example, Morse code. The configuration information is physical configuration information reflecting the field device 110 itself, for example, the battery power, whether a component operates normally, and the parameter configuration of some component, etc. Such configuration information can also be collectively encoded into a format of code, for example, Morse code.

[0069] The status information/configuration information read and acquired in the step S630 can be displayed on the mobile terminal 120. As a result, the operator can easily and accurately read the status information/configuration information of each field device 110; and rather than outputting the currently limited several types of simple status information, the types of the information output by the field device through the status indicator light 111 are greatly

widened, so as to facilitate the maintenance and detection of the field device.

[0070] In the above description, when a component is said to be “connected” or “coupled” to another component, the component may be directly connected or coupled to the another component, or an intermediate component may be interposed therebetween.

[0071] It is to be understood that the elements disclosed and described herein (including the flow charts and the block diagrams in the figures) mean logical boundaries between elements. However, according to the software or hardware engineering practice, the depicted elements and their functions may be implemented by a computer executable medium on a machine having a processor capable of executing program instructions stored thereon, in which the program instructions serve as a monolithic software structure, an independent software module, a module using an external program, code, and service etc., or any combination thereof, and all of these execution solutions fall within the scope of the present disclosure.

[0072] Although some components have been particularly described in various non-limiting embodiments, the embodiments of the present invention are not limited to these specific combinations. Some of the components or features from any non-limiting embodiments may be combined with the components or features from any other non-limiting embodiments.

[0073] Although a particular sequence of steps is shown, disclosed and claimed, it should be understood that the steps may be performed in any order, separated or combined, unless otherwise specified; and the present disclosure will still benefit therefrom.

[0074] The foregoing description is illustrative and not intended to be limiting. Various non-limiting embodiments are disclosed herein; however, those of ordinary skill in the art will appreciate that various modifications and variations will fall within the scope of the appended claims in accordance with the above teachings. Accordingly, it should be understood that other disclosures than the specific disclosure herein can be made without departing from the scope of the appended claims. For this reason, the appended claims should be studied to determine the true scope and content.

CLAIMS**1.** A control system, comprising:

one or more field devices, provided with a status indicator light and configured to, at least based on corresponding identity (ID) information of the field device, control a flashing state of the status indicator light to transmit the ID information;

a mobile terminal, configured to acquire the ID information of the field device by sensing the flashing state of the status indicator light, and to acquire corresponding physical location information and correlate the physical location information with the acquired ID information of the field device; and

a control center, coupled to the one or more field devices and configured to acquire the ID information of each field device, and to acquire the ID information and the physical location information correlated therewith of each field device from the mobile terminal.

2. The control system according to claim 1, wherein the ID information of the field device is serial number information of the field device.

3. The control system according to claim 1, wherein the mobile terminal is a smart phone terminal, which is in communication connection with the control center to transmit the ID information of the field device and the physical location information correlated with the ID information in real time or at a regular interval.

4. The control system according to claim 1 or 3, wherein the mobile terminal comprises:

a sensor, configured to sense the flashing state of the status indicator light;

a converter module, configured to analyze the flashing state and acquire the ID information through conversion;

an input module, configured to acquire the physical location information by means of a positioning chip or by user input; and

a correlation module, configured to correlate the input physical location information with the acquired corresponding ID information of the field device.

5. The control system according to claim 4, wherein the mobile terminal further comprises:

a display module, at least configured to display the ID information acquired through conversion.

6. The control system according to claim 1, wherein the field device comprises:

a drive module, configured to, at least based on the corresponding ID information of the field device, control the flashing state of the status indicator light in accordance with a predetermined encoding format.

7. The control system according to claim 6, wherein the drive module is configured to convert each bit of data of the ID information into the flashing of the status indicator light in accordance

with the predetermined encoding format; and

the mobile terminal is further configured to analyze the flashing state of the status indicator light, so as to read a corresponding code and convert the code into the ID information.

8. The control system according to claim 6, wherein the drive module is further configured to, at least based on status information/configuration information of the field device, control the flashing state of the status indicator light in accordance with a predetermined encoding format; and

the mobile terminal is further configured to acquire the status information/configuration information of the field device by sensing the flashing state of the status indicator light.

9. The control system according to claim 8, wherein the drive module is further configured to convert each bit of data representing the status information/configuration information into the flashing of the status indicator light in accordance with the predetermined encoding format; and

the mobile terminal is further configured to analyze the flashing state of the status indicator light, so as to read a corresponding code and convert the code into the data representing the status information/configuration information, thus acquiring the status information/configuration information of the field device.

10. The control system according to claim 1, wherein the control center is configured to acquire the ID information of the field device from the one or more field devices in wired or wireless connection therewith.

11. The control system according to claim 1, wherein the control center is configured to, based on the ID information of the field device, match out the physical location information of the field device and determine the physical location information as the physical location information of the field device.

12. The control system according to claim 11, wherein the control center is configured to allocate a logical address to each field device and correlate the logical address with the corresponding physical location information.

13. The control system according to claim 1, wherein the mobile terminal is further configured to record the corresponding field device after the physical location information is correlated with the ID information.

14. The control system according to claim 1, wherein the control system is a fire detection and alarm system inside a building.

15. A method for determining physical location information of a field device, comprising the steps of:

S510: flashing a status indicator light of the field device at least based on corresponding identity (ID) information of the field device;

S520: sensing, by a mobile terminal, a flashing state of the status indicator light and acquiring

the ID information of the field device ;

S540: acquiring corresponding physical location information of the field device by means of a positioning chip of the mobile terminal or by user input;

S550: correlating the physical location information with the acquired ID information of the field device, and sending both of them to a control center; and

S560: matching out, by the control center, the physical location information of the field device based on the ID information of the field device, and determining the physical location information as the physical location information of the field device.

16. The method according to claim 15, wherein the mobile terminal is a smart phone terminal; and in the step S550, the smart phone terminal is in communication connection with the control center to transmit the ID information of the field device and the physical location information correlated with the ID information to the control center in real time or at a regular interval.

17. The method according to claim 15, wherein in the step S510, each bit of data of the ID information is converted into the flashing of the status indicator light in accordance with a predetermined encoding format; and

in the step S520, the flashing state of the status indicator light is analyzed, so as to read a corresponding code and convert the code into the ID information.

18. The method according to claim 15, further comprising the step of:
displaying the acquired ID information.

19. The method according to claim 15, further comprising the steps of:
flashing the status indicator light of the field device at least based on status information/configuration information of the field device in accordance with a predetermined encoding format;

sensing, by the mobile terminal, the flashing state of the status indicator light and acquiring the status information/configuration information of the field device; and

displaying the acquired status information/configuration information.

20. The method according to claim 15, further comprising the step of:
after the step S550, recording the field device in the mobile terminal.

21. A field device, provided with a status indicator light and a drive module for driving the status indicator light, wherein the drive module is configured to, at least based on identity (ID) information of the field device, control a flashing state of the status indicator light in accordance with a predetermined encoding format, to transmit the ID information.

22. The field device according to claim 21, wherein the ID information of the field device is serial number information of the field device.

23. The field device according to claim 21, wherein the drive module is configured to convert each bit of data of the ID information into the flashing of the status indicator light in accordance with a predetermined encoding format.

24. The field device according to claim 21, wherein the drive module is further configured to, at least based on status information/configuration information of the field device, control the flashing state of the status indicator light in accordance with a predetermined encoding format.

25. The field device according to claim 24, wherein the drive module is further configured to convert each bit of data representing the status information/configuration information into the flashing of the status indicator light.

26. A mobile terminal for interacting at least with a field device, which is configured to acquire identity (ID) information of the field device by sensing a flashing state of a status indicator light of the field device, and to acquire corresponding physical location information and correlate the physical location information with the acquired ID information of the field device.

27. The mobile terminal according to claim 26, wherein the mobile terminal is a smart phone terminal, which is in communication connection with a control center to transmit the ID information of the field device and the physical location information correlated with the ID information in real time or at a regular interval.

28. The mobile terminal according to claim 26, wherein the mobile terminal comprises:
a sensor, configured to sense the flashing state of the status indicator light;
a converter module, configured to analyze the flashing state and acquire the ID information through conversion;

an input module, configured to acquire the physical location information by means of a positioning chip or by user input; and

a correlation module, configured to correlate the input physical location information with the acquired corresponding ID information of the field device.

29. The mobile terminal according to claim 26, wherein the mobile terminal further comprises:
a display module, at least configured to display the ID information acquired through conversion.

30. The mobile terminal according to claim 26, wherein the mobile terminal further comprises a communication module in communication connection with the control center.

31. The mobile terminal according to claim 26, wherein the mobile terminal is configured to analyze the flashing state of the status indicator light expressed in a predetermined encoding format, so as to read a corresponding code and convert the code into the ID information.

32. The mobile terminal according to claim 26, wherein the mobile terminal is further configured to acquire status information/configuration information of the field device by sensing

the flashing state of the status indicator light.

33. The mobile terminal according to claim 32, wherein the mobile terminal is further configured to analyze the flashing state of the status indicator light expressed in a predetermined encoding format, so as to read a corresponding code and convert the code into the status information/configuration information of the field device.

34. The mobile terminal according to claim 26, wherein the mobile terminal is further configured to record the corresponding field device after the physical location information is correlated with the ID information.

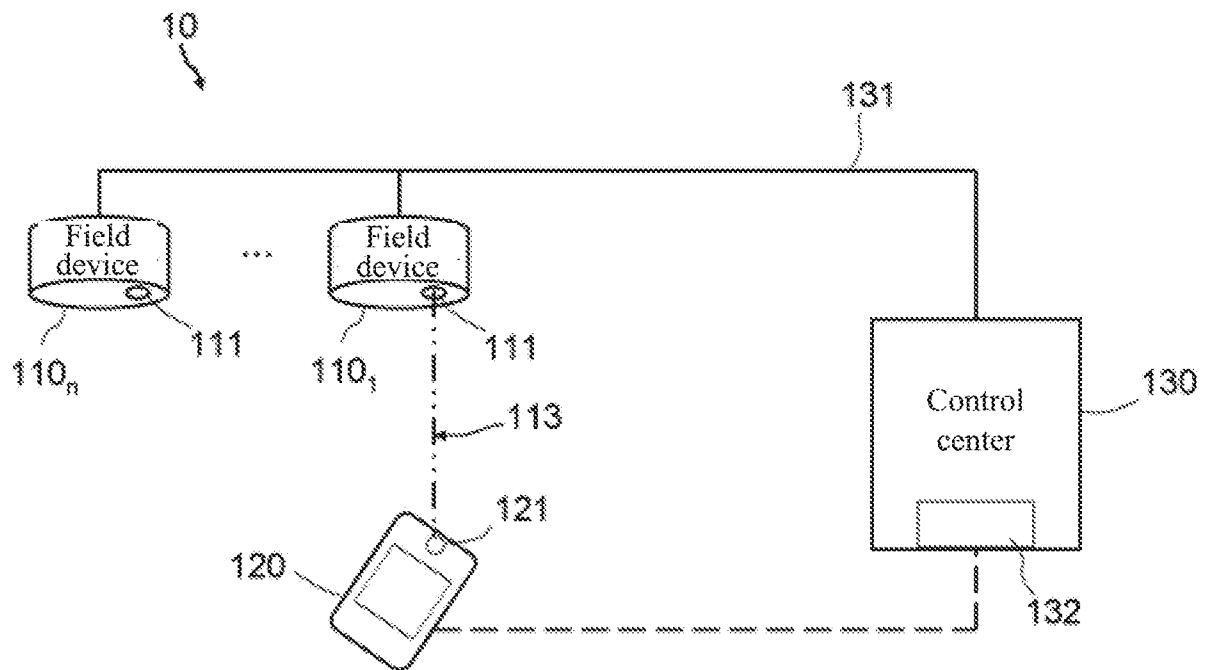


FIG. 1

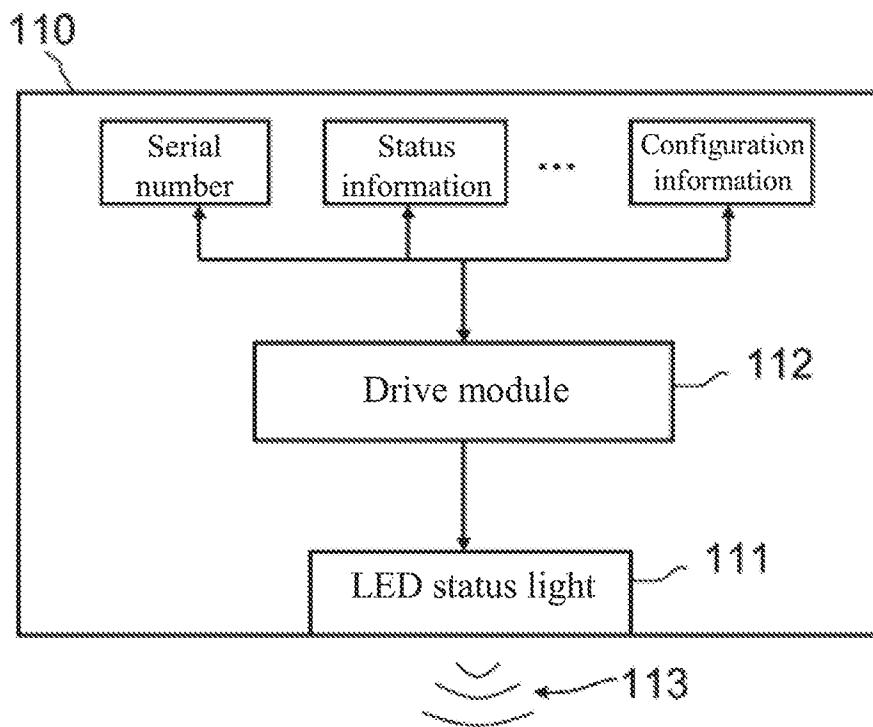
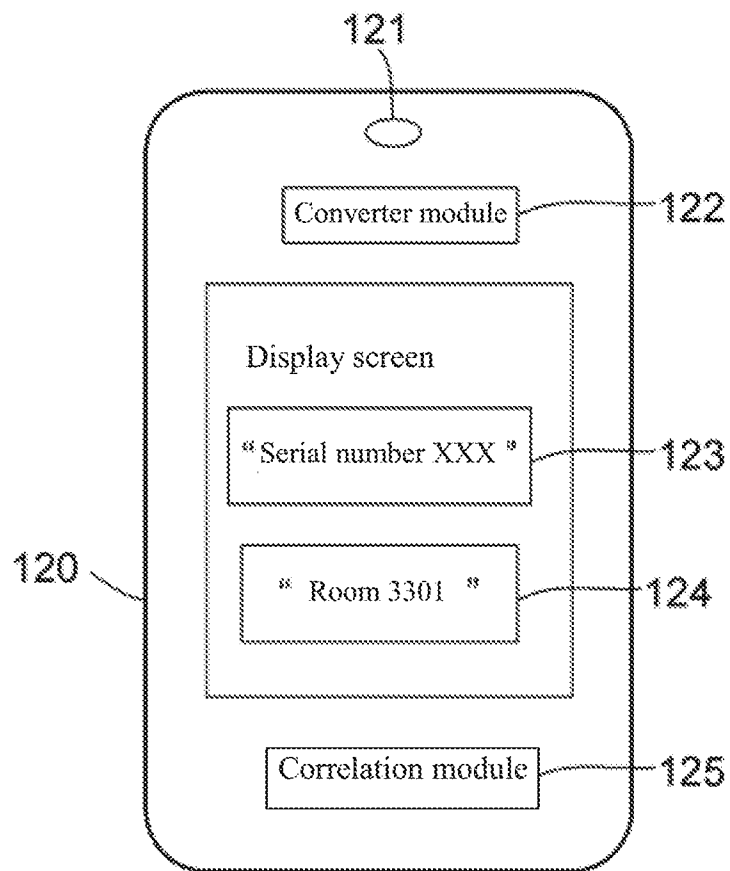
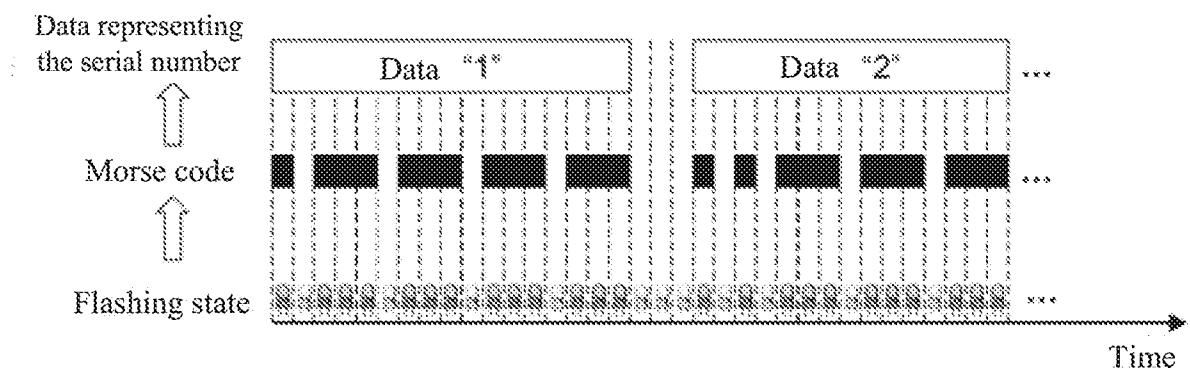
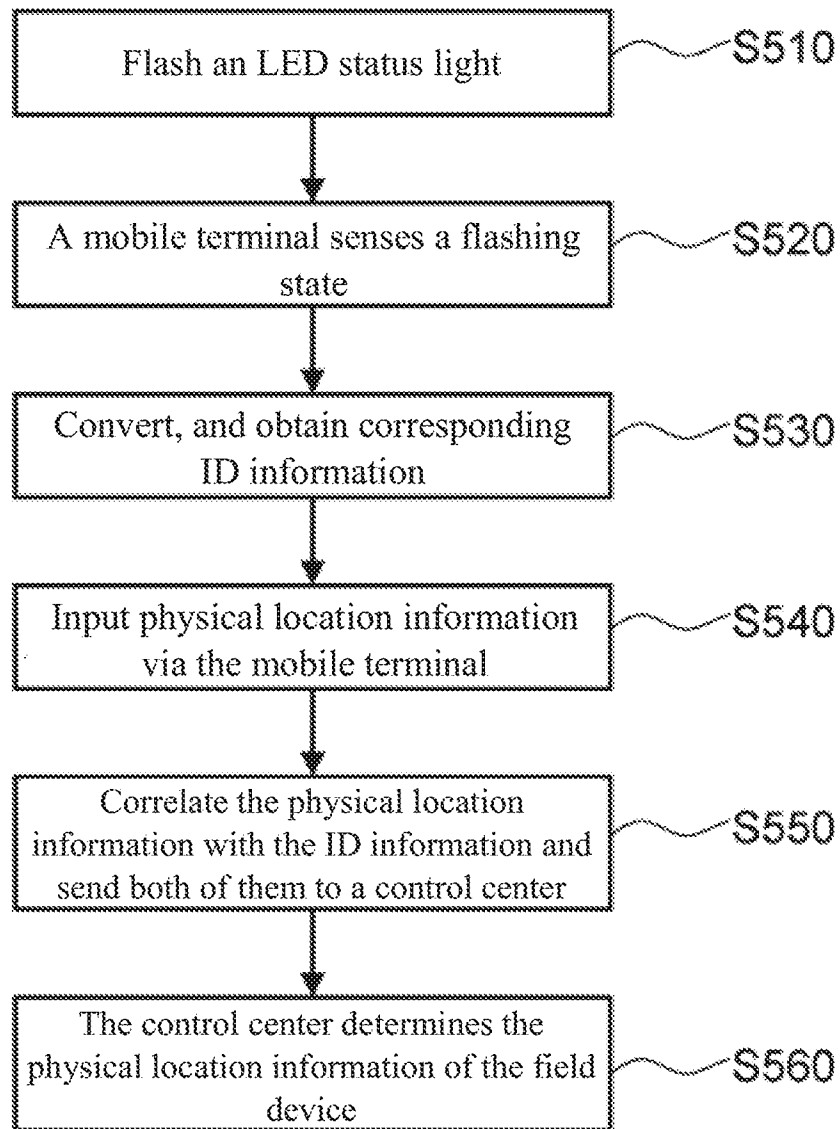
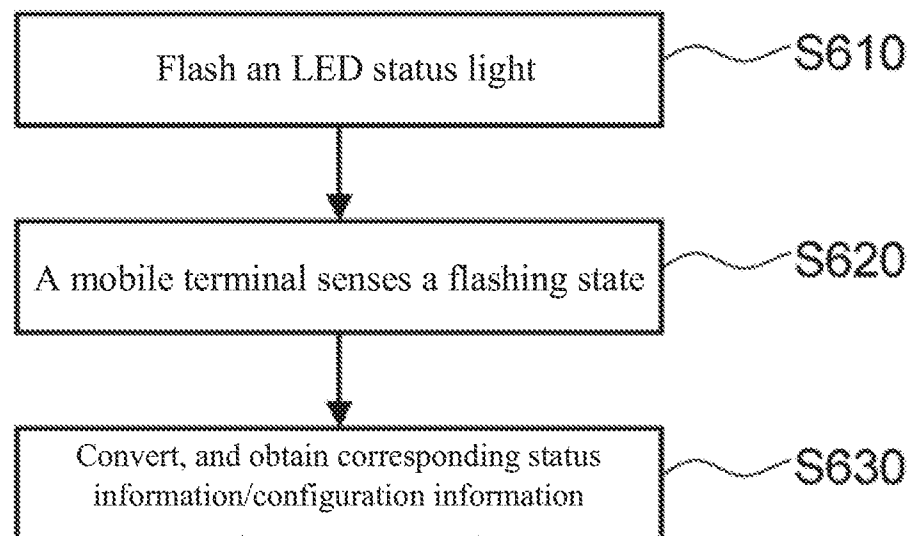


FIG. 2

**FIG. 3****FIG. 4**

**FIG. 5****FIG. 6**

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2017/054702

A. CLASSIFICATION OF SUBJECT MATTER

INV. G08B25/00 G08B17/00 G08B29/14
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 2009/072962 A1 (HITCHIN MARK L [GB]) 19 March 2009 (2009-03-19) paragraphs [0025] - [0031]; figures 1-6 -----	1-34
X	US 2015/372753 A1 (JOVICIC ALEKSANDAR [US] ET AL) 24 December 2015 (2015-12-24) paragraphs [0005], [0006], [0065] - [0067]; figure 1 -----	26-34



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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